SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

HUAWEI TECHNOLOGIES CO., LTD.
HUAWEI OCEANSTOR™ S6800T

SPC-1 V1.12

Submitted for Review: August 31, 2011
Submission Identifier: A00107
Revised: December 13, 2012

First Edition – August 2011

Trademarks

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AUDIT CERTIFICATION

Eric He
Huawei Symantec Technologies Co., Ltd.
The West Zone Science Park of UESTC
No. 88, Tianchen Road
Chengdu, 611731 P.R. China

August 29, 2011

The SPC Benchmark 1™ Reported Data listed below for the Huawei Symantec Oceanspace™ S6800T were produced in compliance with the SPC Benchmark 1™ v1.12 Remote Audit requirements.

SPC Benchmark 1™ v1.12 Reported Data	
Tested Storage Product (TSP) Name: Huawei Symantec Oceanspace™ S6800T	
Metric	**Reported Result**
SPC-1 IOPS™	150,061.17
SPC-1 Price-Performance	$3.08/SPC-1 IOPS™
Total ASU Capacity	43,937.515 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$461,471.75

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with 1.12 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 Symantec 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.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters that were changed from default values.

Storage Performance Council
643 Bair Island Road, Suite 103
Redwood City, CA 94062
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AUDIT CERTIFICATION *(CONT.)*

- SPC-1 Workload Generator commands and parameters used for the audited SPC Test Runs.
- The following Host System requirements were verified by physical inspection and information supplied by Huawei Symantec Technologies Co., Ltd.:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the SPC-1 Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The Test Results Files and resultant Summary Results Files received from Huawei Symantec 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

Walter E. Baker
SPC Auditor

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LETTER OF GOOD FAITH

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http://www.huaweisymantec.com/en/

Date: July 6, 2011

From: Huawei Symantec 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 Symantec Oceanspace S6800T

Huawei Symantec 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 V1.12 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: 2011. 7. 6.

Fan ruiqi
Vice President

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 No. 1899, Xiyuan Road Chengdu, 611731 P.R. China Phone: 0086 28 65281999 FAX: 0086 28 64686419
Test Sponsor Alternate Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Xu Zhong – xuzhong@huawei.com No. 1899, Xiyuan Road Chengdu, 611731 P.R. China Phone: 0086 65281927 FAX: 0086 28 64696419
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	V1.12
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	August 31, 2011
Date the FDR was submitted to the SPC	August 31, 2011
Date revised FDR was submitted to the SPC Updated company name, logo and product name to reflect the complete acquisition of Huawei Symantec by Huawei Technologies Co., Ltd.	December 13, 2012
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	August 29, 2011

Tested Storage Product (TSP) Description

Huawei's enterprise storage systems OceanStor™ S6800T is new generation of enterprise high end storage products. Based on powerful hardware specification, it consolidates multiple industry leading technologies including TurboModule that provides the ability of high density and hot swap I/O modules, and TurboBoost, which includes high-performance enhancements such as the new generation PCI-E 2.0 bus technology, SAS 2.0 high-speed I/O channel technology, multi-core CPUs, and multi-channel memory. The OceanStor™ S6800T products can meet the requirements of large scale database including OLTP/OLAP, HPC, digital media, internet service providers, backup, disaster recovery, data migration and other scenarios.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Huawei OceanStor™ S6800T	
Metric	**Reported Result**
SPC-1 IOPS™	150,061.17
SPC-1 Price-Performance™	$3.08/SPC-1 IOPS™
Total ASU Capacity	43,937.515 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$461,471.75

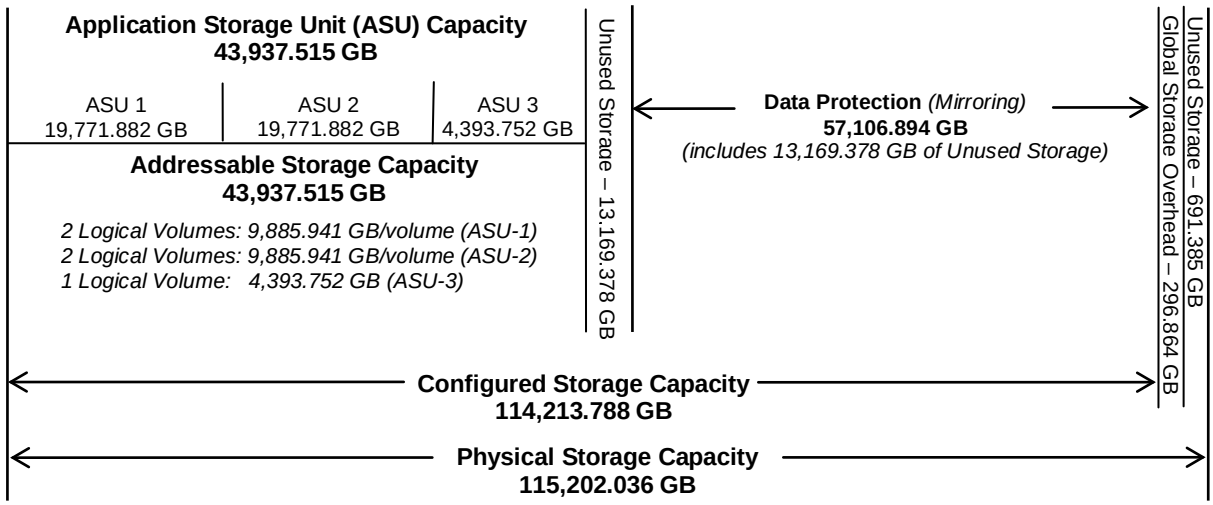
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

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

Storage Capacities, Relationships, and Utilization

The following diagram 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	38.14%
Protected Application Utilization	87.36%
Unused Storage Ratio	23.46%

Application Utilization: Total ASU Capacity *(43,937.515 GB)* divided by Physical Storage Capacity *(115,202.036 GB)*

Protected Application Utilization: (Total ASU Capacity *(43,937.515 GB)* plus total Data Protection Capacity *(57,106.894 GB)* minus unused Data Protection Capacity *(402.588 GB)* divided by Physical Storage Capacity *(115,202.036 GB)*

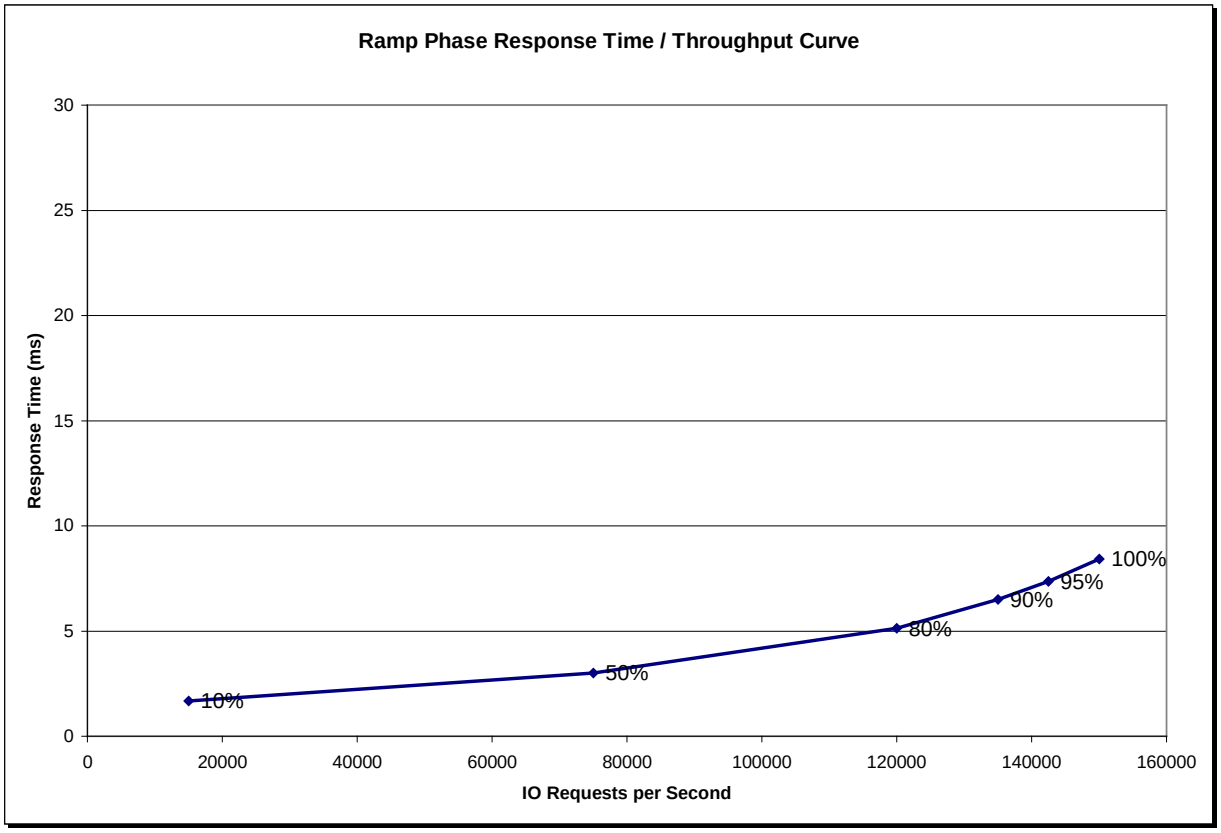
Unused Storage Ratio: Total Unused Capacity *(27,030.142 GB)* divided by Physical Storage Capacity *(115,202.036 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 20-21 in the Full Disclosure Report.

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	14,995.54	74,984.21	120,008.47	135,005.34	142,509.73	150,061.17
Average Response Time (ms):						
All ASUs	1.68	3.00	5.14	6.50	7.36	8.42
ASU-1	2.20	3.85	6.28	7.58	8.34	9.36
ASU-2	1.89	4.26	8.66	12.24	15.18	18.30
ASU-3	0.47	0.64	1.18	1.68	1.84	2.11
Reads	3.55	6.63	11.24	13.92	15.83	18.11
Writes	0.45	0.64	1.17	1.66	1.84	2.11

Priced Storage Configuration Pricing

Item	Description	Quantity	Unit Price(USD)	Total Price(USD)
S6800TBB	S6800T, dual controllers, AC, 192GB cache, with UPS Cache Protected Module,without Front-End & Back-End Port	1	76,428.00	76,428.00
SDE35U4BB	DAE12435U4-03 Disk Enclosure(4U,220V AC,SAS Expansion Module,24X3.5" HD Slots without Disk Unit,with HS SAS in Band Management Software),with 2 SAS 1M Cables	16	3,292.00	52,672.00
STIO6GSAS	2*24Gbps SAS-wide I/O modules(2 ports each) backend expansion for JBOD	8	1,052.00	8,416.00
STIO8GFC	4*8Gbps Fibre Channel I/O modules(4 ports each)	4	1,304.00	5,216.00
SHD35SA300	3.5 inch 300GB 15K RPM SAS	352	473.00	166,496.00
SHD35SA600	3.5 inch 600GB 15K RPM SAS	16	756.00	12,096.00
S5000MP	S5000T Multi-Path Software (specify WIN, LINUX, AIX)	1	682.00	682.00
S6800ISM	ISM Software License for S6800T (ESSENTIAL)	1	6,982.00	6,982.00
S5000SSLC	Storage Array Control System Software License for S5000T (ESSENTIAL)	1	0.00	0.00
	Patch Cord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m - No Charge	14	0.00	0.00
	Purchased Cable,MiniSAS Cable,Key246,3m - No Charge	1	0.00	0.00
	External Mini-SAS Cable - 26-pin 4x Mini-SAS (SFF-8088) to 26-pin 4x Mini-SAS (SFF-8088)	4	147.00	588.00
Warranty Uplift Option(3 Years)				
TSGS6800AIO	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	1	21,712.00	21,712.00
TSGSTJ4SA60	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	16	4,823.00	77,168.00
Third Party				
QLE2562-CK	QLogic Dual Port 8Gb Fibre Channel to PCI Express Host Bus Adapter (QLE2562-CK)	7	2,598.00	18,186.00
5042A6U	Lenovo ThinkCentre M75e 5042 Tower	1	549.00	549.00
With Sales Tax (4.1%) Colorado Only			**Total**	**461,471.75**

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:

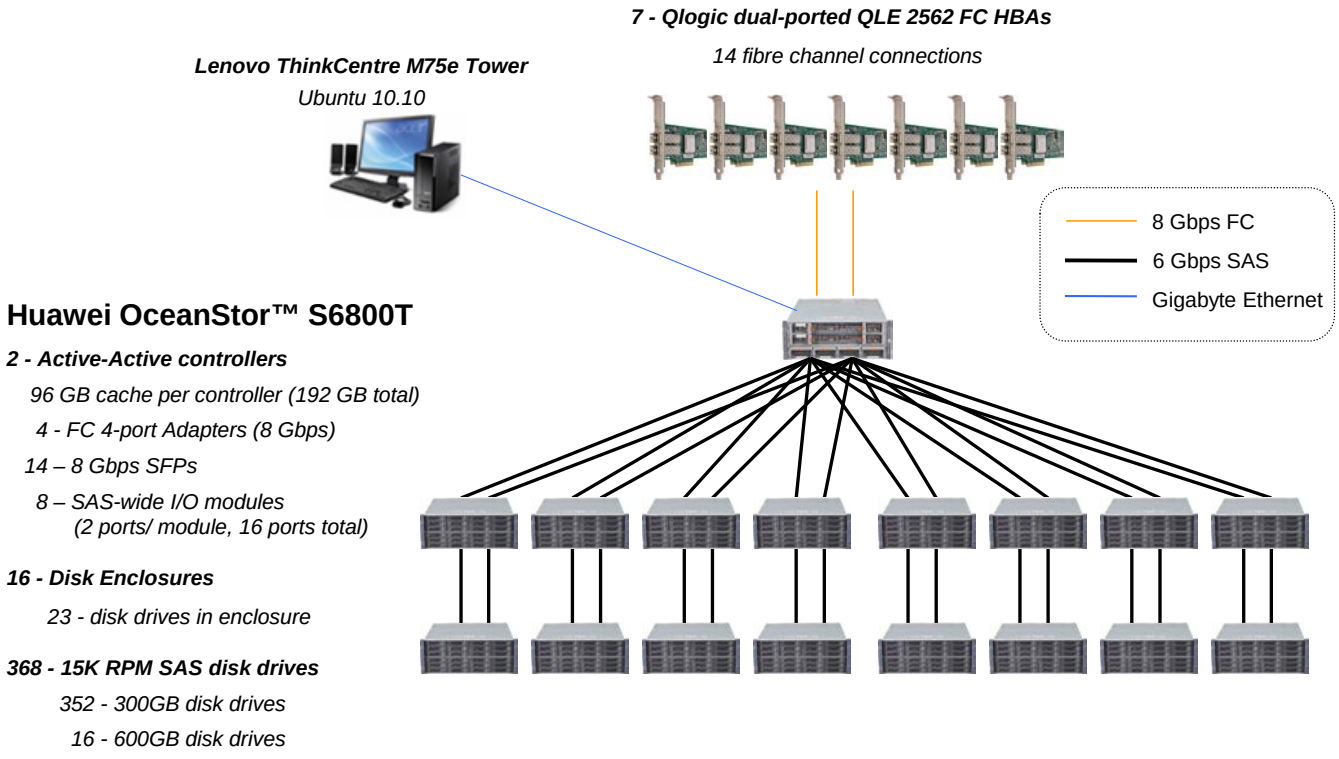
- Acknowledgement of new and existing problems with four (4) hours.
- Onsite present of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Price Storage Configuration that 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 81 *("Appendix F: Third Party Quotation")* for a copy of the third-party reseller quotation.

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 Diagram



Priced Storage Configuration Components

Priced Storage Configuration:
Lenovo ThinkCenter M75e Tower *(Ubuntu 10.10)* used for configuration management
7 – Qlogic dual-port QLE2562 FC HBAs
Huawei OceanStor™ S6800T **2 - Active-Active controllers** 96 GB cache per controller *(192 GB total)* 4 – Fibre Channel 4-port adapters (8 Gbps) 16 – 8 Gbps front-end connections (*14 used)* 14 – 8 Gbps SFPs 8 – SAS backend connections per controller *(16 total, 16 used)*
16 – Disk Enclosures 24 – 3.5” HD slots per enclosure 2 –SAS 1m cables per enclosure 23 – disk drives in each enclosures
368 – 15K RPM SAS disk drives 352 – 300 GB disk drives 16 – 600 GB 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 storage network configuration is illustrated on page 18 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

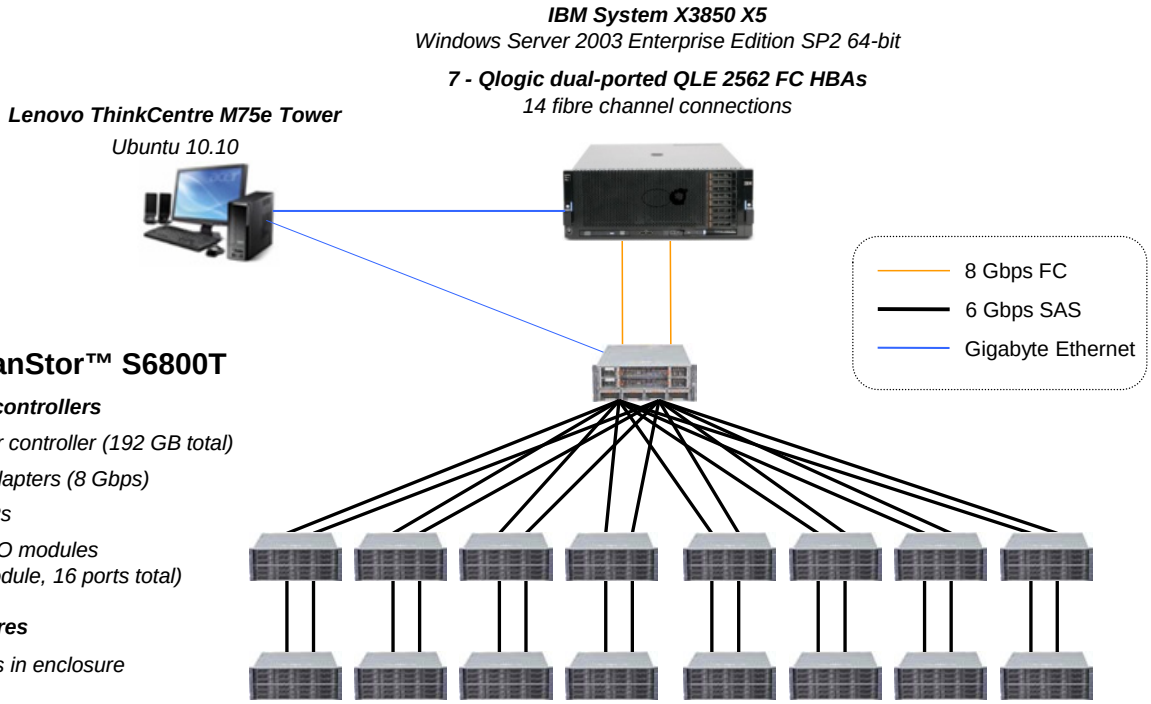
Host System and Tested Storage Configuration (TSC) Table of Components

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(s) and Tested Storage Configuration Components).*

Benchmark Configuration/Tested Storage Configuration Diagram



Huawei OceanStor™ S6800T

2 - Active-Active controllers

96 GB cache per controller (192 GB total)

4 - FC 4-port Adapters (8 Gbps)

14 – 8 Gbps SFPs

8 – SAS-wide I/O modules
(2 ports/ module, 16 ports total)

16 - Disk Enclosures

23 - disk drives in enclosure

368 - 15K RPM SAS disk drives

352 - 300GB disk drives

16 - 600GB disk drives

Host System(s) and Tested Storage Configuration Components

Host System:	Tested Storage Configuration (TSC):
IBM System x3850 X5 Server with:	Lenovo ThinkCenter M75e Tower *(Ubuntu 10.10)* used for configuration management
4 – Intel Xeon X7542 2.66 GHz 6 Core Processor with 18 MB L3 cache	7 – Qlogic dual-port QLE2562 FC HBAs
64 GB main memory	**Huawei OceanStor™ S6800T** **2 - Active-Active controllers** 96 GB cache per controller *(192 GB total)* 4 – Fibre Channel 4-port adapters (8 Gbps) 16 – 8 Gbps front-end connections (*14 used)* 14 – 8 Gbps SFPs 8 – SAS backend connections per controller *(16 total, 16 used)*
Windows Server 2003 Enterprise Edition 64-bit with SP2	16 – Disk Enclosures 24 – 3.5” HD slots per enclosure 2 –SAS 1m cables per enclosure 23 – disk drives in each enclosures
PCIe	368 – 15K RPM SAS disk drives 352 – 300 GB disk drives 16 – 600 GB 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 62 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 63 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 74.

