SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

HUAWEI TECHNOLOGIES CO., LTD.
HUAWEI OCEANSTOR™ S5600

SPC-1 V1.12

Submitted for Review: March 18, 2010
Submission Identifier: A00091
Revised: December 13, 2012

First Edition – March 2010

Trademarks

Table of Contents

AUDIT CERTIFICATION

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

March 17, 2010

The SPC Benchmark 1™ results listed below for the Huawei Symantec Oceanspace S5600 were produced in compliance with the SPC Benchmark 1™ 1.12 Remote Audit requirements.

SPC Benchmark 1™ 1.12 Results	
Tested Storage Configuration (TSC) Name: Huawei Symantec Oceanspace S5600	
Metric	**Reported Result**
SPC-1 IOPS™	34,002.20
SPC-1 Price-Performance	CNY 21.75/SPC-1 IOPS™
Total ASU Capacity	7,200.00 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	CNY 739,605

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, based on 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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650.556.9384

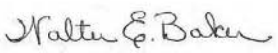
AUDIT CERTIFICATION *(CONT.)*

- SPC-1 Workload Generator commands and parameters used for the audited SPC Test Runs.
- The following Host System requirements, based on 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 each Host System.
  - ✓ The TSC boundary within each 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 (TSC) used for the benchmark and Priced Storage.
- The submitted pricing information met all of the requirements and constraints of Clause 8 of the SPC-1 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 9 of the SPC-1 Benchmark Specification.
- This successfully audited SPC measurement is not subject to an SPC Confidential Review.

Audit Notes:

There were no audit notes or exceptions.

Respectfully,



Walter E. Baker
SPC Auditor

Storage Performance Council
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LETTER OF GOOD FAITH

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

Date: March 17, 2010

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 S5600

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.

Sincerely,

Su Liqing
Senior Vice President R&D

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	March 18, 2010
Date the FDR was submitted to the SPC	March 18, 2010
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	March 17, 2010

Tested Storage Product (TSP) Description

Targeting the mid-range and high-end storage markets, the Huawei OceanStor™ S5600 is the first end-to-end fiber channel network storage system with exclusive intellectual property rights in China. With high density storage, dual plane, modular interface design, and multi-layer data protection, the S5600 satisfies various applications' storage requirements including large databases, high-end computing, online transaction processing (OLTP), centralized storage, disaster backup and recovery, and data migration. The S5600 effectively guarantees the safety, security and continuity of enterprise activities.

Summary of Results

SPC-1 Results	
Tested Storage Product (TSP) Name: Huawei OceanStor™ S5600	
Metric	**Reported Result**
SPC-1 IOPS™	34,002.20
SPC-1 Price-Performance	CNY 21.75/SPC-1 IOPS™
Total ASU Capacity	7,200.000 GB
Data Protection Level	Protected *(Mirroring)*
Total TSP Price (including three-year maintenance)	CNY 739,605

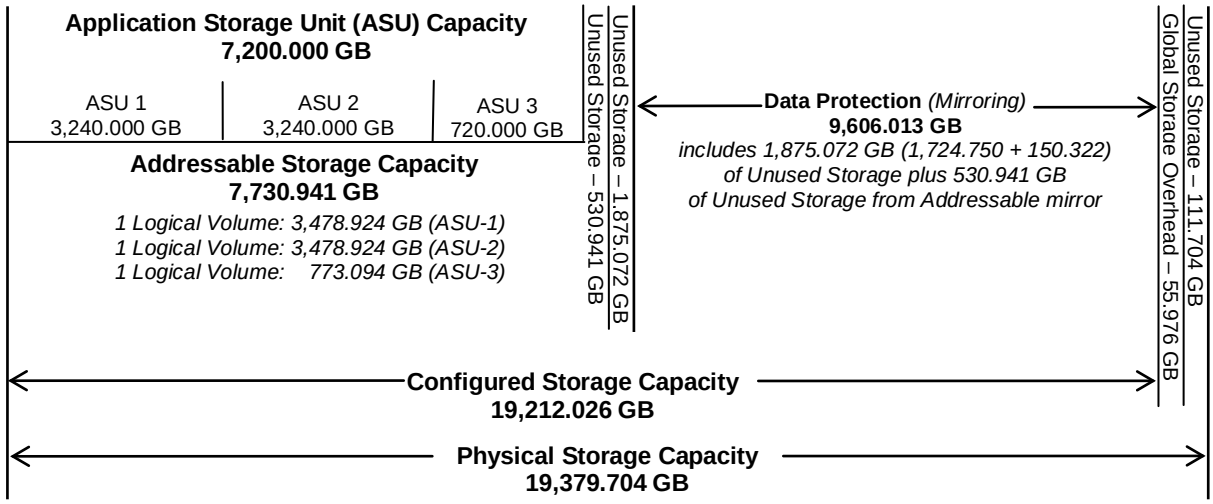
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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 **Protected** using ***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	37.15%
Protected Application Utilization	74.30%
Unused Storage Ratio	25.41%

Application Utilization: Total ASU Capacity *(7,200.000 GB)* divided by Physical Storage Capacity *(19,397.704 GB)*

Protected Application Utilization: (Total ASU Capacity *(7,200.000 GB)* plus total Data Protection Capacity *(9,606.013 GB)* minus unused Data Protection Capacity *(2,406.013 GB)* divided by Physical Storage Capacity *(19,397.