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 58 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

SPC-1 Storage Capacities		
Storage Hierarchy Component	**Units**	**Capacity**
Total ASU Capacity	Gigabytes (GB)	43,937.515
Addressable Storage Capacity	Gigabytes (GB)	43,937.515
Configured Storage Capacity	Gigabytes (GB)	114,213.788
Physical Storage Capacity	Gigabytes (GB)	115,202.036
Data Protection *(Mirroring)*	Gigabytes (GB)	57,106.894
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	296.864
Total Unused Storage	Gigabytes (GB)	27,030.142

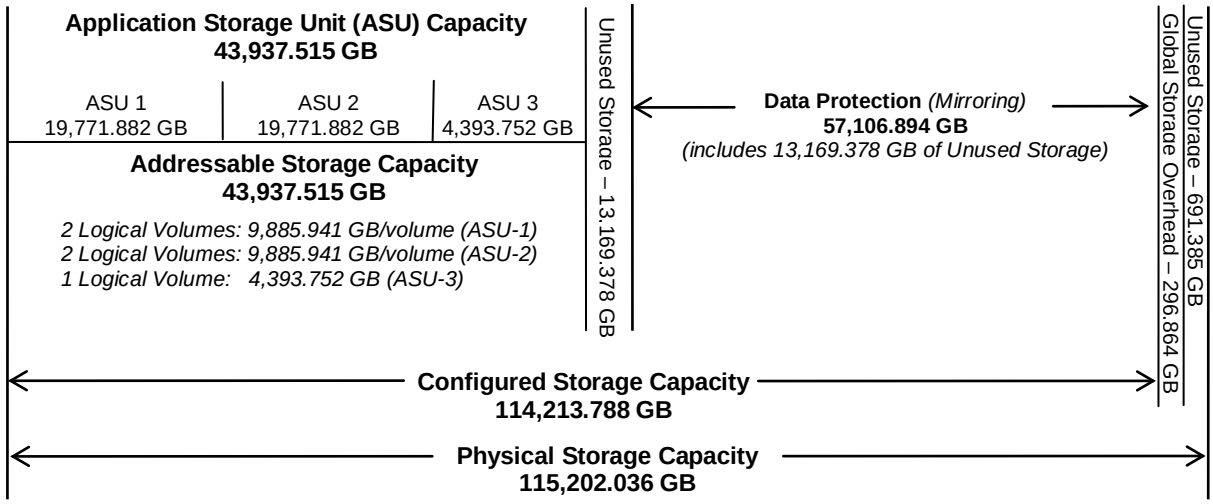
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	38.47%	38.14%
Required for Data Protection *(Mirrored)*		50.00%	49.57%
Addressable Storage Capacity		38.47%`	38.14%
Required Storage		0.00%	0.00%
Configured Storage Capacity			99.14%
Global Storage Overhead			0.26%
Unused Storage:			
Addressable	0.00%		
Configured		23.06%	
Physical			0.60%

The Physical Storage Capacity consisted of 115,202.036 GB distributed over 352 disk drives, each with a formatted capacity of 300.000 GB and 16 disk drives, each with a formatted capacity of 600.127GB for a total of 368 disk drives. There was 691.385 GB (0.60%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 296.864 GB (0.26%) of the Physical Storage Capacity. There was 26,338.757 GB (23.06%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100% 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 57,106.894 GB of which 56,704.306 GB was utilized. The total Unused Storage was 27,030.142 GB.

SPC-1 Storage Capacities and Relationships Illustration

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



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 (19,771.882 GB)	**ASU-2 (19,771.882 GB)**	**ASU-3 (4,393.752 GB)**
2 Logical Volumes 9,885.941 GB per Logical Volume (9,885.941 used per Logical Volume)	2 Logical Volumes 9,885.941 GB per Logical Volume (9,885.941 used per Logical Volume)	1 Logical Volume 4,393.752 GB per Logical Volume (4,393.752 used per Logical Volume)

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

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	38.14%
Protected Application Utilization	87.36%
Unused Storage Ratio	23.46%

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. "SPC-1 Test Execution Definitions" on page 59 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 three (3) 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 76.

Sustainability Test Results File

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

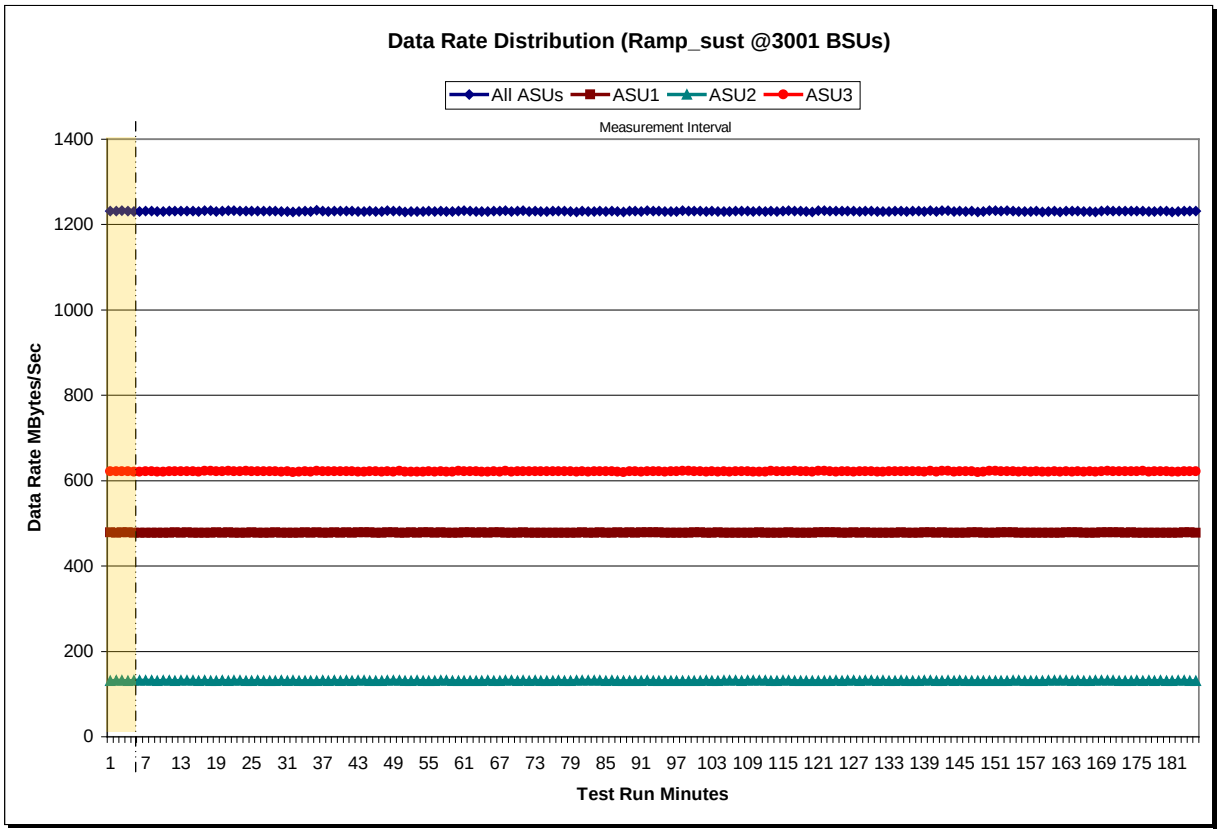
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	20:35:55	20:40:55	0-4	0:05:00
Measurement Interval	20:40:55	23:40:55	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	1,231.31	478.74	131.14	621.43	63	1,230.20	478.51	131.26	620.43	126	1,231.20	478.65	131.68	620.87
1	1,231.86	477.80	131.91	622.16	64	1,230.67	478.02	131.58	621.08	127	1,230.78	478.12	131.14	621.52
2	1,232.33	478.32	131.79	622.22	65	1,232.08	478.49	131.31	622.28	128	1,231.71	478.26	131.55	621.89
3	1,231.75	478.27	131.48	621.99	66	1,231.20	478.55	131.46	621.19	129	1,231.50	477.76	131.57	622.17
4	1,230.60	477.69	131.56	621.34	67	1,232.50	477.63	131.70	623.17	130	1,230.76	477.98	131.41	621.37
5	1,231.05	477.95	131.81	621.29	68	1,230.99	477.90	131.93	621.15	131	1,230.54	478.13	131.55	620.86
6	1,231.64	478.18	131.76	621.70	69	1,231.60	478.08	131.30	622.22	132	1,231.07	477.87	131.46	621.73
7	1,231.32	477.58	131.57	622.17	70	1,232.50	478.47	132.01	622.02	133	1,231.28	477.95	131.50	621.84
8	1,230.91	478.19	131.40	621.32	71	1,231.01	478.16	131.30	621.54	134	1,231.93	478.26	131.72	621.95
9	1,230.99	478.03	131.61	621.35	72	1,231.70	478.07	131.75	621.88	135	1,230.79	477.98	131.39	621.43
10	1,232.05	478.06	131.76	622.23	73	1,231.09	477.98	131.51	621.61	136	1,231.48	478.17	131.34	621.98
11	1,231.44	478.59	131.21	621.65	74	1,231.15	478.09	131.29	621.77	137	1,231.61	477.81	131.45	622.35
12	1,232.02	477.95	132.23	621.84	75	1,231.24	478.07	131.23	621.94	138	1,230.72	478.52	131.71	620.49
13	1,232.15	478.30	131.65	622.20	76	1,231.53	477.78	131.82	621.93	139	1,232.84	478.41	131.57	622.85
14	1,231.42	477.60	131.74	622.09	77	1,231.85	478.19	131.52	622.14	140	1,230.57	477.96	131.33	621.28
15	1,230.45	477.78	131.47	621.20	78	1,230.87	478.00	131.31	621.56	141	1,232.50	478.34	131.46	622.70
16	1,232.29	478.12	131.63	622.54	79	1,230.05	477.74	131.64	620.68	142	1,232.46	478.06	131.95	622.46
17	1,232.50	478.18	131.50	622.82	80	1,231.71	478.30	131.85	621.57	143	1,230.28	477.67	131.36	621.24
18	1,231.07	478.29	131.17	621.61	81	1,230.95	478.20	131.60	621.15	144	1,231.58	478.14	131.79	621.65
19	1,231.63	477.96	131.62	622.04	82	1,230.89	477.52	131.96	621.40	145	1,231.10	477.76	131.27	622.07
20	1,232.36	478.31	131.52	622.53	83	1,232.01	478.38	131.64	621.99	146	1,231.47	478.40	131.41	621.66
21	1,232.28	478.15	131.91	622.22	84	1,230.91	477.77	131.42	621.72	147	1,229.99	478.61	131.49	619.89
22	1,231.92	477.84	131.94	622.15	85	1,231.55	478.26	131.56	621.73	148	1,230.59	478.18	131.35	621.06
23	1,231.77	478.14	131.18	622.45	86	1,230.52	478.27	131.14	621.11	149	1,232.29	477.95	131.35	622.99
24	1,231.97	478.48	131.52	621.97	87	1,229.38	477.81	131.33	620.24	150	1,232.35	478.04	131.38	622.93
25	1,231.19	477.70	131.59	621.90	88	1,231.88	478.47	131.08	622.32	151	1,231.48	478.30	131.17	622.01
26	1,231.47	477.89	131.48	622.11	89	1,231.61	477.98	131.37	622.27	152	1,232.33	478.70	131.41	622.22
27	1,231.75	478.12	131.44	622.20	90	1,230.43	478.32	131.32	620.79	153	1,232.05	478.30	132.04	621.71
28	1,231.60	478.64	131.53	621.43	91	1,232.32	478.27	131.67	622.38	154	1,230.79	477.78	131.85	621.15
29	1,230.52	478.15	131.67	620.70	92	1,232.12	478.51	131.36	622.25	155	1,230.67	477.87	131.26	621.54
30	1,230.85	478.09	131.08	621.68	93	1,231.70	478.26	131.26	622.18	156	1,230.48	477.74	131.39	621.35
31	1,230.13	478.19	131.63	620.31	94	1,230.21	478.00	131.40	620.81	157	1,231.28	477.89	131.06	622.33
32	1,230.44	477.89	131.28	621.27	95	1,231.06	477.72	131.21	622.13	158	1,229.75	478.07	131.00	620.67
33	1,231.41	478.42	131.27	621.72	96	1,230.83	478.12	131.22	621.50	159	1,231.12	478.15	131.61	621.36
34	1,230.35	477.76	131.24	621.35	97	1,232.55	478.16	131.50	622.89	160	1,231.49	478.01	131.71	621.77
35	1,233.44	478.74	131.38	623.32	98	1,231.80	477.88	131.41	622.51	161	1,229.95	477.73	131.65	620.57
36	1,231.34	478.01	131.70	621.62	99	1,231.84	478.43	131.42	622.00	162	1,231.92	478.28	131.54	622.10
37	1,230.94	477.84	131.39	621.71	100	1,231.37	478.41	131.53	621.44	163	1,231.30	478.67	131.30	621.33
38	1,232.13	478.50	131.56	622.07	101	1,230.37	478.10	131.58	620.69	164	1,231.67	478.46	131.65	621.55
39	1,231.21	478.00	131.51	621.71	102	1,231.48	477.98	131.27	622.23	165	1,230.18	477.60	131.22	621.37
40	1,232.09	478.32	131.96	621.80	103	1,230.67	478.52	131.46	620.70	166	1,231.05	478.11	131.09	621.84
41	1,232.04	478.23	131.45	622.36	104	1,231.06	477.41	131.65	621.99	167	1,230.01	477.67	131.60	620.74
42	1,230.49	478.30	131.58	620.60	105	1,230.37	477.78	131.62	620.97	168	1,232.15	478.69	131.66	621.80
43	1,230.78	478.28	131.67	620.83	106	1,231.51	478.05	132.01	621.46	169	1,233.01	478.79	131.64	622.59
44	1,232.08	478.50	131.25	622.34	107	1,231.47	477.67	131.41	622.39	170	1,232.09	478.51	131.58	622.00
45	1,231.07	477.60	131.14	622.33	108	1,231.18	478.13	131.58	621.47	171	1,231.30	478.46	131.41	621.43
46	1,230.26	477.86	131.49	620.91	109	1,230.95	478.05	131.53	621.37	172	1,231.68	477.95	131.44	622.29
47	1,232.21	478.52	131.57	622.12	110	1,231.62	478.43	131.82	621.36	173	1,231.27	478.44	131.29	621.53
48	1,231.65	478.84	131.68	621.13	111	1,231.06	478.01	131.68	621.37	174	1,231.42	477.82	131.78	621.81
49	1,232.14	477.80	131.70	622.64	112	1,231.58	477.90	131.05	622.63	175	1,231.42	477.70	131.23	622.48
50	1,230.14	477.59	131.41	621.15	113	1,230.86	477.97	131.33	621.55	176	1,230.82	477.83	131.67	621.32
51	1,230.98	478.69	131.45	620.84	114	1,231.20	477.90	131.63	621.67	177	1,230.96	477.91	131.38	621.67
52	1,230.18	478.18	131.54	620.46	115	1,232.31	478.41	131.82	622.07	178	1,231.56	477.73	131.63	622.20
53	1,230.97	478.78	131.53	620.66	116	1,231.79	477.92	131.37	622.50	179	1,231.41	477.74	131.29	622.39
54	1,231.44	478.64	131.29	621.52	117	1,231.30	477.96	131.41	621.93	180	1,229.78	477.76	131.06	620.97
55	1,230.58	478.02	131.26	621.30	118	1,230.66	477.75	131.47	621.44	181	1,231.07	477.99	131.77	621.31
56	1,231.94	478.28	131.75	621.91	119	1,229.97	477.69	131.31	620.97	182	1,232.13	478.34	131.57	622.22
57	1,230.43	477.84	131.59	621.00	120	1,232.64	478.77	131.44	622.43	183	1,231.29	478.30	131.24	621.75
58	1,230.74	478.05	131.35	621.35	121	1,232.49	478.53	131.52	622.43	184	1,231.27	478.02	131.37	621.88
59	1,231.80	477.82	131.52	622.46	122	1,232.01	478.50	131.32	622.19					
60	1,232.43	478.88	131.48	622.07	123	1,231.18	478.29	131.79	621.10					
61	1,231.85	478.44	131.52	621.89	124	1,231.32	478.22	131.32	621.78					
62	1,231.13	478.14	131.36	621.63	125	1,231.25	477.99	131.56	621.71					

Sustainability – Data Rate Distribution Graph

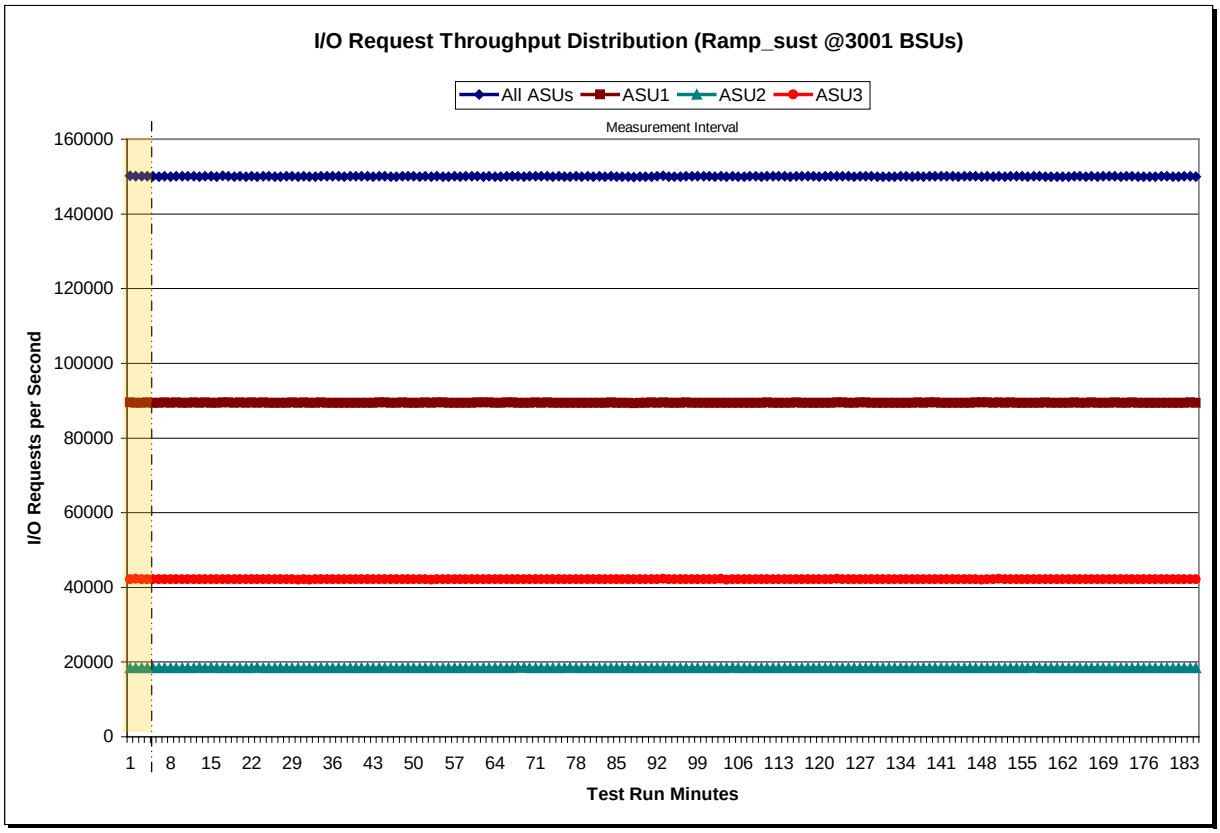


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	20:35:55	20:40:55	0-4	0:05:00
Measurement Interval	20:40:55	23:40:55	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	150,152.60	89,516.28	18,447.07	42,189.25	63	150,025.88	89,445.57	18,470.67	42,109.65	126	150,091.15	89,490.10	18,452.93	42,148.12
1	150,129.87	89,415.27	18,481.27	42,233.33	64	150,028.95	89,420.20	18,439.32	42,169.43	127	150,042.22	89,451.97	18,440.00	42,150.25
2	150,088.60	89,441.57	18,480.75	42,166.28	65	150,047.28	89,457.00	18,436.72	42,153.57	128	150,036.15	89,393.95	18,474.93	42,167.27
3	150,090.03	89,446.28	18,461.30	42,182.45	66	150,037.52	89,471.98	18,461.17	42,104.37	129	149,976.33	89,343.72	18,449.12	42,183.50
4	150,042.55	89,398.73	18,462.03	42,181.78	67	150,114.77	89,408.53	18,490.05	42,216.18	130	149,966.30	89,400.73	18,436.08	42,129.48
5	150,014.82	89,376.87	18,468.47	42,169.48	68	150,033.52	89,401.97	18,498.00	42,133.55	131	150,001.92	89,426.88	18,453.63	42,121.40
6	150,060.35	89,449.50	18,459.95	42,150.90	69	150,060.30	89,424.50	18,440.53	42,195.27	132	150,008.82	89,380.73	18,439.90	42,188.18
7	150,022.18	89,369.80	18,448.35	42,204.03	70	150,124.73	89,466.38	18,475.87	42,182.48	133	150,066.83	89,434.43	18,469.82	42,162.58
8	150,109.02	89,491.52	18,442.02	42,175.48	71	150,058.47	89,437.87	18,434.15	42,186.45	134	150,059.10	89,433.35	18,461.17	42,164.58
9	150,050.63	89,388.38	18,480.47	42,181.78	72	150,125.32	89,450.23	18,479.53	42,195.55	135	150,026.13	89,387.27	18,452.52	42,186.35
10	150,070.00	89,415.68	18,467.28	42,187.03	73	150,026.18	89,429.20	18,447.68	42,149.30	136	150,088.62	89,452.20	18,454.62	42,181.80
11	150,094.43	89,495.53	18,443.37	42,155.53	74	150,044.72	89,405.38	18,474.33	42,165.00	137	150,004.57	89,397.47	18,451.03	42,156.07
12	150,027.07	89,379.15	18,503.22	42,144.70	75	150,035.17	89,418.77	18,443.88	42,172.52	138	150,057.58	89,459.93	18,449.55	42,148.10
13	150,101.62	89,463.98	18,454.92	42,182.72	76	150,010.07	89,368.27	18,491.73	42,150.07	139	150,117.57	89,460.72	18,439.65	42,217.20
14	150,057.92	89,392.33	18,510.13	42,155.45	77	150,053.90	89,411.50	18,458.10	42,184.30	140	150,036.47	89,438.85	18,451.20	42,146.42
15	150,035.63	89,425.17	18,447.63	42,162.83	78	150,033.83	89,428.27	18,427.73	42,177.83	141	150,086.17	89,427.65	18,479.88	42,178.63
16	150,152.47	89,497.70	18,454.65	42,200.12	79	150,044.83	89,404.52	18,486.42	42,153.90	142	150,076.75	89,433.58	18,471.18	42,171.98
17	150,096.35	89,450.08	18,463.88	42,182.38	80	150,010.48	89,382.27	18,462.73	42,165.48	143	149,951.85	89,391.03	18,435.63	42,125.18
18	149,985.50	89,409.45	18,444.75	42,131.30	81	150,070.73	89,422.70	18,474.95	42,173.08	144	150,037.98	89,400.10	18,481.43	42,156.45
19	150,100.98	89,467.98	18,434.32	42,198.68	82	149,981.28	89,381.88	18,481.40	42,118.00	145	150,058.48	89,445.55	18,457.63	42,155.30
20	150,023.33	89,389.57	18,479.62	42,154.15	83	150,078.78	89,457.05	18,478.40	42,143.33	146	150,120.33	89,471.57	18,466.48	42,182.28
21	150,110.08	89,470.60	18,461.05	42,178.43	84	150,034.87	89,425.23	18,457.40	42,152.23	147	150,007.33	89,446.92	18,462.23	42,098.18
22	150,031.33	89,337.53	18,492.85	42,200.95	85	150,023.88	89,412.45	18,432.93	42,178.50	148	150,061.43	89,499.22	18,443.00	42,119.22
23	150,076.58	89,466.63	18,442.75	42,167.20	86	150,033.98	89,441.17	18,427.48	42,165.33	149	150,008.65	89,369.55	18,443.27	42,195.83
24	150,081.42	89,445.40	18,476.43	42,159.58	87	149,881.05	89,318.83	18,443.33	42,118.88	150	150,126.35	89,446.13	18,459.33	42,220.88
25	150,011.05	89,365.28	18,463.10	42,182.67	88	150,012.85	89,407.02	18,413.02	42,192.82	151	150,007.82	89,418.82	18,413.83	42,175.17
26	150,019.17	89,414.72	18,431.45	42,173.00	89	150,022.42	89,401.27	18,456.40	42,164.75	152	150,060.88	89,473.55	18,429.53	42,157.80
27	150,056.87	89,417.02	18,456.92	42,182.93	90	150,025.95	89,461.02	18,451.42	42,113.52	153	150,038.92	89,421.85	18,457.98	42,159.08
28	150,080.28	89,498.22	18,440.63	42,141.43	91	150,105.68	89,425.33	18,476.02	42,204.33	154	150,088.42	89,443.65	18,453.95	42,190.82
29	150,023.77	89,442.38	18,479.82	42,101.57	92	150,172.85	89,474.85	18,453.38	42,244.62	155	150,023.15	89,420.42	18,440.20	42,162.53
30	150,051.05	89,506.08	18,402.90	42,142.07	93	150,019.10	89,415.03	18,411.43	42,192.63	156	150,056.37	89,417.25	18,492.48	42,146.63
31	149,982.42	89,443.07	18,465.78	42,073.57	94	149,976.90	89,422.67	18,449.82	42,104.42	157	150,062.02	89,400.87	18,446.73	42,214.42
32	149,973.82	89,372.68	18,442.23	42,158.90	95	150,013.32	89,406.25	18,437.07	42,170.00	158	149,993.88	89,452.33	18,412.25	42,129.30
33	150,095.62	89,468.25	18,451.80	42,175.57	96	150,119.32	89,491.82	18,431.75	42,195.75	159	150,027.70	89,392.83	18,463.68	42,171.18
34	150,070.55	89,438.77	18,450.27	42,181.52	97	150,067.57	89,430.05	18,459.60	42,177.92	160	150,002.73	89,361.32	18,463.15	42,178.27
35	150,081.55	89,437.32	18,457.30	42,186.93	98	150,062.87	89,400.30	18,462.67	42,199.90	161	150,024.87	89,438.35	18,464.47	42,122.05
36	150,050.80	89,405.33	18,482.52	42,162.95	99	150,055.77	89,425.15	18,442.52	42,188.10	162	150,002.62	89,394.47	18,453.33	42,154.82
37	149,968.32	89,365.53	18,432.40	42,170.38	100	150,066.57	89,430.98	18,458.40	42,177.18	163	150,092.50	89,493.28	18,437.28	42,161.93
38	150,038.47	89,420.97	18,470.53	42,146.97	101	149,952.58	89,394.00	18,442.22	42,116.37	164	150,087.58	89,439.70	18,478.48	42,169.40
39	150,042.97	89,444.67	18,451.15	42,147.15	102	150,135.65	89,435.00	18,482.73	42,217.92	165	149,992.18	89,365.58	18,446.62	42,179.98
40	150,075.83	89,441.50	18,448.58	42,185.75	103	149,981.48	89,432.50	18,456.28	42,092.70	166	150,101.73	89,476.85	18,446.28	42,178.60
41	150,041.13	89,393.55	18,466.37	42,181.22	104	150,105.10	89,420.88	18,497.18	42,187.03	167	149,981.07	89,397.80	18,462.53	42,120.73
42	150,030.42	89,413.87	18,455.85	42,160.70	105	149,978.18	89,370.58	18,473.80	42,133.80	168	150,042.13	89,428.27	18,458.38	42,155.48
43	150,114.73	89,480.40	18,470.25	42,164.08	106	150,031.88	89,380.05	18,478.43	42,173.40	169	150,058.28	89,439.05	18,465.30	42,153.93
44	150,108.23	89,468.17	18,445.48	42,194.58	107	150,040.12	89,370.88	18,478.12	42,191.12	170	150,064.77	89,477.17	18,454.60	42,133.00
45	150,002.70	89,389.03	18,453.60	42,160.07	108	150,078.48	89,443.55	18,448.48	42,186.45	171	150,009.27	89,399.25	18,434.52	42,175.50
46	149,964.17	89,365.83	18,458.25	42,140.08	109	150,030.33	89,433.97	18,442.55	42,153.82	172	150,049.10	89,410.05	18,459.22	42,179.83
47	150,142.45	89,478.02	18,476.68	42,187.75	110	150,097.53	89,480.85	18,455.62	42,161.07	173	150,104.80	89,457.67	18,473.33	42,173.80
48	150,059.47	89,444.45	18,464.23	42,150.78	111	150,044.17	89,397.85	18,483.08	42,163.23	174	150,030.73	89,395.45	18,461.45	42,173.83
49	150,069.23	89,423.65	18,429.23	42,216.35	112	150,048.40	89,401.90	18,457.85	42,188.65	175	150,024.58	89,390.10	18,449.28	42,185.20
50	149,963.30	89,350.08	18,454.98	42,158.23	113	150,068.95	89,401.15	18,469.93	42,197.87	176	149,965.77	89,368.40	18,461.10	42,136.27
51	150,062.35	89,459.87	18,457.10	42,145.38	114	150,032.98	89,402.27	18,459.63	42,171.08	177	150,027.42	89,386.83	18,442.10	42,198.48
52	149,957.70	89,396.30	18,459.52	42,101.88	115	150,115.80	89,474.75	18,436.90	42,204.15	178	150,047.03	89,417.18	18,461.83	42,168.02
53	150,049.28	89,460.08	18,451.22	42,137.98	116	150,066.00	89,431.63	18,454.57	42,179.80	179	150,044.32	89,418.55	18,445.65	42,180.12
54	150,011.25	89,450.50	18,416.72	42,144.03	117	150,054.07	89,407.58	18,448.98	42,197.50	180	150,031.18	89,421.35	18,439.25	42,170.58
55	150,025.12	89,428.12	18,437.68	42,159.32	118	150,051.65	89,443.40	18,470.43	42,137.82	181	150,025.17	89,411.28	18,460.00	42,153.88
56	150,041.82	89,403.57	18,471.25	42,167.00	119	150,016.62	89,397.22	18,437.57	42,181.83	182	150,070.47	89,421.73	18,462.02	42,186.72
57	149,995.38	89,398.18	18,448.32	42,148.88	120	150,062.73	89,430.67	18,448.78	42,183.28	183	150,057.70	89,448.22	18,452.25	42,157.23
58	150,066.00	89,438.15	18,464.47	42,163.38	121	150,067.30	89,433.70	18,458.85	42,174.75	184	149,970.85	89,377.13	18,442.37	42,151.35
59	150,094.13	89,438.82	18,452.30	42,203.02	122	150,135.97	89,481.08	18,435.05	42,219.83	***Average***	***150,046.85***	***89,425.48***	***18,455.65***	***42,165.72***
60	150,094.90	89,492.77	18,432.17	42,169.97	123	150,096.77	89,474.60	18,467.38	42,154.78					
61	150,034.68	89,448.60	18,435.12	42,150.97	124	150,072.05	89,427.25	18,436.85	42,207.95					
62	150,123.85	89,470.43	18,470.27	42,183.15	125	149,967.48	89,418.12	18,441.75	42,107.62					

Sustainability – I/O Request Throughput Distribution Graph

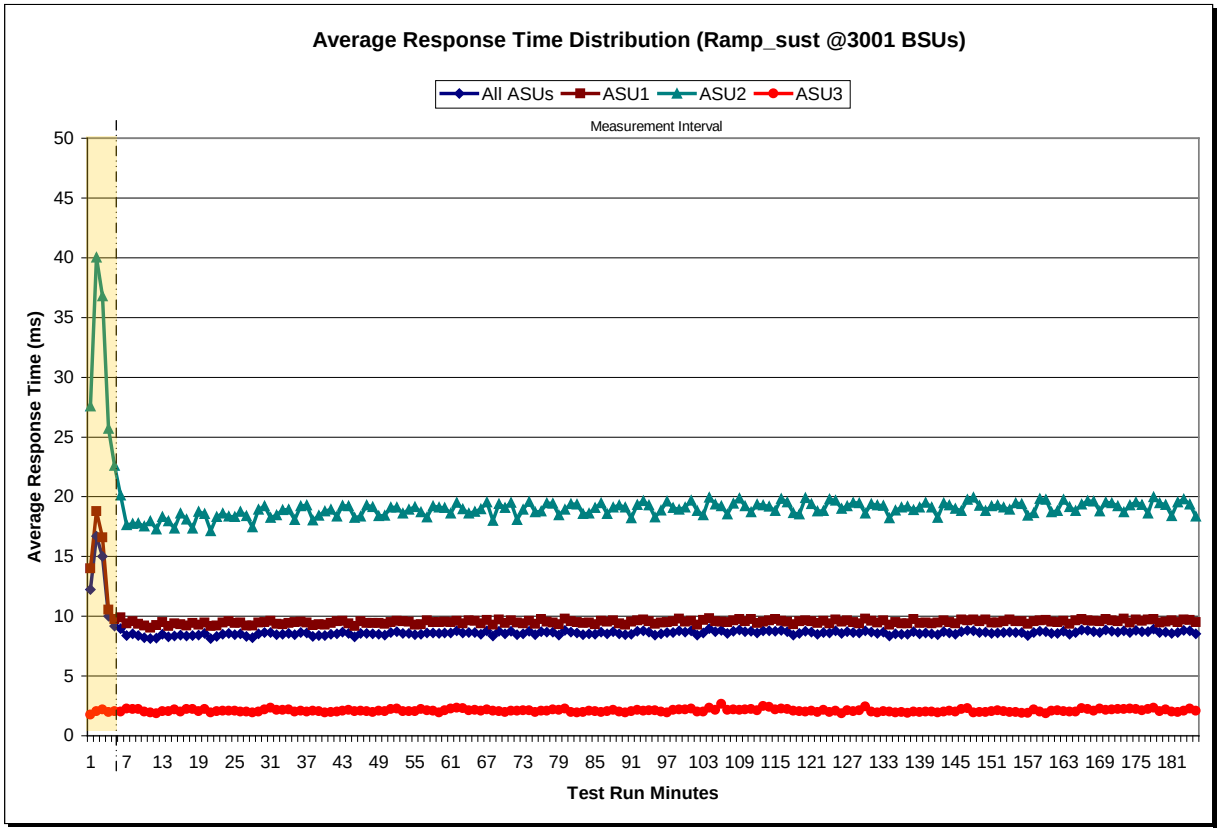


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	20:35:55	20:40:55	0-4	0:05:00
Measurement Interval	20:40:55	23:40:55	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	12.22	13.99	27.57	1.76	63	8.62	9.63	18.60	2.11	126	8.71	9.65	19.22	2.12
1	16.70	18.80	40.05	2.05	64	8.65	9.62	18.76	2.17	127	8.65	9.52	19.49	2.05
2	15.02	16.58	36.78	2.18	65	8.51	9.38	18.98	2.09	128	8.60	9.41	19.46	2.13
3	10.00	10.55	25.69	1.97	66	8.79	9.68	19.55	2.19	129	8.80	9.77	18.60	2.44
4	9.19	9.77	22.61	2.07	67	8.35	9.30	17.99	2.10	130	8.69	9.61	19.42	2.02
5	8.95	9.89	20.14	2.03	68	8.76	9.71	19.42	2.06	131	8.57	9.48	19.28	1.94
6	8.40	9.39	17.63	2.28	69	8.53	9.44	19.09	1.99	132	8.69	9.66	19.25	2.04
7	8.53	9.59	17.75	2.25	70	8.73	9.65	19.51	2.08	133	8.34	9.27	18.23	2.02
8	8.40	9.37	17.79	2.24	71	8.46	9.48	18.07	2.11	134	8.52	9.49	18.88	1.95
9	8.22	9.23	17.53	2.01	72	8.52	9.38	18.92	2.13	135	8.51	9.40	19.11	1.99
10	8.15	9.05	17.96	1.95	73	8.74	9.62	19.59	2.13	136	8.50	9.40	19.20	1.92
11	8.16	9.24	17.27	1.88	74	8.45	9.38	18.73	1.96	137	8.71	9.77	18.89	2.00
12	8.49	9.50	18.31	2.06	75	8.71	9.75	18.80	2.09	138	8.54	9.45	19.11	2.00
13	8.27	9.19	17.98	2.06	76	8.66	9.53	19.46	2.08	139	8.62	9.48	19.51	2.03
14	8.36	9.40	17.35	2.20	77	8.66	9.47	19.45	2.21	140	8.52	9.41	19.11	2.00
15	8.42	9.34	18.60	2.01	78	8.43	9.32	18.48	2.16	141	8.44	9.48	18.26	1.95
16	8.34	9.20	18.10	2.23	79	8.81	9.80	18.92	2.28	142	8.70	9.63	19.46	2.00
17	8.39	9.44	17.37	2.23	80	8.66	9.58	19.40	1.99	143	8.62	9.50	19.28	2.07
18	8.41	9.29	18.74	2.04	81	8.59	9.51	19.37	1.93	144	8.50	9.38	19.00	2.03
19	8.55	9.47	18.59	2.23	82	8.45	9.41	18.59	1.96	145	8.73	9.71	18.82	2.22
20	8.12	9.17	17.13	1.94	83	8.53	9.48	18.62	2.09	146	8.83	9.65	19.75	2.31
21	8.31	9.20	18.33	2.04	84	8.49	9.33	19.08	2.06	147	8.79	9.71	19.94	1.96
22	8.51	9.46	18.60	2.07	85	8.67	9.61	19.49	1.97	148	8.63	9.58	19.25	1.98
23	8.56	9.59	18.36	2.08	86	8.54	9.53	18.58	2.07	149	8.66	9.72	18.83	1.97
24	8.47	9.44	18.31	2.08	87	8.71	9.66	19.10	2.15	150	8.58	9.46	19.24	2.06
25	8.52	9.47	18.77	2.03	88	8.54	9.40	19.28	2.03	151	8.61	9.47	19.30	2.11
26	8.31	9.20	18.38	2.01	89	8.44	9.30	19.11	1.95	152	8.64	9.57	19.12	2.07
27	8.19	9.22	17.46	1.96	90	8.51	9.54	18.23	2.06	153	8.68	9.72	18.93	1.99
28	8.54	9.46	18.94	2.02	91	8.74	9.66	19.32	2.16	154	8.65	9.56	19.49	1.99
29	8.64	9.49	19.21	2.20	92	8.79	9.71	19.66	2.08	155	8.63	9.58	19.39	1.91
30	8.63	9.61	18.26	2.33	93	8.67	9.57	19.30	2.13	156	8.38	9.36	18.43	1.90
31	8.46	9.35	18.47	2.17	94	8.42	9.36	18.29	2.11	157	8.62	9.59	18.66	2.19
32	8.49	9.33	18.90	2.14	95	8.52	9.46	18.86	2.02	158	8.75	9.64	19.84	2.01
33	8.56	9.42	18.92	2.19	96	8.63	9.52	19.63	1.94	159	8.73	9.69	19.76	1.86
34	8.44	9.49	18.06	2.02	97	8.66	9.57	19.08	2.16	160	8.57	9.53	18.71	2.09
35	8.62	9.53	19.22	2.08	98	8.77	9.78	18.92	2.18	161	8.58	9.52	18.82	2.12
36	8.59	9.48	19.30	2.01	99	8.66	9.55	19.12	2.21	162	8.74	9.61	19.77	2.04
37	8.32	9.25	18.02	2.11	100	8.78	9.60	19.68	2.25	163	8.50	9.37	19.16	2.00
38	8.40	9.31	18.42	2.07	101	8.42	9.29	18.81	2.02	164	8.63	9.65	18.82	2.00
39	8.40	9.29	18.81	1.95	102	8.61	9.69	18.46	2.03	165	8.85	9.77	19.36	2.32
40	8.51	9.43	18.92	1.99	103	8.97	9.83	19.95	2.34	166	8.80	9.66	19.67	2.23
41	8.52	9.57	18.38	2.00	104	8.70	9.56	19.38	2.18	167	8.73	9.60	19.63	2.10
42	8.67	9.60	19.26	2.07	105	8.81	9.55	19.21	2.67	168	8.65	9.56	18.78	2.28
43	8.56	9.38	19.21	2.15	106	8.56	9.51	18.54	2.18	169	8.84	9.77	19.56	2.17
44	8.29	9.19	18.26	2.05	107	8.76	9.66	19.42	2.18	170	8.75	9.64	19.46	2.18
45	8.55	9.58	18.38	2.07	108	8.86	9.76	19.87	2.16	171	8.69	9.56	19.22	2.23
46	8.57	9.44	19.29	2.05	109	8.70	9.59	19.21	2.21	172	8.78	9.80	18.73	2.25
47	8.54	9.45	19.15	1.97	110	8.74	9.75	18.73	2.23	173	8.65	9.46	19.29	2.27
48	8.48	9.44	18.40	2.08	111	8.59	9.42	19.35	2.13	174	8.82	9.71	19.56	2.24
49	8.42	9.36	18.42	2.06	112	8.77	9.55	19.31	2.49	175	8.70	9.61	19.34	2.12
50	8.64	9.50	19.13	2.21	113	8.78	9.63	19.18	2.43	176	8.70	9.70	18.60	2.22
51	8.71	9.59	19.12	2.27	114	8.75	9.76	18.81	2.18	177	8.94	9.77	19.97	2.35
52	8.59	9.59	18.62	2.05	115	8.81	9.62	19.83	2.27	178	8.62	9.48	19.47	2.07
53	8.58	9.53	18.95	2.05	116	8.73	9.55	19.56	2.24	179	8.67	9.52	19.33	2.20
54	8.47	9.30	19.16	2.04	117	8.42	9.31	18.65	2.08	180	8.57	9.65	18.39	2.00
55	8.49	9.32	18.71	2.25	118	8.56	9.56	18.54	2.07	181	8.63	9.51	19.54	1.98
56	8.60	9.66	18.30	2.12	119	8.76	9.65	19.92	2.01	182	8.82	9.74	19.81	2.08
57	8.62	9.51	19.22	2.08	120	8.67	9.56	19.39	2.09	183	8.79	9.68	19.38	2.26
58	8.56	9.51	19.10	1.95	121	8.49	9.42	18.79	1.99	184	8.52	9.52	18.38	2.10
59	8.62	9.53	19.08	2.13	122	8.65	9.62	18.81	2.16	***Average***	***8.59***	***9.52***	***18.95***	***2.10***
60	8.59	9.49	18.62	2.28	123	8.60	9.40	19.80	2.00					
61	8.78	9.60	19.51	2.32	124	8.80	9.71	19.69	2.10					
62	8.59	9.41	18.97	2.30	125	8.56	9.55	18.99	1.88					

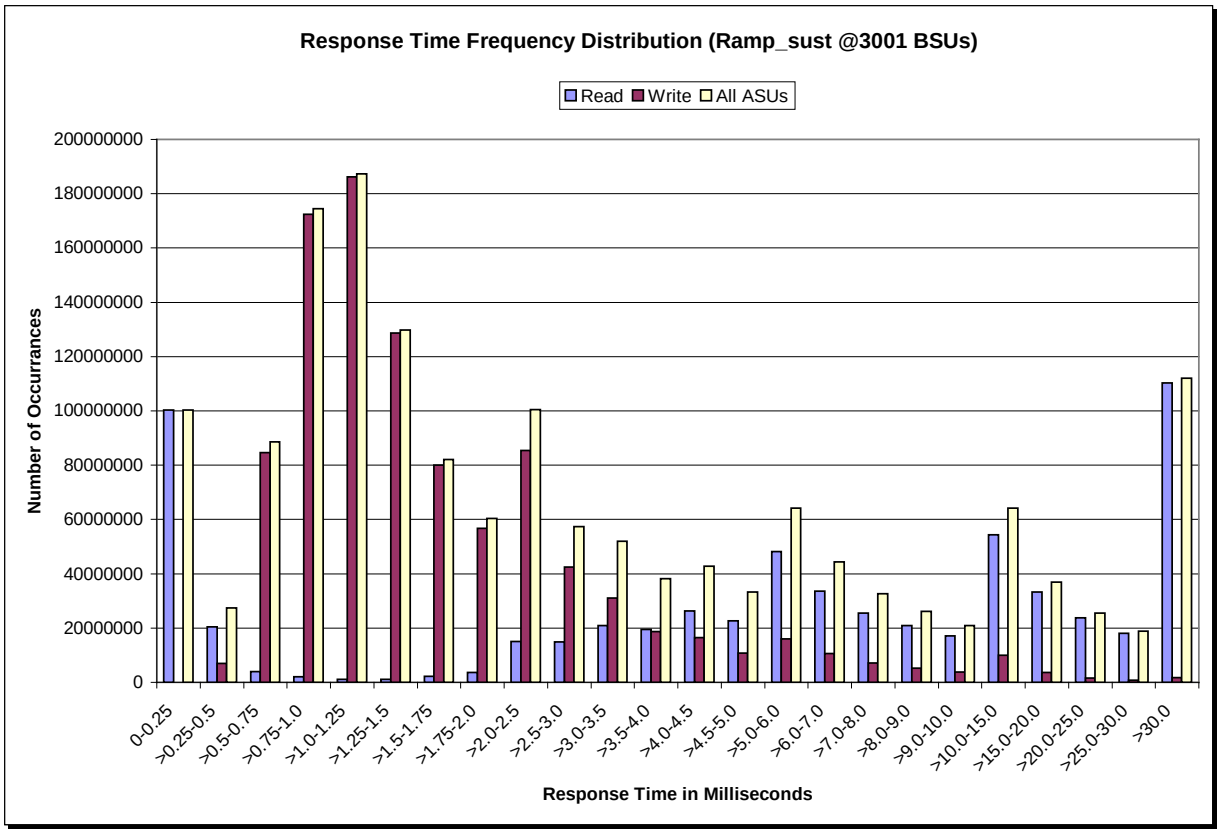
Sustainability – Average Response Time (ms) Distribution Graph



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	100,365,797	20,423,815	3,934,882	2,020,669	1,084,302	1,140,041	2,158,778	3,646,948
Write	565	6,916,832	84,634,059	172,408,924	186,266,596	128,730,411	79,964,192	56,693,472
All ASUs	100,366,362	27,340,647	88,568,941	174,429,593	187,350,898	129,870,452	82,122,970	60,340,420
ASU1	86,609,415	20,726,139	42,159,641	79,099,439	82,441,211	56,143,058	35,786,119	27,316,366
ASU2	13,756,764	3,801,775	10,392,644	18,917,476	19,559,077	13,161,707	8,055,290	5,701,432
ASU3	183	2,812,733	36,016,656	76,412,678	85,350,610	60,565,687	38,281,561	27,322,622
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	14,985,864	14,854,128	20,973,228	19,538,693	26,252,084	22,637,878	48,196,842	33,662,699
Write	85,461,756	42,523,031	31,079,696	18,733,255	16,523,254	10,701,761	16,001,610	10,686,947
All ASUs	100,447,620	57,377,159	52,052,924	38,271,948	42,775,338	33,339,639	64,198,452	44,349,646
ASU1	50,453,252	32,204,857	33,251,014	26,212,652	31,302,532	25,314,241	49,944,371	32,578,766
ASU2	8,762,180	4,511,775	3,712,859	2,928,338	3,438,307	2,798,275	6,445,201	6,556,661
ASU3	41,232,188	20,660,527	15,089,051	9,130,958	8,034,499	5,227,123	7,808,880	5,214,219
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	25,486,276	20,868,393	17,117,274	54,350,757	33,269,804	23,842,366	18,037,274	110,277,322
Write	7,188,441	5,273,979	3,848,493	9,906,719	3,608,608	1,620,039	830,549	1,775,162
All ASUs	32,674,717	26,142,372	20,965,767	64,257,476	36,878,412	25,462,405	18,867,823	112,052,484
ASU1	23,577,766	19,384,698	16,078,944	50,423,000	29,975,303	20,952,092	15,483,855	78,375,449
ASU2	5,589,585	4,188,233	3,012,543	9,024,618	5,163,214	3,744,779	3,003,412	33,094,477
ASU3	3,507,366	2,569,441	1,874,280	4,809,858	1,739,895	765,534	380,556	582,558

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 5.3.13.2

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 5.3.13.3

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	0.002	0.001	0.001	0.001	0.003	0.001	0.002	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 t 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 76.

IOPS Test Results File

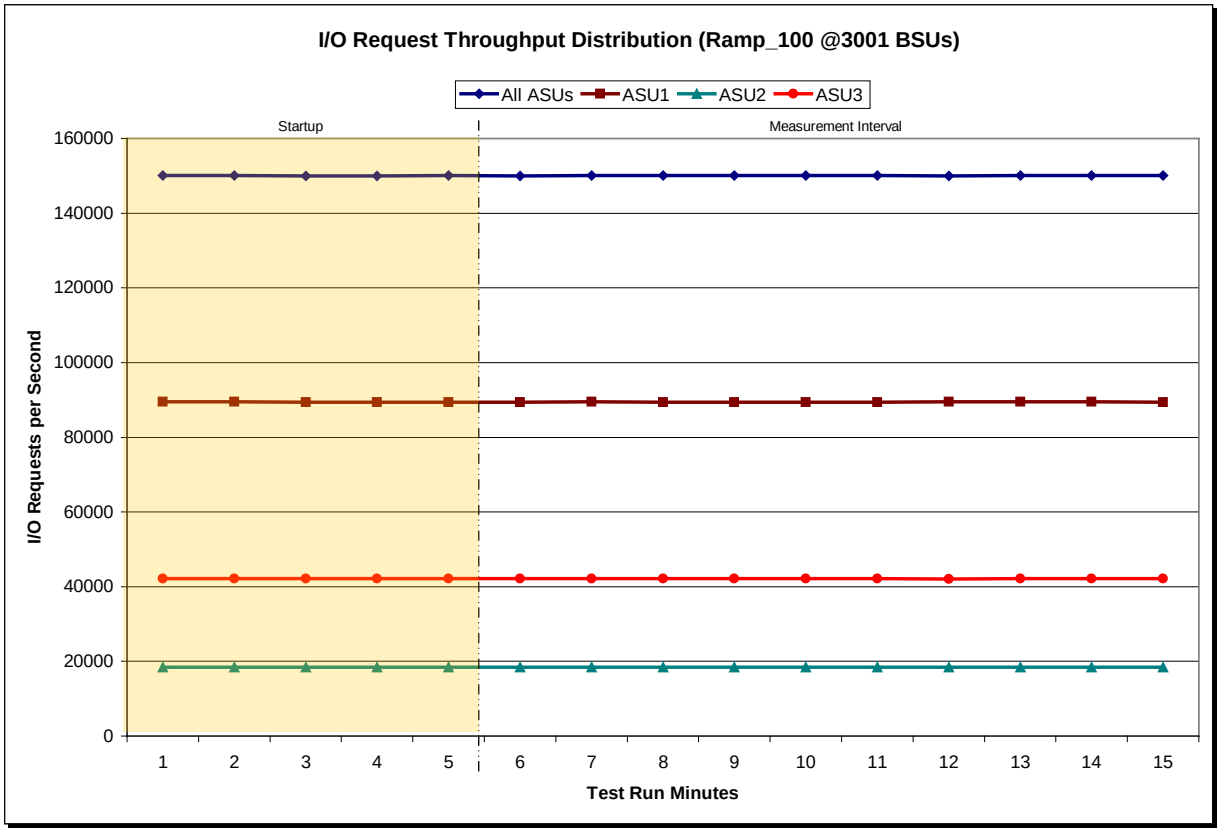
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:41:43	23:46:44	0-4	0:05:01
Measurement Interval	23:46:44	23:56:44	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	150,065.90	89,463.95	18,470.73	42,131.22
1	150,098.20	89,510.10	18,397.42	42,190.68
2	149,969.97	89,350.47	18,441.78	42,177.72
3	150,001.78	89,406.55	18,436.27	42,158.97
4	150,071.83	89,438.05	18,446.87	42,186.92
5	150,011.33	89,421.98	18,454.72	42,134.63
6	150,088.68	89,491.65	18,462.47	42,134.57
7	150,036.62	89,426.03	18,473.48	42,137.10
8	150,085.72	89,429.85	18,483.17	42,172.70
9	150,079.72	89,427.15	18,476.08	42,176.48
10	150,053.02	89,414.70	18,451.35	42,186.97
11	150,035.12	89,455.00	18,481.10	42,099.02
12	150,096.53	89,488.08	18,454.92	42,153.53
13	150,068.00	89,486.75	18,440.12	42,141.13
14	150,057.00	89,442.80	18,433.27	42,180.93
Average	***150,061.17***	***89,448.40***	***18,461.07***	***42,151.71***

IOPS Test Run – I/O Request Throughput Distribution Graph

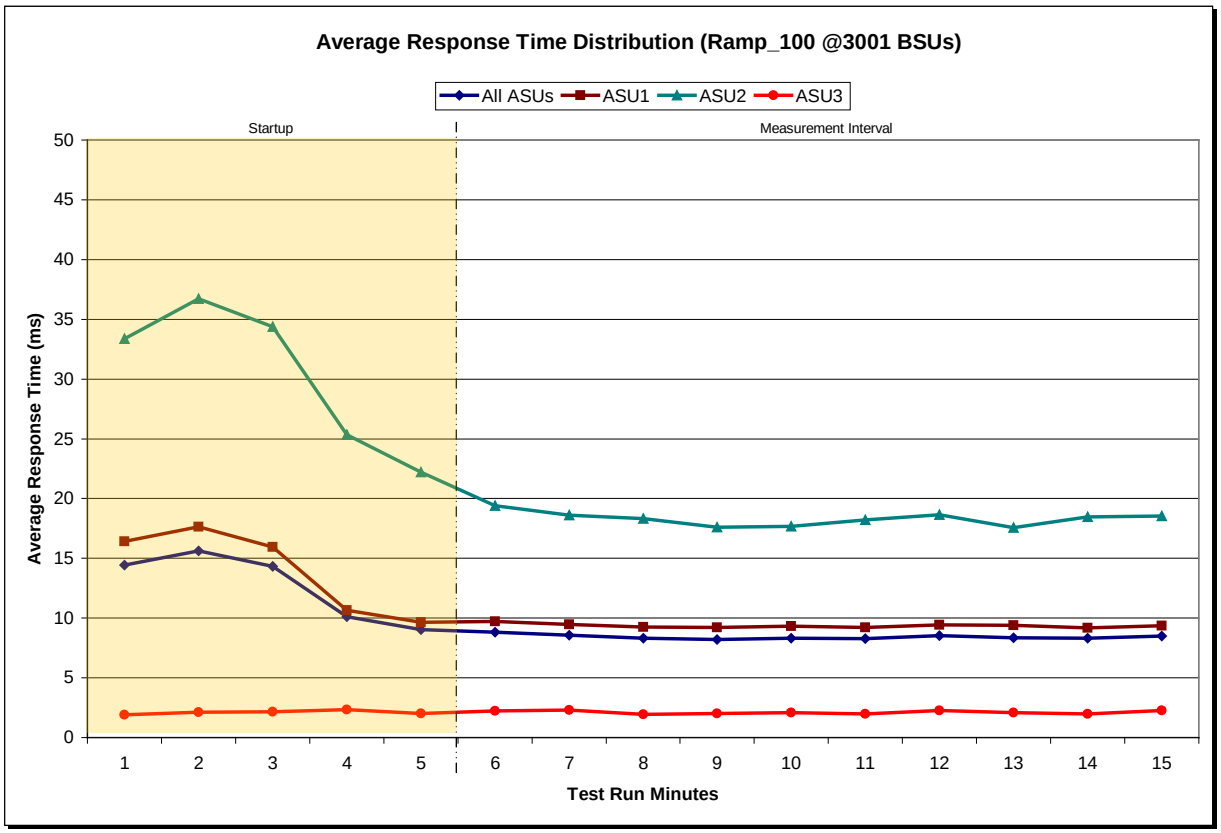


IOPS Test Run – Average Response Time (ms) Distribution Data

3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:41:43	23:46:44	0-4	0:05:01
Measurement Interval	23:46:44	23:56:44	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	14.43	16.42	33.38	1.89
1	15.62	17.65	36.71	2.13
2	14.33	15.94	34.39	2.14
3	10.13	10.66	25.34	2.33
4	9.05	9.65	22.20	2.02
5	8.81	9.71	19.41	2.24
6	8.58	9.47	18.63	2.29
7	8.32	9.25	18.31	1.95
8	8.21	9.20	17.60	2.00
9	8.31	9.31	17.68	2.08
10	8.28	9.22	18.20	1.96
11	8.55	9.42	18.65	2.25
12	8.35	9.41	17.56	2.09
13	8.31	9.19	18.46	1.99
14	8.50	9.37	18.53	2.25
Average	***8.42***	***9.36***	***18.30***	***2.11***

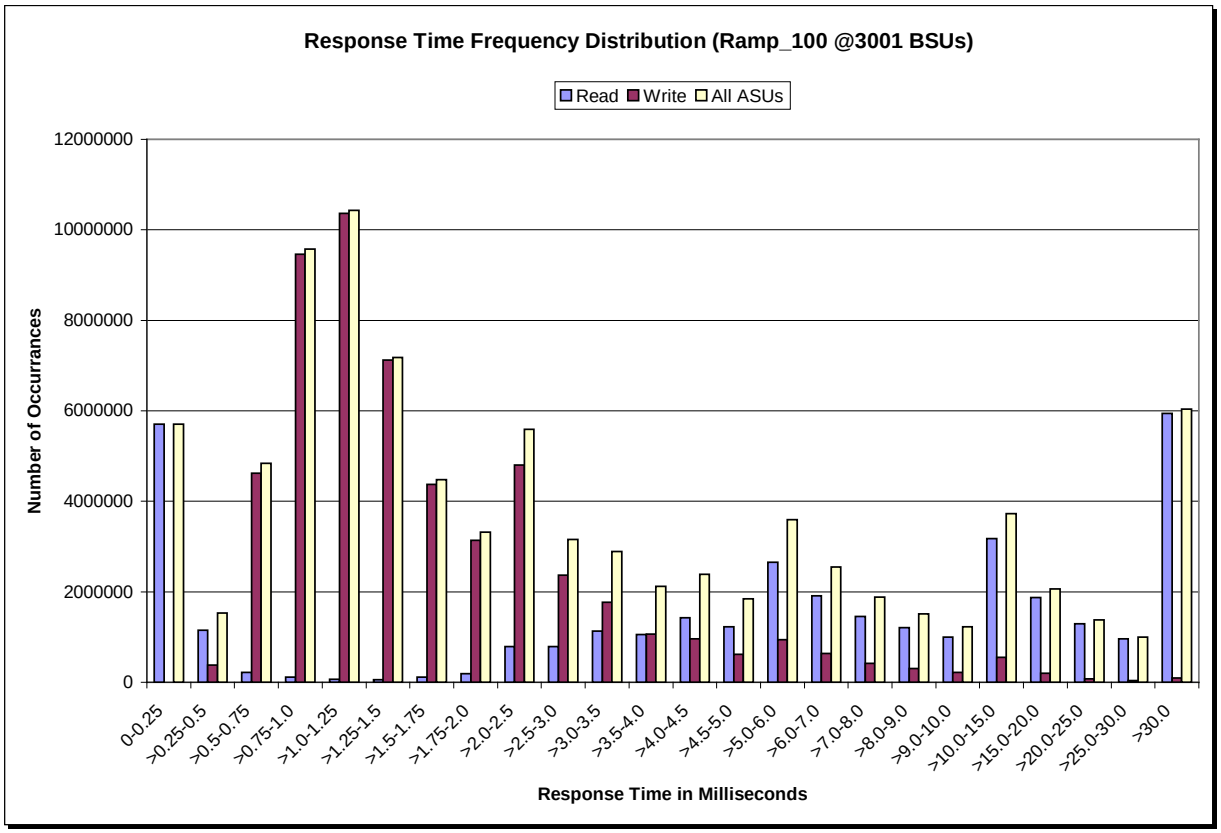
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	5,709,704	1,149,495	221,880	116,477	62,889	60,661	109,943	188,025
Write	28	384,797	4,618,371	9,459,474	10,366,280	7,119,691	4,370,924	3,134,859
All ASUs	5,709,732	1,534,292	4,840,251	9,575,951	10,429,169	7,180,352	4,480,867	3,322,884
ASU1	4,921,714	1,162,168	2,307,046	4,347,950	4,595,206	3,104,183	1,948,596	1,498,014
ASU2	788,010	215,974	569,001	1,038,556	1,088,020	727,964	441,321	316,418
ASU3	8	156,150	1,964,204	4,189,445	4,745,943	3,348,205	2,090,950	1,508,452
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	788,327	790,588	1,127,917	1,053,200	1,429,896	1,229,519	2,649,522	1,915,966
Write	4,805,182	2,368,475	1,765,461	1,063,389	961,390	615,517	941,465	633,130
All ASUs	5,593,509	3,159,063	2,893,378	2,116,589	2,391,286	1,845,036	3,590,987	2,549,096
ASU1	2,784,186	1,757,430	1,827,090	1,434,053	1,728,627	1,386,650	2,774,827	1,876,727
ASU2	494,264	252,193	209,550	164,366	196,041	157,032	356,795	363,505
ASU3	2,315,059	1,149,440	856,738	518,170	466,618	301,354	459,365	308,864
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	1,458,907	1,204,470	1,002,923	3,171,853	1,871,056	1,295,254	963,597	5,945,608
Write	421,100	305,998	223,175	553,866	195,651	78,850	39,085	91,525
All ASUs	1,880,007	1,510,468	1,226,098	3,725,719	2,066,707	1,374,104	1,002,682	6,037,133
ASU1	1,363,958	1,127,753	941,818	2,930,674	1,678,233	1,130,660	822,078	4,218,530
ASU2	310,351	233,390	175,232	525,260	294,259	206,255	162,940	1,789,654
ASU3	205,698	149,325	109,048	269,785	94,215	37,189	17,664	28,949

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
90,035,360	83,998,227	6,037,133

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 5.3.13.2

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 5.3.13.3

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	0.035	0.2809
COV	0.002	0.001	0.002	0.001	0.003	0.001	0.002	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 76.

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 - 3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:41:43	23:46:44	0-4	0:05:01
Measurement Interval	23:46:44	23:56:44	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	150,065.90	89,463.95	18,470.73	42,131.22
1	150,098.20	89,510.10	18,397.42	42,190.68
2	149,969.97	89,350.47	18,441.78	42,177.72
3	150,001.78	89,406.55	18,436.27	42,158.97
4	150,071.83	89,438.05	18,446.87	42,186.92
5	150,011.33	89,421.98	18,454.72	42,134.63
6	150,088.68	89,491.65	18,462.47	42,134.57
7	150,036.62	89,426.03	18,473.48	42,137.10
8	150,085.72	89,429.85	18,483.17	42,172.70
9	150,079.72	89,427.15	18,476.08	42,176.48
10	150,053.02	89,414.70	18,451.35	42,186.97
11	150,035.12	89,455.00	18,481.10	42,099.02
12	150,096.53	89,488.08	18,454.92	42,153.53
13	150,068.00	89,486.75	18,440.12	42,141.13
14	150,057.00	89,442.80	18,433.27	42,180.93
Average	*150,061.17*	*89,448.40*	*18,461.07*	*42,151.71*

95% Load Level - 2850 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:57:25	0:02:26	0-4	0:05:01
Measurement Interval	0:02:26	0:12:26	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	142,440.42	84,975.43	17,487.20	39,977.78
1	142,488.77	84,903.82	17,512.50	40,072.45
2	142,436.93	84,865.68	17,524.83	40,046.42
3	142,557.55	84,974.22	17,541.27	40,042.07
4	142,445.70	84,894.32	17,532.33	40,019.05
5	142,522.45	84,930.27	17,528.98	40,063.20
6	142,495.63	84,930.68	17,509.55	40,055.40
7	142,541.52	84,958.35	17,527.08	40,056.08
8	142,420.83	84,877.88	17,553.32	39,989.63
9	142,486.98	84,945.20	17,540.88	40,000.90
10	142,487.00	84,968.87	17,513.28	40,004.85
11	142,536.68	84,917.38	17,533.87	40,085.43
12	142,561.73	84,981.42	17,522.50	40,057.82
13	142,559.25	84,969.85	17,537.82	40,051.58
14	142,485.20	84,965.58	17,535.62	39,984.00
Average	*142,509.73*	*84,944.55*	*17,530.29*	*40,034.89*

90% Load Level - 2700 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:13:12	0:18:13	0-4	0:05:01
Measurement Interval	0:18:13	0:28:13	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	134,966.10	80,480.50	16,584.18	37,901.42
1	134,993.68	80,446.55	16,617.78	37,929.35
2	135,039.50	80,502.97	16,625.43	37,911.10
3	135,001.27	80,487.28	16,598.78	37,915.20
4	135,042.42	80,481.43	16,598.52	37,962.47
5	135,000.27	80,446.15	16,600.37	37,953.75
6	134,944.95	80,419.40	16,608.50	37,917.05
7	134,958.30	80,472.18	16,570.90	37,915.22
8	135,034.68	80,471.72	16,611.77	37,951.20
9	134,977.75	80,469.57	16,595.52	37,912.67
10	135,055.15	80,485.48	16,603.37	37,966.30
11	134,971.77	80,490.05	16,620.80	37,860.92
12	135,094.23	80,534.57	16,613.68	37,945.98
13	134,953.85	80,448.05	16,585.43	37,920.37
14	135,062.48	80,480.90	16,643.62	37,937.97
Average	*135,005.34*	*80,471.81*	*16,605.40*	*37,928.14*

80% Load Level - 2400 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:28:54	0:33:55	0-4	0:05:01
Measurement Interval	0:33:55	0:43:55	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	119,998.60	71,534.73	14,730.98	33,732.88
1	119,940.62	71,469.27	14,748.55	33,722.80
2	120,091.57	71,560.60	14,773.87	33,757.10
3	120,036.27	71,542.98	14,759.65	33,733.63
4	119,986.48	71,516.18	14,762.40	33,707.90
5	119,959.57	71,532.90	14,760.98	33,665.68
6	119,990.62	71,521.33	14,751.28	33,718.00
7	120,099.78	71,547.32	14,786.30	33,766.17
8	119,982.02	71,520.97	14,759.23	33,701.82
9	120,049.88	71,546.73	14,783.78	33,719.37
10	120,020.38	71,601.97	14,738.98	33,679.43
11	119,985.43	71,510.97	14,750.52	33,723.95
12	120,001.85	71,513.93	14,751.12	33,736.80
13	119,985.27	71,518.40	14,767.65	33,699.22
14	120,009.92	71,499.83	14,759.77	33,750.32
Average	*120,008.47*	*71,531.44*	*14,760.96*	*33,716.08*

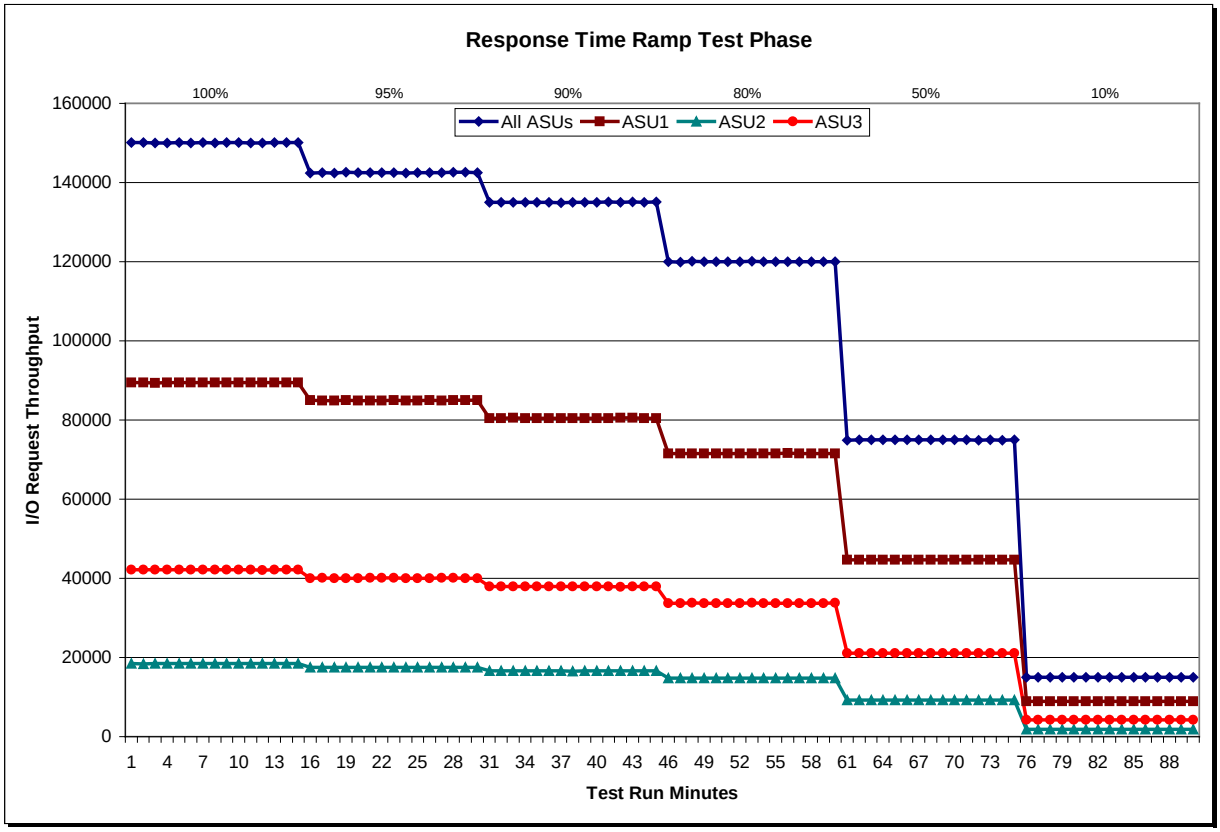
50% Load Level - 1500 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:44:33	0:49:34	0-4	0:05:01
Measurement Interval	0:49:34	0:59:34	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	74,928.97	44,645.93	9,224.08	21,058.95
1	75,019.57	44,708.17	9,237.92	21,073.48
2	74,971.38	44,661.35	9,224.78	21,085.25
3	74,954.10	44,681.30	9,215.27	21,057.53
4	75,024.37	44,707.73	9,251.12	21,065.52
5	75,027.60	44,724.35	9,231.75	21,071.50
6	75,017.35	44,719.00	9,231.88	21,066.47
7	75,023.68	44,714.83	9,223.63	21,085.22
8	74,960.82	44,688.48	9,229.63	21,042.70
9	74,947.67	44,660.98	9,211.93	21,074.75
10	75,009.40	44,682.95	9,240.42	21,086.03
11	74,929.97	44,686.35	9,208.30	21,035.32
12	75,020.27	44,694.62	9,245.22	21,080.43
13	74,924.92	44,665.98	9,201.17	21,057.77
14	74,980.43	44,697.15	9,223.33	21,059.95
Average	*74,984.21*	*44,693.47*	*9,224.73*	*21,066.01*

10% Load Level - 300 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:00:08	1:05:09	0-4	0:05:01
Measurement Interval	1:05:09	1:15:09	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	15,004.35	8,928.27	1,853.05	4,223.03
1	14,991.02	8,923.85	1,846.65	4,220.52
2	14,990.85	8,937.62	1,843.52	4,209.72
3	15,020.40	8,950.73	1,850.27	4,219.40
4	14,979.20	8,915.07	1,849.13	4,215.00
5	14,995.07	8,933.48	1,842.97	4,218.62
6	14,979.55	8,928.67	1,845.00	4,205.88
7	14,986.33	8,944.40	1,839.13	4,202.80
8	15,018.60	8,955.97	1,841.68	4,220.95
9	14,991.93	8,937.42	1,846.02	4,208.50
10	14,993.83	8,941.18	1,836.90	4,215.75
11	14,990.67	8,944.75	1,837.12	4,208.80
12	15,004.23	8,944.08	1,856.23	4,203.92
13	14,994.05	8,943.98	1,846.52	4,203.55
14	15,001.13	8,941.47	1,845.88	4,213.78
Average	*14,995.54*	*8,941.54*	*1,843.75*	*4,210.26*

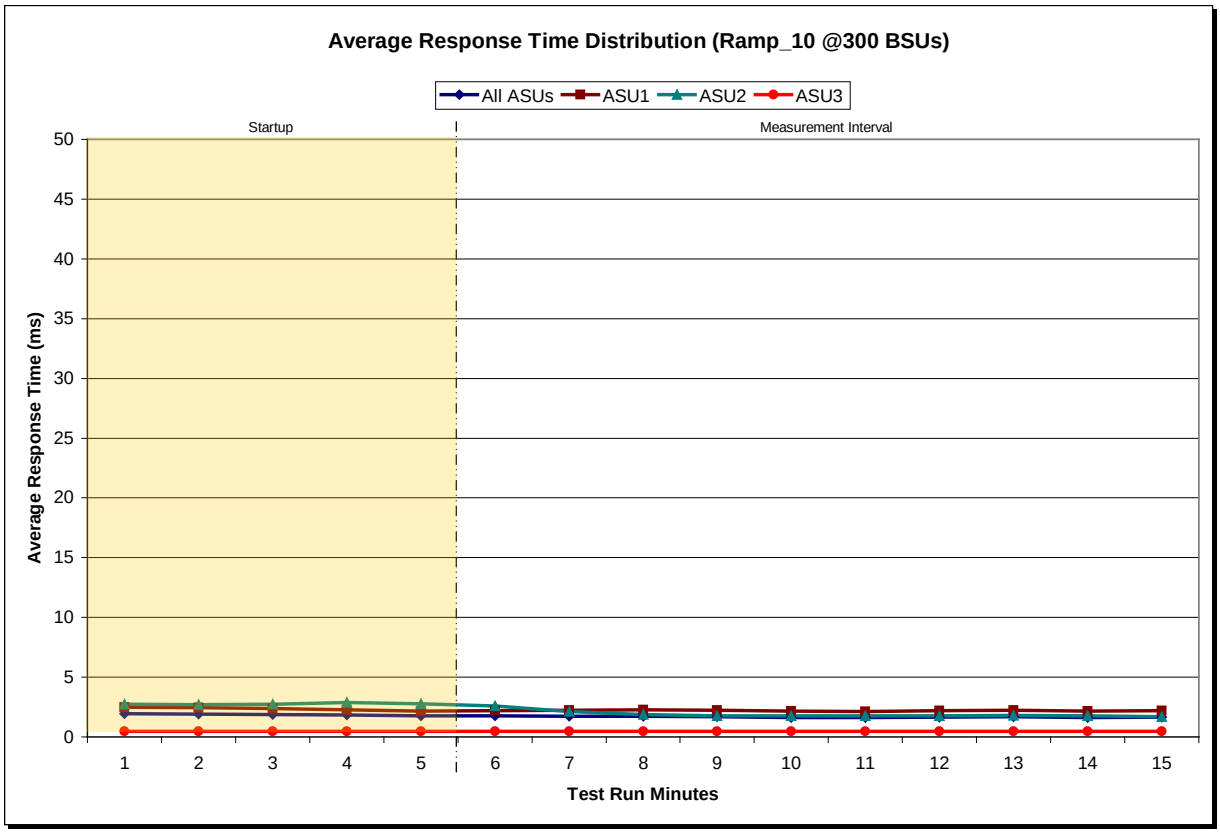
Response Time Ramp Distribution (IOPS) Graph



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

300 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:00:08	1:05:09	0-2	0:05:01
Measurement Interval	1:05:09	1:15:09	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.94	2.48	2.75	0.45
1	1.91	2.44	2.72	0.46
2	1.89	2.38	2.74	0.46
3	1.84	2.28	2.89	0.46
4	1.77	2.17	2.78	0.46
5	1.77	2.21	2.57	0.47
6	1.73	2.24	2.13	0.47
7	1.72	2.28	1.87	0.47
8	1.67	2.23	1.76	0.47
9	1.63	2.16	1.76	0.47
10	1.62	2.13	1.77	0.46
11	1.67	2.21	1.78	0.46
12	1.68	2.23	1.79	0.47
13	1.63	2.14	1.76	0.46
14	1.64	2.19	1.69	0.46
Average	***1.68***	***2.20***	***1.89***	***0.47***

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 5.3.13.2

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 5.3.13.3

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	0.2813	0.0701	0.2100	0.0180	0.0699	0.0350	0.2808
COV	0.005	0.001	0.003	0.002	0.009	0.004	0.004	0.001

Repeatability Test

Clause 5.4.5

The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ primary metric and 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 76.

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	***150,061.17***
Repeatability Test Phase 1	150,039.95
Repeatability Test Phase 2	150,056.08

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	***1.68 ms***
Repeatability Test Phase 1	1.64 ms
Repeatability Test Phase 2	1.67 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)..

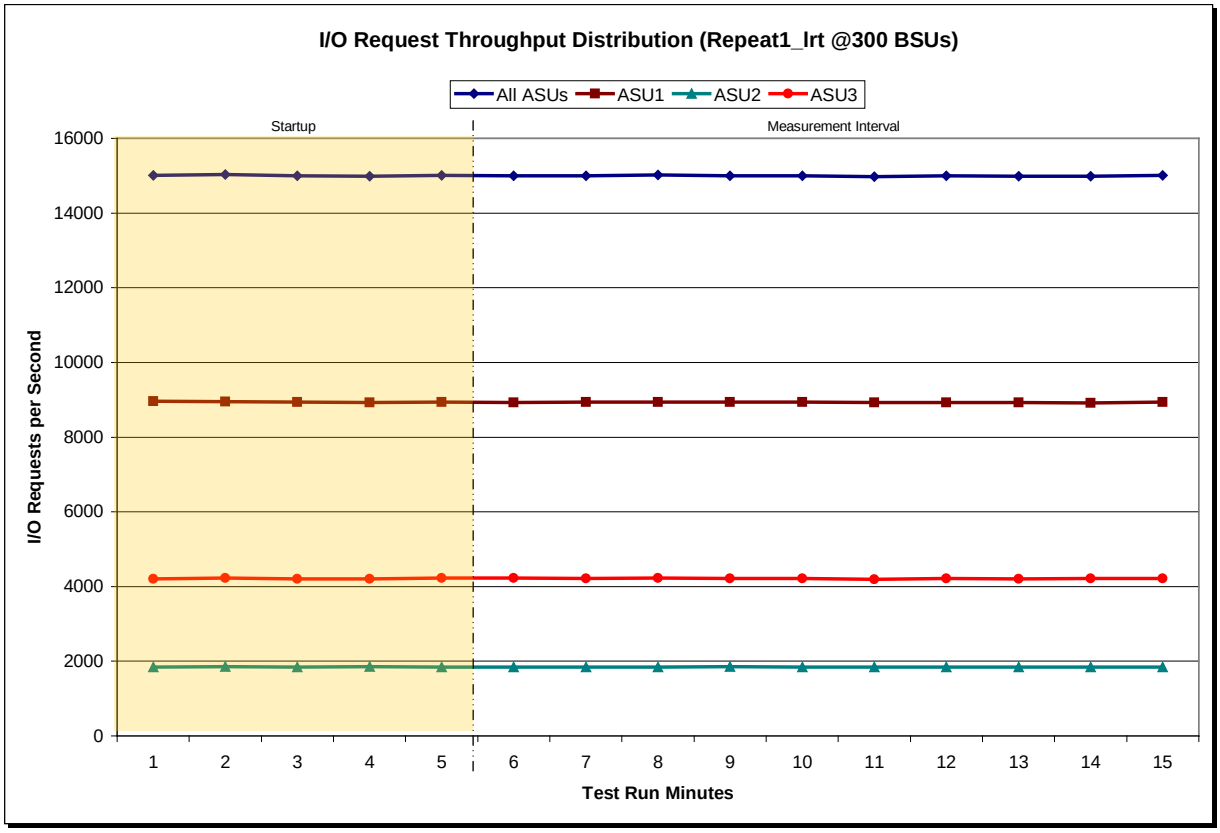
A link to the test result file generated from each Repeatability Test Run is listed below.

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

300 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:16:13	1:21:13	0-4	0:05:00
Measurement Interval	1:21:13	1:31:13	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	15,004.42	8,956.88	1,846.45	4,201.08
1	15,028.50	8,952.82	1,850.87	4,224.82
2	14,992.63	8,939.07	1,845.60	4,207.97
3	14,989.63	8,931.87	1,852.70	4,205.07
4	15,007.63	8,942.78	1,839.93	4,224.92
5	14,998.45	8,921.98	1,845.40	4,231.07
6	14,996.17	8,933.05	1,847.05	4,216.07
7	15,019.77	8,944.02	1,846.92	4,228.83
8	15,000.97	8,938.93	1,849.18	4,212.85
9	14,997.28	8,942.58	1,844.13	4,210.57
10	14,976.67	8,930.57	1,848.20	4,197.90
11	15,000.90	8,932.22	1,847.08	4,221.60
12	14,986.03	8,931.75	1,845.20	4,209.08
13	14,980.72	8,919.83	1,839.97	4,220.92
14	15,005.67	8,943.18	1,842.40	4,220.08
Average	***14,996.26***	***8,933.81***	***1,845.55***	***4,216.90***

Repeatability 1 LRT – I/O Request Throughput Distribution Graph

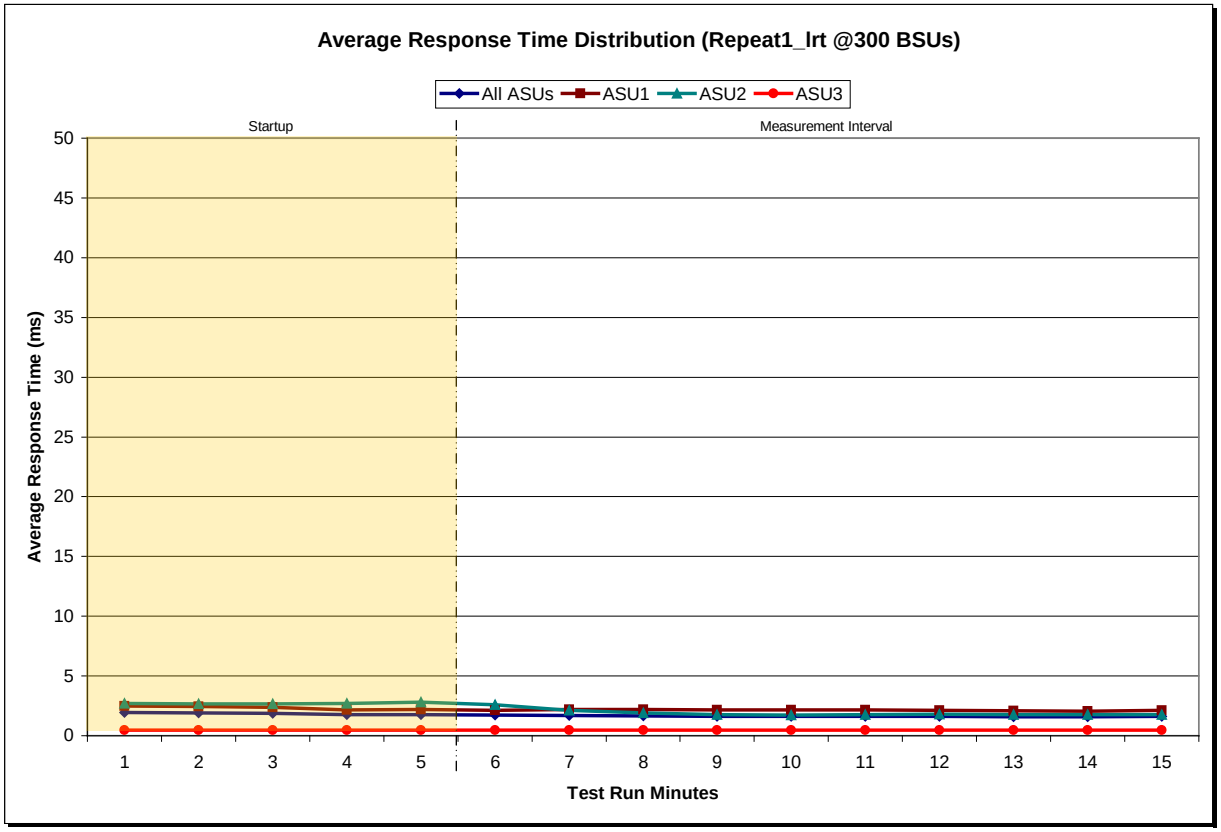


Repeatability 1 LRT –Average Response Time (ms) Distribution Data

300 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:16:13	1:21:13	0-4	0:05:00
Measurement Interval	1:21:13	1:31:13	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.94	2.48	2.71	0.45
1	1.92	2.46	2.68	0.46
2	1.88	2.39	2.67	0.46
3	1.75	2.16	2.69	0.46
4	1.78	2.19	2.82	0.46
5	1.72	2.14	2.60	0.47
6	1.71	2.21	2.12	0.46
7	1.66	2.18	1.89	0.47
8	1.63	2.15	1.77	0.47
9	1.63	2.16	1.72	0.46
10	1.63	2.15	1.76	0.46
11	1.62	2.13	1.80	0.46
12	1.59	2.09	1.78	0.46
13	1.57	2.06	1.78	0.46
14	1.62	2.13	1.77	0.46
Average	***1.64***	***2.14***	***1.90***	***0.46***

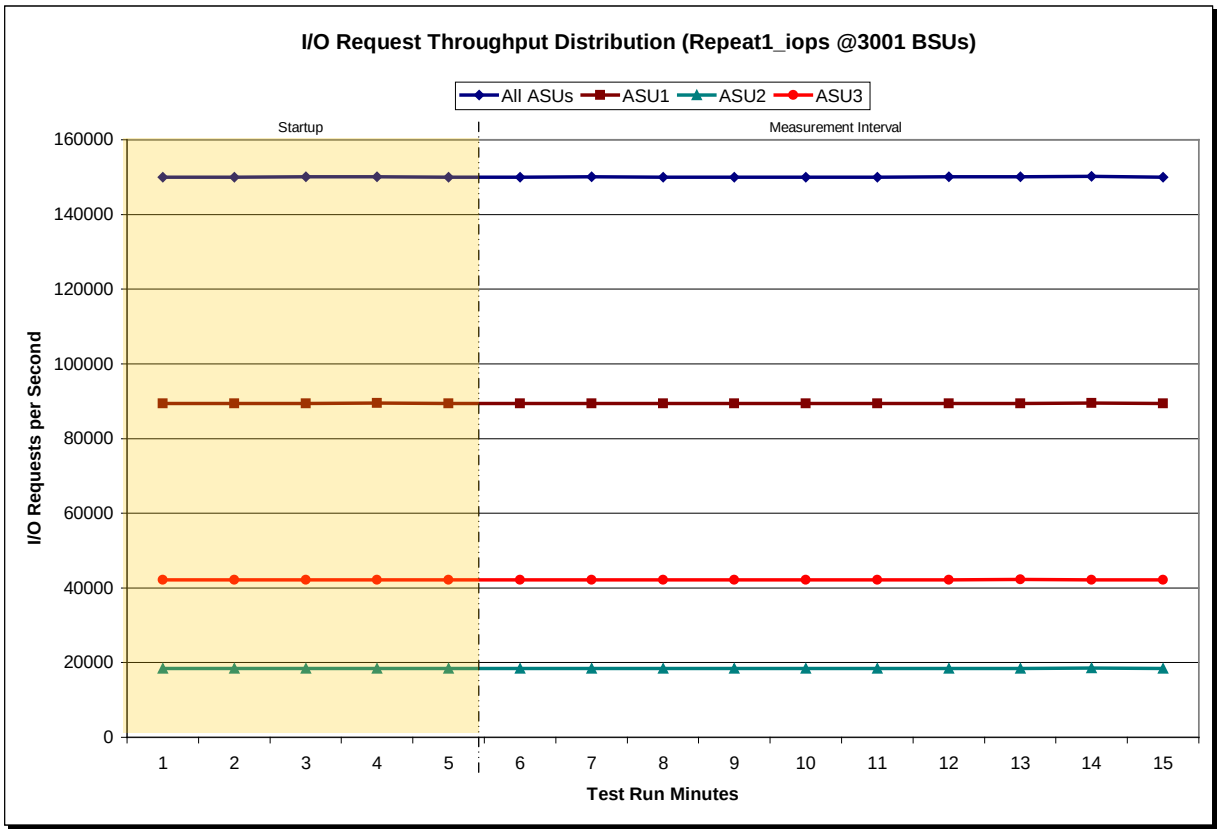
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:31:49	1:36:50	0-4	0:05:01
Measurement Interval	1:36:50	1:46:50	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	150,034.93	89,437.40	18,442.17	42,155.37
1	149,939.80	89,351.37	18,433.68	42,154.75
2	150,109.22	89,419.52	18,479.47	42,210.23
3	150,107.58	89,483.15	18,457.98	42,166.45
4	149,962.73	89,414.85	18,429.38	42,118.50
5	150,012.53	89,383.38	18,460.48	42,168.67
6	150,039.82	89,414.60	18,457.52	42,167.70
7	150,000.47	89,394.70	18,470.15	42,135.62
8	149,996.15	89,361.92	18,486.47	42,147.77
9	150,023.62	89,424.55	18,476.20	42,122.87
10	150,018.57	89,422.88	18,448.57	42,147.12
11	150,047.93	89,413.42	18,452.07	42,182.45
12	150,074.85	89,423.28	18,418.83	42,232.73
13	150,161.52	89,511.17	18,491.33	42,159.02
14	150,024.05	89,391.23	18,444.93	42,187.88
Average	***150,039.95***	***89,414.11***	***18,460.66***	***42,165.18***

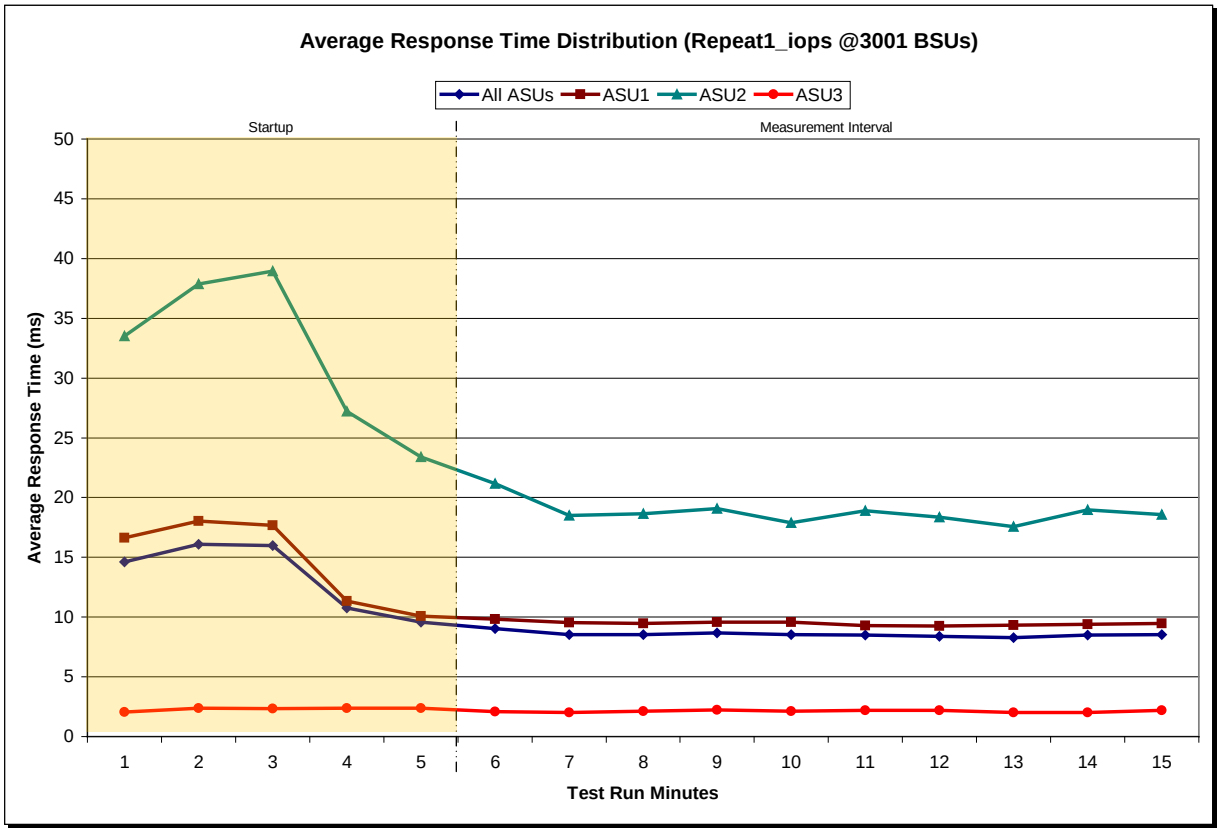
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:31:49	1:36:50	0-4	0:05:01
Measurement Interval	1:36:50	1:46:50	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.61	16.63	33.50	2.07
1	16.08	18.05	37.88	2.38
2	15.98	17.67	38.96	2.33
3	10.78	11.35	27.20	2.38
4	9.56	10.09	23.40	2.39
5	9.04	9.83	21.17	2.08
6	8.53	9.55	18.49	2.02
7	8.52	9.45	18.63	2.11
8	8.68	9.56	19.08	2.24
9	8.52	9.58	17.91	2.13
10	8.49	9.29	18.91	2.21
11	8.40	9.27	18.35	2.20
12	8.27	9.31	17.56	2.03
13	8.49	9.38	18.97	2.02
14	8.54	9.47	18.59	2.20
Average	***8.55***	***9.47***	***18.77***	***2.12***

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

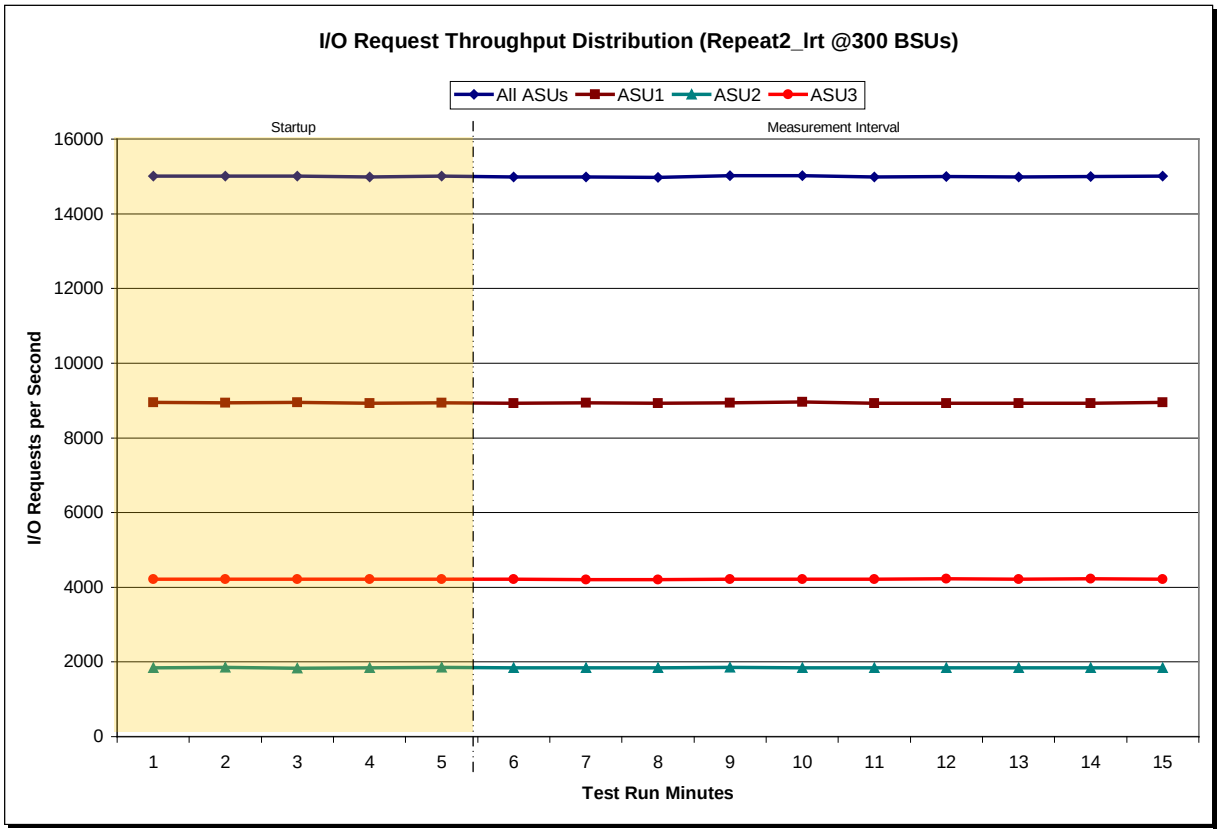


Repeatability 2 LRT – I/O Request Throughput Distribution Data

300 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:47:58	1:52:58	0-4	0:05:00
Measurement Interval	1:52:58	2:02:58	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	15,014.42	8,954.10	1,843.73	4,216.58
1	15,010.07	8,940.32	1,851.98	4,217.77
2	15,003.93	8,955.58	1,836.80	4,211.55
3	14,991.98	8,929.73	1,841.12	4,221.13
4	15,006.45	8,942.38	1,850.43	4,213.63
5	14,992.05	8,932.63	1,844.70	4,214.72
6	14,984.47	8,939.98	1,838.03	4,206.45
7	14,977.27	8,929.38	1,838.10	4,209.78
8	15,017.17	8,942.62	1,856.13	4,218.42
9	15,025.42	8,957.80	1,847.17	4,220.45
10	14,988.68	8,925.83	1,841.87	4,220.98
11	14,998.50	8,930.97	1,842.35	4,225.18
12	14,987.97	8,932.97	1,842.32	4,212.68
13	14,998.85	8,926.57	1,846.57	4,225.72
14	15,005.92	8,948.17	1,839.02	4,218.73
Average	***14,997.63***	***8,936.69***	***1,843.63***	***4,217.31***

Repeatability 2 LRT – I/O Request Throughput Distribution Graph

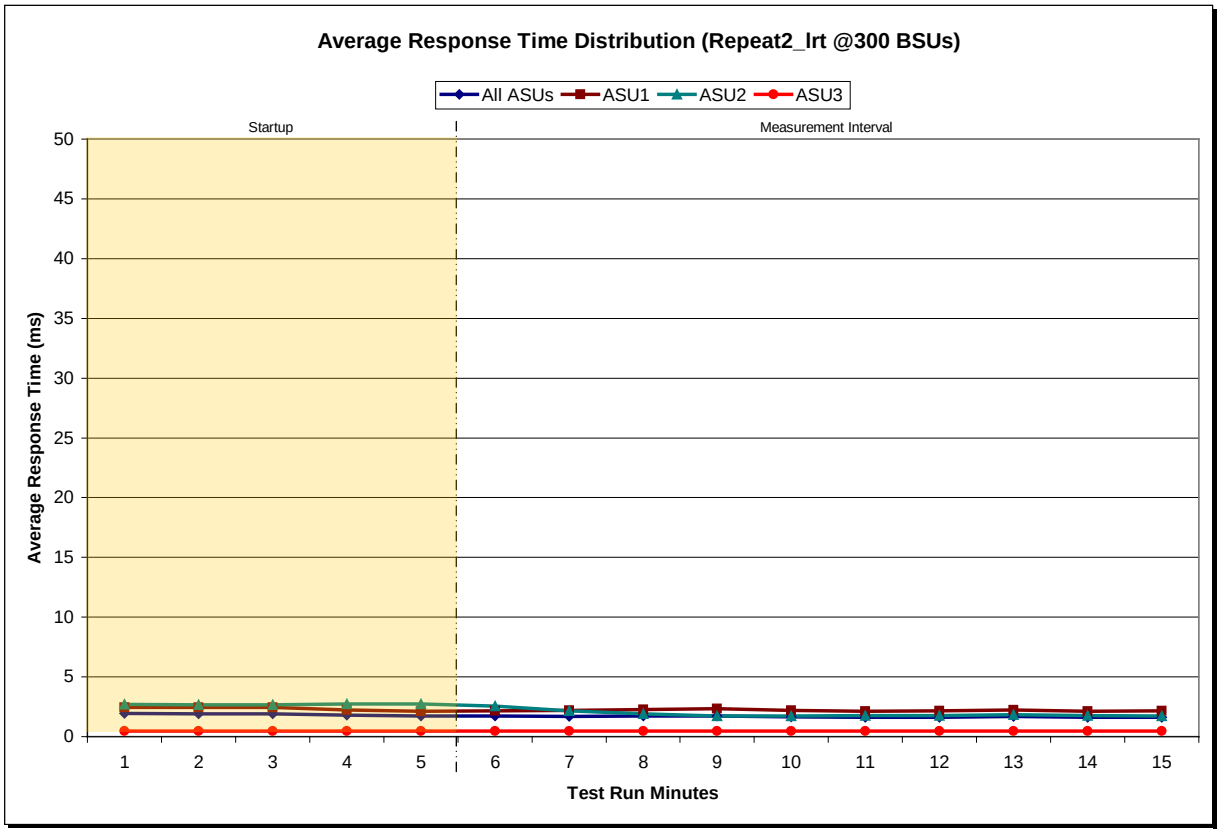


Repeatability 2 LRT –Average Response Time (ms) Distribution Data

300 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:47:58	1:52:58	0-4	0:05:00
Measurement Interval	1:52:58	2:02:58	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.93	2.46	2.72	0.45
1	1.91	2.43	2.66	0.46
2	1.91	2.44	2.67	0.46
3	1.79	2.23	2.74	0.46
4	1.73	2.12	2.74	0.46
5	1.73	2.15	2.55	0.46
6	1.70	2.18	2.15	0.47
7	1.72	2.28	1.90	0.46
8	1.74	2.33	1.73	0.47
9	1.66	2.21	1.74	0.46
10	1.61	2.13	1.75	0.46
11	1.63	2.16	1.78	0.46
12	1.69	2.23	1.82	0.47
13	1.61	2.11	1.76	0.46
14	1.63	2.16	1.73	0.47
Average	***1.67***	***2.19***	***1.89***	***0.46***

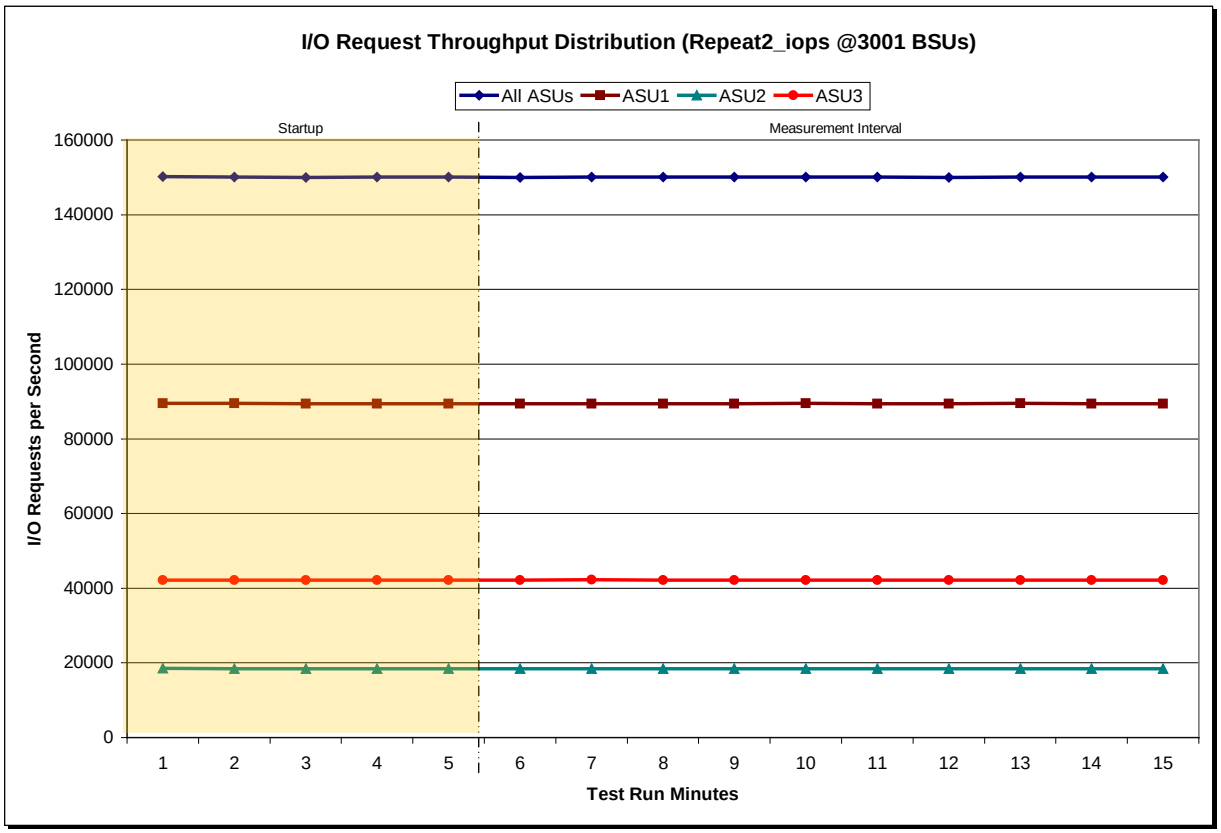
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:03:39	2:08:40	0-4	0:05:01
Measurement Interval	2:08:40	2:18:40	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	150,156.33	89,488.88	18,491.65	42,175.80
1	150,088.37	89,458.07	18,449.67	42,180.63
2	149,979.82	89,396.03	18,428.15	42,155.63
3	150,045.98	89,418.48	18,430.60	42,196.90
4	150,090.20	89,444.85	18,468.10	42,177.25
5	150,032.93	89,420.03	18,461.08	42,151.82
6	150,120.10	89,420.95	18,479.30	42,219.85
7	150,058.37	89,443.90	18,445.63	42,168.83
8	150,059.48	89,435.20	18,458.75	42,165.53
9	150,036.52	89,445.72	18,462.30	42,128.50
10	150,082.17	89,441.23	18,452.32	42,188.62
11	150,013.18	89,393.48	18,444.22	42,175.48
12	150,048.15	89,455.43	18,439.62	42,153.10
13	150,061.78	89,396.63	18,458.72	42,206.43
14	150,048.13	89,375.88	18,473.73	42,198.52
Average	***150,056.08***	***89,422.85***	***18,457.57***	***42,175.67***

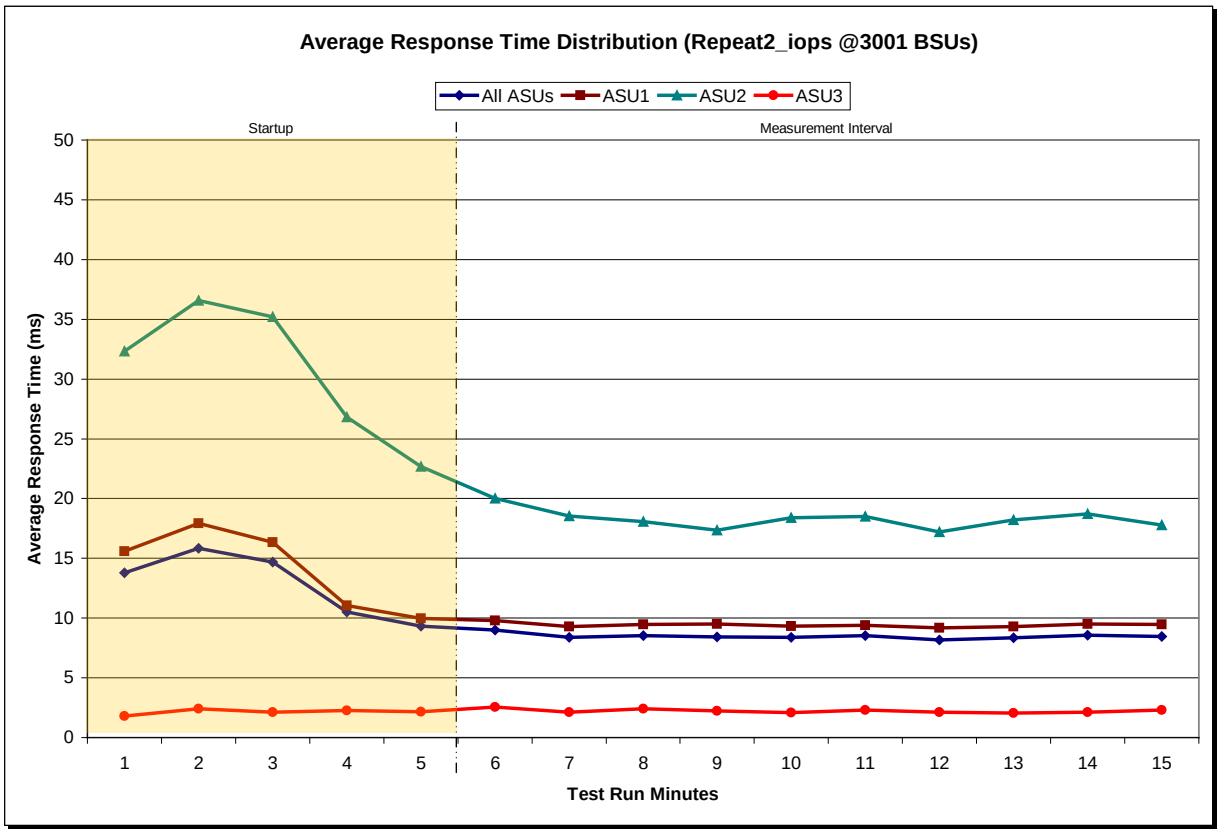
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

3001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:03:39	2:08:40	0-4	0:05:01
Measurement Interval	2:08:40	2:18:40	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	13.78	15.60	32.34	1.79
1	15.86	17.92	36.57	2.41
2	14.67	16.36	35.20	2.11
3	10.52	11.05	26.82	2.28
4	9.32	9.95	22.66	2.14
5	9.02	9.80	20.00	2.54
6	8.40	9.28	18.55	2.12
7	8.54	9.47	18.07	2.40
8	8.43	9.51	17.36	2.22
9	8.40	9.32	18.38	2.07
10	8.53	9.41	18.52	2.30
11	8.18	9.18	17.19	2.12
12	8.36	9.30	18.21	2.07
13	8.56	9.50	18.71	2.13
14	8.47	9.46	17.80	2.30
Average	***8.49***	***9.42***	***18.28***	***2.23***

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 5.3.13.2

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 5.3.13.3

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	0.2097	0.0180	0.0700	0.0351	0.2812
COV	0.003	0.003	0.005	0.003	0.007	0.003	0.005	0.002

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	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.001	0.001	0.002	0.001	0.002	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	0.2812	0.0701	0.2096	0.0179	0.0700	0.0350	0.2812
COV	0.005	0.002	0.003	0.002	0.008	0.004	0.007	0.001

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	0.0700	0.2099	0.0180	0.0700	0.0350	0.2811
COV	0.001	0.000	0.002	0.001	0.002	0.001	0.001	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.*

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 76.

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	424,944
Total Number of Logical Blocks Verified	422,706
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

If approved by the SPC Auditor, the SPC-2 Persistence Test may be used to meet the SPC-1 persistence requirements. Both the SPC-1 and SPC-2 Persistence Tests provide the same level of functionality and verification of data integrity. The SPC-2 Persistence Test may be easily configured to address an SPC-1 storage configuration. The SPC-2 Persistence Test extends the size of storage configurations that may be tested and significantly reduces the test duration of such configurations.

The SPC-2 Persistence Test was approved for use in this set of audited measurements.

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 9.2.4.9

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™ S6800T 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 found in the Priced Storage Configuration Pricing section on page 14.

TESTED STORAGE CONFIGURATION (TSC) AND PRICED STORAGE CONFIGURATION DIFFERENCES

Clause 9.4.3.3.7

The Executive Summary shall contain a pricing a list of all differenced 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™ S6800T .

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: This level will ensure data protection in the event of a single point of failure of any configured storage device. A brief description of the data protection utilized is included in the Executive Summary.

Unprotected: No claim of data protection is asserted in the event of a single point of failure.

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.

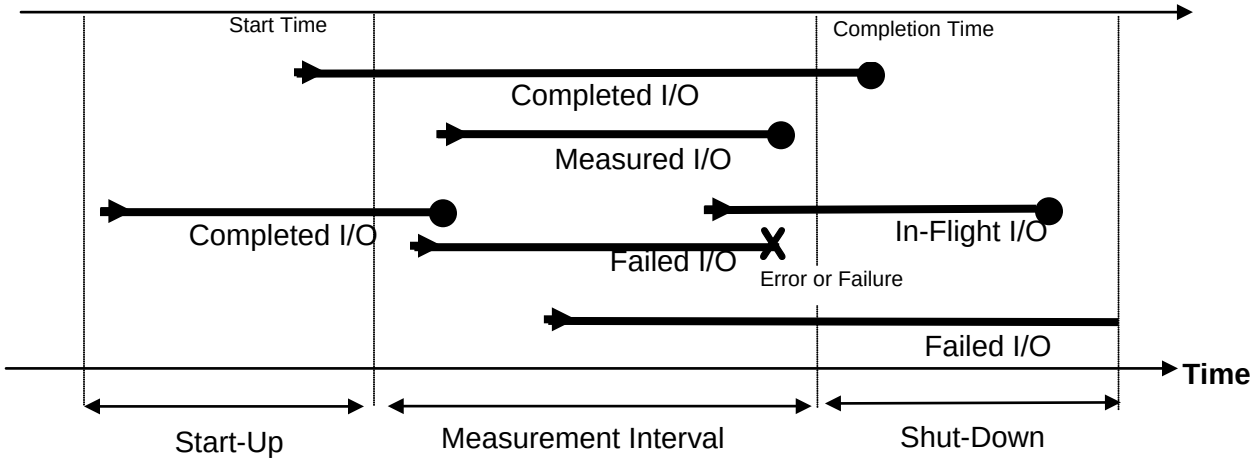
Test: A collection of Test Phases and or Test Runs sharing a common objective.

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

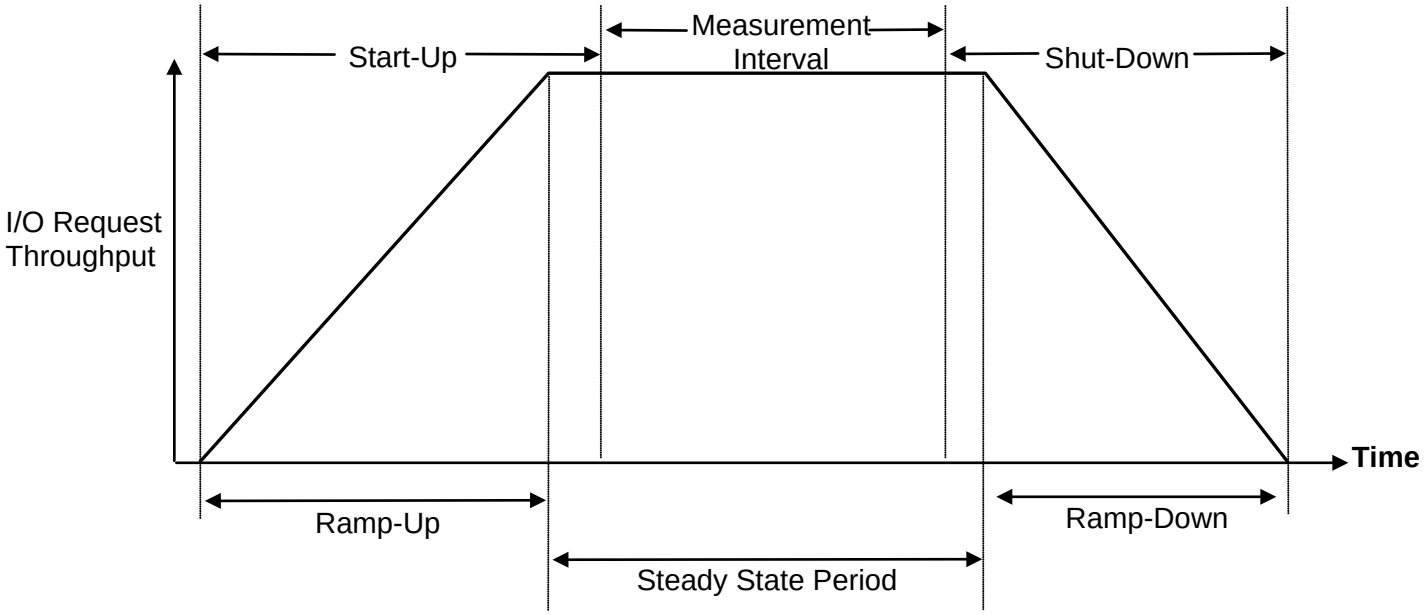
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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

There were no customer tunable parameter and options that were changed from their default values for the audited measurements.

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

1. Create Host Group and Host

Execute the following commands in OceanStor™ S6800T's CLI to create one host group *HostGroup001*, and add one host *Host_115* to the host group, then add fourteen (14) host FC ports WWNs to *Host_115*. The **-t** parameter is used in the command **createhostgroup** to define the host operating system type, and type 1 means Windows. The **-type** parameter of command **addhostport** means port type, and type 1 means FC host port.

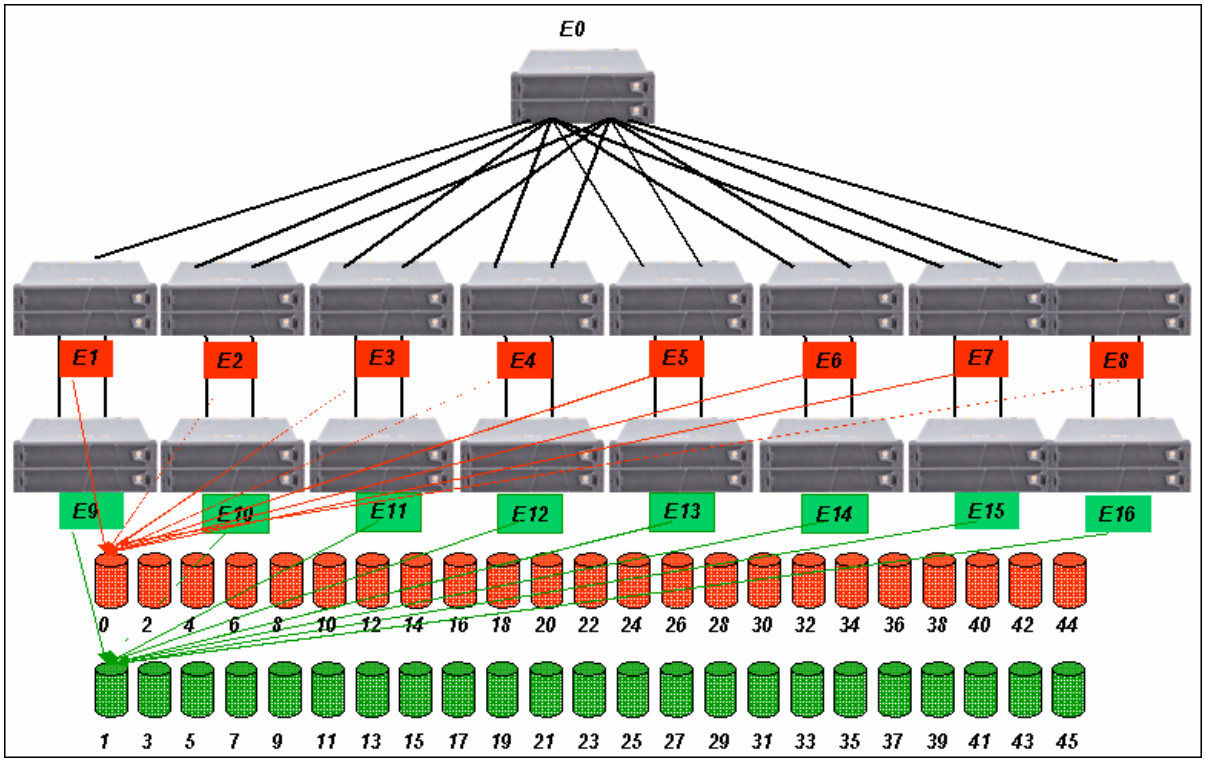
```
createhostgroup -n HostGroup001 -t 1
addhost -group 1 -n Host_115
addhostport -host 0 -type 1 -wwn 21000024ff28ea5d -n FCInitiator001
addhostport -host 0 -type 1 -wwn 21000024ff208897 -n FCInitiator002
addhostport -host 0 -type 1 -wwn 21000024ff2089b3 -n FCInitiator003
addhostport -host 0 -type 1 -wwn 21000024ff2088d5 -n FCInitiator004
addhostport -host 0 -type 1 -wwn 21000024ff2c952b -n FCInitiator005
addhostport -host 0 -type 1 -wwn 21000024ff2c952a -n FCInitiator006
addhostport -host 0 -type 1 -wwn 21000024ff2088d4 -n FCInitiator007
addhostport -host 0 -type 1 -wwn 21000024ff28ea28 -n FCInitiator008
addhostport -host 0 -type 1 -wwn 21000024ff28ea29 -n FCInitiator009
addhostport -host 0 -type 1 -wwn 21000024ff208896 -n FCInitiator010
addhostport -host 0 -type 1 -wwn 21000024ff2089b2 -n FCInitiator011
addhostport -host 0 -type 1 -wwn 21000024ff28ea5c -n FCInitiator012
addhostport -host 0 -type 1 -wwn 21000024ff28eaaa -n FCInitiator013
addhostport -host 0 -type 1 -wwn 21000024ff28eaab -n FCInitiator014
```

2. Create RAID Groups and LUNs

The TSC was configured with 252 300GB disk drives and 16 600GB disk drives. Each of the 16 disk enclosures contained 22 300GB disk drives and one (1) 600 GB disk drive. The disks at slot 0-3 of the first enclosure were vault disk drives, which reserves 23 GiB per disk drive to retain uncommitted data in the case of unexpected power loss.

The **mklun.sh** script, listed below, is executed on the **Lenovo ThinkCentre M75e Tower** desktop which has **ubuntu 10.10 Linux** and **expect** installed, to create 46 RAID groups and 46 LUNs (one LUN per RAID group), and map those LUNs to the host group 1 created above in step #1.

Eight (8) disk drives from eight (8) different disk enclosures were selected to create each RAID group. As illustrated below, disk drives in the even numbered RAID groups (0,2…44) were selected from enclosures E1-E8 and disk drives in the odd numbered RAID groups (1,3…45) were selected from enclosures E9-E16.



The **createlun** command in the **mklun.sh** script creates the 46 LUNs, one LUN per RAID group.

The **addhostmap** command in the **mklun.sh** script maps each LUN to a host or a host 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*

3. Create SPC-1 Logical Volumes

The **mkvolume.sh** script, listed below, is executed to create SPC-1 Logical Volumes. First, disks are re-scanned. Then each disk is brought online and converted to a basic MBR disk, and one 8 MB partition is created with 8 MB alignment, and then converted to a dynamic disk. And then, striped volumes are created as the SPC-1 Logical Volumes, one per ASU. As the final step, the **asu.cfg** and **sd.cfg** files are created.

- The **asu.cfg** file specifies the SPC-1 Logical Volume parameters *("sd=)* that are part of the SPC-1 Workload Generator configuration files.
- The **sd.cfg** file specifies the SPC-2 Logical Volume parameters *("sd=)* that are part of the SPC-2 Workload Generator configuration files.

mklun.sh

```
#!/bin/bash

stor=129.22.248.55
stor_user=admin
stor_pswd=123456

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

     send "showdisk -logic\r"
     expect ">"

     for {set disk 0} { \$disk <= 21 } { incr disk } {
            foreach enclosure {1:2:3:4:5:6:7:8: 9:10:11:12:13:14:15:16:} {
                   set disk_list [string map [list : ,\$disk:] \$enclosure]
                   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
                   }
```

```
                    send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -c \$ctrl\r"
                    set sucsses 0
                    while { \$sucsses == 0 } {
                           expect {
                                  "Error" {
                                         expect ">"
                                         sleep 1
                                         send "createlun -rg \$rgid -n ASU-\$lunid -
susize 512 -c \$ctrl\r"
                                  }
                                  ">" {
                                         set sucsses 1
                                  }
                           }
                    }
                    send "showlun -lun \$lunid\r"
                    expect ">"
                    send "addhostmap -group 1 -devlun \$lunid\r"
                    set sucsses 0
                         while { \$sucsses == 0 } {
                                 expect {
                                         "Error" {
                                                 expect ">"
                                                 sleep 1
                                                 send "addhostmap -group 1 -devlun
\$lunid\r"
                                         }
                                         ">" {
                                                 set sucsses 1
                                         }
                                 }
                         }
                    send "showhostmap -map [expr \$lunid + 1048576]\r"
                    expect ">"
                    incr lunid
                    incr rgid
             }
      }
      for {set disk 23} { \$disk <= 23 } { incr disk } {
             foreach enclosure {1:2:3:4:5:6:7:8: 9:10:11:12:13:14:15:16:} {
                    set disk_list [string map [list : ,\$disk:] \$enclosure]
                    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
                    }
                    send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -
lunsize 2097152m -c \$ctrl\r"
                    set sucsses 0
                    while { \$sucsses == 0 } {
```

```
                        expect {
                               "Error" {
                                      expect ">"
                                      sleep 1
                                      send "createlun -rg \$rgid -n ASU-\$lunid -
susize 512 -lunsize 2097152m -c \$ctrl\r"
                               }
                               ">" {
                                      set sucsses 1
                               }
                        }
                }
                      send "showlun -lun \$lunid\r"
                      expect ">"
                      send "addhostmap -group 1 -devlun \$lunid\r"
                set sucsses 0
                      while { \$sucsses == 0 } {
                              expect {
                                       "Error" {
                                              expect ">"
                                              sleep 1
                                              send "addhostmap -group 1 -devlun
\$lunid\r"
                                       }
                                       ">" {
                                              set sucsses 1
                                       }
                              }
                      }
                      send "showhostmap -map [expr \$lunid + 1048576]\r"
                      expect ">"
                      incr lunid
                      incr rgid
            }
        }
     send "showrg\r"
     expect ">"
     send "showlun\r"
     expect ">"
     send "showhostmap -group 1\r"
     expect ">"
     send "showdisk -logic\r"
     expect ">"
     send "exit\r"
     expect "(y/n):"
     send "y\r"
     expect EOF
__END_CREATE_LUN

formating=1

while (( $formating > 0 ))
do
        sleep 5
        expect <<__END_SHOW_LUN | tee tmp.log
                spawn ssh $stor_user@$stor
                expect "assword"
                send "$stor_pswd\r"
                expect ">"
                set timeout 60
                send "showlun\r"
                expect ">"
                send "exit\r"
```

```
                expect "(y/n):"
                send "y\r"
                expect EOF
__END_SHOW_LUN
        formating=`cat tmp.log | grep Formatting | wc -l`
done
```

mkvolume.sh

```
#!/bin/bash

master=129.22.241.115
slaves=""
username=administrator
password=Huawei123

diskcount=46
vgdiskcount=22
asu3diskcount=2

asu1disksize=428544
asu2disksize=428544
asu3disksize=2095104

letters=H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z

scan_disk(){
     host=$1
     expect <<__END_SCAN_DISK | tee tmp.log
            set timeout 300
            spawn telnet $host
            expect "login:"
            send "$username\r"
            expect "password:"
            send "$password\r"
            expect ">"
            send "diskpart\r"
            expect ">"
            send "rescan\r"
            expect ">"
            sleep 5
            send "rescan\r"
            expect ">"
            send "list disk\r"
            expect ">"
            send "exit\r"
            expect ">"
            send "exit\r"
            expect EOF
__END_SCAN_DISK
     return `cat tmp.log  | grep GB | wc -l`
}

export LANG=C

echo "Creating Volume... "

scan_disk $master
while (( $? != $diskcount + 1 ))
do
     sleep 5
     scan_disk $master
```

```
done


asu1disklists=""
for (( i=1; i<=$[diskcount-asu3diskcount]; i=$[i+vgdiskcount] ))
do
     asu1disklist=""
     for (( j=$i; j<=$[i+vgdiskcount-2]; j=$[j+1] ))
     do
            asu1disklist="$asu1disklist$j,"
     done
        asu1disklists="$asu1disklists $asu1disklist$[i+vgdiskcount-1]"
done

asu2disklists=$asu1disklists

asu3disklist=""
for (( j=$[diskcount-asu3diskcount+1]; j<$diskcount; j=$[j+1] ))
do
     asu3disklist="$asu3disklist$j,"
done

asu3disklist="$asu3disklist$diskcount"

asu3disklists="$asu3disklist"

expect <<__END_CREATE_VOLUME
     set timeout 300
        spawn telnet $master
        expect "login:"
        send "$username\r"
        expect "password:"
        send "$password\r"
        expect ">"
        send "diskpart\r"
        expect ">"
     send "list disk\r"
        expect ">"
     for {set disk 1} { \$disk <= $diskcount } { incr disk } {
            send "select disk \$disk\r"
            expect ">"
            send "convert basic\r"
            expect ">"
            send "convert mbr\r"
            expect ">"
            send "create partition primary size=8 align=8192\r"
            expect ">"
            send "convert dynamic\r"
            expect ">"
     }
     set letterlist [split $letters ","]
     set letterindex -1
     foreach asu1disklist { $asu1disklists } {
            set letter [lindex \$letterlist [incr letterindex]]
            send "create volume stripe size=$asu1disksize disk=\$asu1disklist
noerr\r"
            expect ">"
            send "assign letter=\$letter\r"
            expect ">"
     }
     foreach asu2disklist { $asu2disklists } {
            set letter [lindex \$letterlist [incr letterindex]]
```

```
            send "create volume stripe size=$asu2disksize disk=\$asu2disklist
 noerr\r"
            expect ">"
            send "assign letter=\$letter\r"
            expect ">"
      }
      foreach asu3disklist { $asu3disklists } {
            set letter [lindex \$letterlist [incr letterindex]]
            send "create volume stripe size=$asu3disksize disk=$asu3disklist noerr\r"
            expect ">"
            send "assign letter=\$letter\r"
            expect ">"
      }
            send "list disk\r"
      expect ">"
         send "list volume\r"
      expect ">"
      send "exit\r"
      expect ">"
         send "cd /d C:\\\\spc1_test\r"
         expect "spc1_test>"
      send "del asu.cfg\r"
         expect "spc1_test>"
      send "del sd.cfg\r"
         expect "spc1_test>"
      set letterindex -1
      set asu1index 0
      set sdindex 0
      foreach asu1disklist { $asu1disklists } {
            set letter [lindex \$letterlist [incr letterindex]]
            incr asu1index
            send "echo
 sd=asu1_\$asu1index,lun=\\\\\\\\.\\\\\$letter:,size=$[asu1disksize*vgdiskcount*1024*
 1024] >> asu.cfg\r"
            expect "spc1_test>"
            sleep 0.2
            incr sdindex
            send "echo
 sd=sd\$sdindex,lun=\\\\\\\\.\\\\\$letter:,size=$[asu1disksize*vgdiskcount*1024*1024]
 >> sd.cfg\r"
            expect "spc1_test>"
            sleep 0.2
      }
      set asu2index 0
      foreach asu2disklist { $asu2disklists } {
                set letter [lindex \$letterlist [incr letterindex]]
                incr asu2index
                send "echo
 sd=asu2_\$asu2index,lun=\\\\\\\\.\\\\\$letter:,size=$[asu2disksize*vgdiskcount*1024*
 1024] >> asu.cfg\r"
                expect "spc1_test>"
            sleep 0.2
            incr sdindex
                send "echo
 sd=sd\$sdindex,lun=\\\\\\\\.\\\\\$letter:,size=$[asu2disksize*vgdiskcount*1024*1024]
 >> sd.cfg\r"
                expect "spc1_test>"
            sleep 0.2
         }
      set asu3index 0
      foreach asu3disklist { $asu3disklists } {
            set letter [lindex \$letterlist [incr letterindex]]
                incr asu3index
```

```
            send "echo
sd=asu3_\$asu3index,lun=\\\\\\\\.\\\\\$letter:,size=$[asu3disksize*asu3diskcount*102
4*1024] >> asu.cfg\r"
            expect "spc1_test>"
            sleep 0.2
            incr sdindex
            send "echo
sd=sd\$sdindex,lun=\\\\\\\\.\\\\\$letter:,size=$[asu3disksize*asu3diskcount*1024*102
4] >> sd.cfg\r"
            expect "spc1_test>"
            sleep 0.2
      }
      send "type asu.cfg\r"
      expect "spc1_test>"
      send "type sd.cfg\r"
      expect "spc1_test>"
      send "exit\r"
      expect EOF
__END_CREATE_VOLUME

for slave in $slaves
do
      scan_disk $slave
      while (( $? != $diskcount + 1 ))
      do
            sleep 5
            scan_disk $slave
      done
      expect <<__END_IMPORT_VOLUME
             set timeout 300
            spawn telnet $slave
             expect "login:"
            send "$username\r"
             expect "password:"
                  send "$password\r"
             expect ">"
             send "diskpart\r"
             expect ">"
            send "list disk\r"
             expect ">"
            for {set disk 1} { \$disk <= $diskcount } { incr disk } {
                  send "select disk \$disk\r"
                     expect ">"
                    send "online disk\r"
                  expect ">"
                     send "ATTRIBUTES DISK CLEAR READONLY\r"
                    expect ">"
             }
            send "list disk\r"
             expect ">"
            for {set disk 1} { \$disk <= $[diskcount-asu3diskcount] } { incr disk
$vgdiskcount} {
                  send "select disk \$disk\r"
                   expect ">"
                  send "import\r"
                  expect ">"
            }
            send "select disk $[diskcount-asu3diskcount+1]\r"
            expect ">"
            send "import\r"
            expect ">"
            send "list volume\r"
             expect ">"
```

```
            send "list disk\r"
             expect ">"
            send "exit\r"
             expect ">"
             send "cd /d C:\\\\spc1_test\r"
            expect "spc1_test>"
            send "del asu.cfg\r"
             expect "spc1_test>"
            send "del sd.cfg\r"
            expect "spc1_test>"
            set letterindex -1
            set asu1index 0
            set sdindex 0
            foreach asu1disklist { $asu1disklists } {
                  set letter [lindex \$letterlist [incr letterindex]]
                  incr asu1index
                  send "echo
sd=asu1_\$asu1index,lun=\\\\\\\\.\\\\\$letter:,size=$[asu1disksize*vgdiskcount*1024*
1024] >> asu.cfg\r"
                  expect "spc1_test>"
                  sleep 0.2
                  incr sdindex
                  send "echo
sd=sd\$sdindex,lun=\\\\\\\\.\\\\\$letter:,size=$[asu1disksize*vgdiskcount*1024*1024]
>> sd.cfg\r"
                  expect "spc1_test>"
                  sleep 0.2
            }
            set asu2index 0
            foreach asu2disklist { $asu2disklists } {
                   set letter [lindex \$letterlist [incr letterindex]]
                  incr asu2index
                     send "echo
sd=asu2_\$asu2index,lun=\\\\\\\\.\\\\\$letter:,size=$[asu2disksize*vgdiskcount*1024*
1024] >> asu.cfg\r"
                    expect "spc1_test>"
                  sleep 0.2
                  incr sdindex
                   send "echo
sd=sd\$sdindex,lun=\\\\\\\\.\\\\\$letter:,size=$[asu2disksize*vgdiskcount*1024*1024]
>> sd.cfg\r"
                  expect "spc1_test>"
                  sleep 0.2
            }
            set asu3index 0
            foreach asu3disklist { $asu3disklists } {
                  set letter [lindex \$letterlist [incr letterindex]]
                  incr asu3index
                  send "echo
sd=asu3_\$asu3index,lun=\\\\\\\\.\\\\\$letter:,size=$[asu3disksize*asu3diskcount*102
4*1024] >> asu.cfg\r"
                  expect "spc1_test>"
                  sleep 0.2
                  incr sdindex
                  send "echo
sd=sd\$sdindex,lun=\\\\\\\\.\\\\\$letter:,size=$[asu3disksize*asu3diskcount*1024*102
4] >> sd.cfg\r"
                  expect "spc1_test>"
                  sleep 0.2
            }
            send "type asu.cfg\r"
            expect "spc1_test>"
            send "type sd.cfg\r"
```

```
            expect "spc1_test>"
            send "exit\r"
            expect EOF
__END_IMPORT_VOLUME
done
```

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

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

Master JVM

```
host=master
slaves=(H1_1,H1_2,H1_3,H1_4,H1_5,H1_6,H1_7,H1_8,H1_9,H1_10,H1_11,H1_12,H1_13,H1_14,H
1_15,H1_16,H1_17,H1_18,H1_19,H1_20,H1_21,H1_22,H1_23,H1_24,H1_25,H1_26,H1_27,H1_28,H
1_29,H1_30,H1_31,H1_32)
sd=asu1_1,lun=\\.\H:,size=9885940973568
sd=asu1_2,lun=\\.\I:,size=9885940973568
sd=asu2_1,lun=\\.\J:,size=9885940973568
sd=asu2_2,lun=\\.\K:,size=9885940973568
sd=asu3_1,lun=\\.\L:,size=4393751543808
```

Slave JVM *(Slave JVM 1)*

The command and parameter file for the remaining slave JVMs are identical with the exception of the *"host="* parameter, which designates the specific slave JVM.

```
master=129.22.241.115
host=H1_1
sd=asu1_1,lun=\\.\H:,size=9885940973568
sd=asu1_2,lun=\\.\I:,size=9885940973568
sd=asu2_1,lun=\\.\J:,size=9885940973568
sd=asu2_2,lun=\\.\K:,size=9885940973568
sd=asu3_1,lun=\\.\L:,size=4393751543808
```

Persistence Test

The content of SPC-2 Workload Generator command and parameter files, used in this benchmark to execute the Persistence Test, is listed below.

Persistence Test Run 1 (write phase)

```
host=localhost,jvms=1,maxstreams=200
sd=sd1,lun=\\.\H:,size=9885940973568
sd=sd2,lun=\\.\I:,size=9885940973568
sd=sd3,lun=\\.\J:,size=9885940973568
sd=sd4,lun=\\.\K:,size=9885940973568
sd=sd5,lun=\\.\L:,size=4393751543808
maxlatestart=1
reportinginterval=5
segmentlength=512m
rd=default,rampup=180,periods=90,measurement=300,runout=0,rampdown=0,buffers=1
rd=default,rdpct=0,xfersize=1024k
rd=TR1-101s_SPC-2-persist-w,streams=101
```

Persistence Test Run 2 (read phase)

```
host=localhost,jvms=1,maxstreams=200
sd=sd1,lun=\\.\H:,size=9885940973568
sd=sd2,lun=\\.\I:,size=9885940973568
sd=sd3,lun=\\.\J:,size=9885940973568
```

```
sd=sd4,lun=\\.\K:,size=9885940973568
sd=sd5,lun=\\.\L:,size=4393751543808
maxlatestart=1
reportinginterval=5
segmentlength=512m
maxpersistenceerrors=10
rd=default,buffers=1,rdpct=100,xfersize=1024k
rd=TR1-101s_SPC-2-persist-r
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

Primary Metrics Test, Repeatability Test, and Persistence Test Run 1

The following scripts was used to execute the 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.

batch.sh

```
bsu=3001
./shstorage.sh | tee profile1_storage.log
./shvolume.sh | tee profile1_volume.log
./spc1.sh metrics $bsu 300 | tee metrics.log
sleep 5
./spc1.sh repeat1 $bsu 300 | tee repeat1.log
sleep 5
./spc1.sh repeat2 $bsu 300 | tee repeat2.log
sleep 5
./persist1.sh $bsu | tee persist1.log
```

spc1.sh

```
#!/bin/bash

phase=$1
bsu=$2
startup=$3
master=129.22.241.115
slaves=""
username=administrator
password=Huawei123

slavecount=`echo $slaves | wc -w`

echo "Starting spc1.$phase of bsu=$bsu ..."

jvmcount=$[(bsu/100+1)/(slavecount+1)+1]

hostcount=0
for host in $master $slaves
do
     hostcount=$[hostcount+1]
     echo "starting slaves on $host ..."
     expect <<__END_START_SLAVES > tmp.log &
            spawn telnet $host
            expect "login:"
            send "$username\r"
            expect "password:"
            send "$password\r"
            expect ">"
            set timeout 86400
            send "cd /d C:\\\\spc1_test\r"
            expect "spc1_test>"
            for {set jvm 1} { \$jvm < $jvmcount } { incr jvm } {
                  set ID H${hostcount}_\$jvm
                  send "echo master=$master > \$ID.cfg\r"
                  expect "spc1_test>"
                  send "echo host=\$ID >> \$ID.cfg\r"
```

```
                    expect "spc1_test>"
                    send "type asu.cfg >> \$ID.cfg\r"
                    expect "spc1_test>"
                    send "type \$ID.cfg\r"
                    expect "spc1_test>"
                    send "start java -Xmx1024m -cp ..\\\\spc1 spc1 -f \$ID.cfg\r"
                    expect "spc1_test>"
               }
               set ID H${hostcount}_\$jvm
                    send "echo master=$master > \$ID.cfg\r"
                    expect "spc1_test>"
                    send "echo host=\$ID >> \$ID.cfg\r"
                    expect "spc1_test>"
                    send "type asu.cfg >> \$ID.cfg\r"
                    expect "spc1_test>"
                    send "type \$ID.cfg\r"
                    expect "spc1_test>"
                    send "java -Xmx1024m -cp ../spc1 spc1 -f \$ID.cfg\r"
                    expect "spc1_test>"
               send "exit\r"
               expect EOF
__END_START_SLAVES
done

slaveline="slaves=("

hostcount=0
for host in $master $slaves
do
        hostcount=$[hostcount+1]
     for (( jvm=1; jvm <= $jvmcount; jvm++ ))
     do
            slaveline="${slaveline}H${hostcount}_$jvm,"
     done
done
slaveline=`echo $slaveline | sed 's/,$/)/g'`

expect <<__END_SPC1_TEST
     spawn telnet $master
        expect "login:"
        send "$username\r"
        expect "password:"
        send "$password\r"
        expect ">"
     set timeout 86400
        send "cd /d C:\\\\spc1_test\r"
        expect "spc1_test>"
     send "echo host=master > spc1.cfg\r"
        expect "spc1_test>"
     send "echo $slaveline >> spc1.cfg\r"
        expect "spc1_test>"
     send "type asu.cfg >> spc1.cfg\r"
     expect "spc1_test>"
     send "type spc1.cfg\r"
     expect "spc1_test>"
     send "java -Xmx1024m -cp ..\\\\spc1 $phase -b $bsu -s $startup\r"
     expect "spc1_test>"
     send "exit\r"
        expect EOF
__END_SPC1_TEST

killall expect
```

persist1.sh

```
#!/bin/bash

bsu=$1

master=129.22.241.115
slaves=""
username=administrator
password=Huawei123

streams=$[bsu/30+1]
jvms=$[streams/200+1]

echo "Starting persist1 ..."

expect <<__END_SPC2_TEST
     spawn telnet $master
        expect "login:"
        send "$username\r"
        expect "password:"
        send "$password\r"
        expect ">"
     set timeout 86400
        send "cd /d C:\\\\spc1_test\r"
        expect "spc1_test>"

     send "echo host=localhost,jvms=$[jvms],maxstreams=200 > persist1.cfg\r"
        expect "spc1_test>"
     send "type sd.cfg >> persist1.cfg\r"
     expect "spc1_test>"
     send "echo maxlatestart=1 >> persist1.cfg\r"
     expect "spc1_test>"
     send "echo reportinginterval=5 >> persist1.cfg\r"
     expect "spc1_test>"
     send "echo segmentlength=512m >> persist1.cfg\r"
     expect "spc1_test>"
     send "echo
rd=default,rampup=180,periods=90,measurement=300,runout=0,rampdown=0,buffers=1 >>
persist1.cfg\r"
     expect "spc1_test>"
     send "echo rd=default,rdpct=0,xfersize=1024k >> persist1.cfg\r"
     expect "spc1_test>"
     send "echo rd=TR1-$[streams]s_SPC-2-persist-w,streams=$streams >>
persist1.cfg\r"
     expect "spc1_test>"

     send "type persist1.cfg\r"
     expect "spc1_test>"
     send "..\\\\spc2\\\\spc2.bat -f persist1.cfg -o init -init\r"
     expect "spc1_test>"
     send "..\\\\spc2\\\\spc2.bat -f persist1.cfg -o persist1\r"
     expect "spc1_test>"
     send "exit\r"
        expect EOF
__END_SPC2_TEST
```

Persistence Test Run 2

The following script was used to execute Persistence Test Run 2.

batch_persist2.sh

```
bsu=3001
./shstorage.sh | tee profile2_storage.log
./shvolume.sh | tee profile2_volume.log
./persist2.sh $bsu | tee persist2.log
```

persist2.sh

```
#!/bin/bash

bsu=$1

master=129.22.241.115
slaves=""
username=administrator
password=Huawei123

streams=$[bsu/30+1]
jvms=$[streams/200+1]

echo "Starting persist2 ..."

expect <<__END_SPC2_TEST
     spawn telnet $master
        expect "login:"
        send "$username\r"
        expect "password:"
        send "$password\r"
        expect ">"
     set timeout 86400
        send "cd /d C:\\\\spc1_test\r"
        expect "spc1_test>"

     send "echo host=localhost,jvms=$jvms,maxstreams=200 > persist2.cfg\r"
        expect "spc1_test>"
     send "type sd.cfg >> persist2.cfg\r"
     expect "spc1_test>"
     send "echo maxlatestart=1 >> persist2.cfg\r"
     expect "spc1_test>"
     send "echo reportinginterval=5 >> persist2.cfg\r"
     expect "spc1_test>"
     send "echo segmentlength=512m >> persist2.cfg\r"
     expect "spc1_test>"
     send "echo maxpersistenceerrors=10 >> persist2.cfg\r"
     expect "spc1_test>"
     send "echo rd=default,buffers=1,rdpct=100,xfersize=1024k >> persist2.cfg\r"
     expect "spc1_test>"
     send "echo rd=TR1-$[streams]s_SPC-2-persist-r >> persist2.cfg\r"
     expect "spc1_test>"

     send "type persist2.cfg\r"
     expect "spc1_test>"
     send "..\\\\spc2\\\\spc2.bat -f persist2.cfg -o persist2\r"
     expect "spc1_test>"
     send "exit\r"
        expect EOF
```

```
__END_SPC2_TEST
```

APPENDIX F: THIRD PARTY QUOTATION

PO Box 647 Eastlake, CO 80614
Main: 888.725.2606 Ex 501
Fax: 888.725.2607

www.RakanSystems.com

Quote

Date	Quote #
7/21/2011	2011-178

Quote Prepared for:

Huawei Symantec
20400 Stevens Creek Blvd., Suite 200
Cupertino , CA 95014

Prepared by:

Paul Foote
pfoote.RakanSystems.com
303.419.0746

Expiration Date:

10/31/2011

RFQ#

# of business days for delivery:	Terms:
	Due on receipt

Item	Description	Qty	Rate	Total:
S6800TBB	S6800T, dual controllers, AC, 192GB cache, with UPS Cache Protected Module,without Front-End & Back-End Port	1	76,428.00	76,428.00T
SDE35U4BB	DAE12435U4-03 Disk Enclosure(4U,220V AC,SAS Expansion Module,24X3.5" HD Slots without Disk Unit,with HS SAS in Band Management Software),with 2 SAS 1M Cables	16	3,292.00	52,672.00T
STIO6GSAS	2*24Gbps SAS-wide I/O modules(2 ports each)	8	1,052.00	8,416.00T
STIO8GFC	4*8Gbps Fibre Channel I/O modules(4 ports each)	4	1,304.00	5,216.00T
SHD35SA300	3.5 inch 300GB 15K RPM SAS	352	473.00	166,496.00T
SHD35SA600	3.5 inch 600GB 15K RPM SAS	16	756.00	12,096.00T
S5000MP	S5000T Multi-Path Software	1	682.00	682.00T
S6800ISM	ISM Software License for S6800T (ESSENTIAL)	1	6,982.00	6,982.00T

If you agree to this Quote and would like to place an order, please Sign, date and fax or email this quote back to your sales representative. Then provide a purchase order or credit card for payment. Your sales representative will also need the billing and shipping address.

Subtotal	
Sales Tax (4.1%) Colorado Only	
Total:	

Accepted by:

Signature: _____ **Date:** _____

This quote MAY NOT include applicable taxes, insurance, shipping, delivery, setup fees, or any cables or cabling services or material unless specifically listed above. All prices are subject to change without notice. Supply subject to availability.

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APPENDIX F: THIRD PARTY QUOTATION *(CONT.)*

PO Box 647 Eastlake, CO 80614
Main: 888.725.2606 Ex 501
Fax: 888.725.2607

www.RakanSystems.com

Quote

Date	Quote #
7/21/2011	2011-178

Quote Prepared for:

Huawei Symantec
20400 Stevens Creek Blvd., Suite 200
Cupertino , CA 95014

Prepared by:

Paul Foote
pfoote.RakanSystems.com
303.419.0746

Expiration Date:

10/31/2011

RFQ#

# of business days for delivery:	Terms:
	Due on receipt

Item	Description	Qty	Rate	Total:
S5000SSLC	Storage Array Control System Software License for S5000T (ESSENTIAL) 14 - Patch Cord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m - No Charge 1 - Purchased Cable,MiniSAS Cable,Key246,3m - No Charge	1	0.00	0.00T
CS-SAS2MU...	External Mini-SAS Cable - 26-pin 4x Mini-SAS (SFF-8088) to 26-pin 4x Mini-SAS (SFF-8088)	4	147.00	588.00T
TSGS6800AIO	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	1	21,712.00	21,712.00

If you agree to this Quote and would like to place an order, please Sign, date and fax or email this quote back to your sales representative. Then provide a purchase order or credit card for payment. Your sales representative will also need the billing and shipping address.

Subtotal	
Sales Tax (4.1%) Colorado Only	
Total:	

Accepted by:

Signature: _____ **Date:** _____

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APPENDIX F: THIRD PARTY QUOTATION *(CONT.)*

PO Box 647 Eastlake, CO 80614
Main: 888.725.2606 Ex 501
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Quote

Date	Quote #
7/21/2011	2011-178

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303.419.0746

Expiration Date:

10/31/2011

RFQ#

# of business days for delivery:	Terms:
	Due on receipt

Item	Description	Qty	Rate	Total:
TSGSTJ4SA60	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	16	4,823.00	77,168.00
QLE2562-CK	QLogic Dual Port 8Gb Fibre Channel to PCI Express Host Bus Adapter (QLE2562-CK)	7	2,598.00	18,186.00T
5042A6U	Lenovo ThinkCentre M75e 5042 Tower	1	549.00	549.00T

If you agree to this Quote and would like to place an order, please Sign, date and fax or email this quote back to your sales representative. Then provide a purchase order or credit card for payment. Your sales representative will also need the billing and shipping address.

Subtotal	$447,191.00
Sales Tax (4.1%) Colorado Only	$14,280.75
Total:	$461,471.75

Accepted by:

Signature: _____ **Date:** _____

This quote MAY NOT include applicable taxes, insurance, shipping, delivery, setup fees, or any cables or cabling services or material unless specifically listed above. All prices are subject to change without notice. Supply subject to availability.

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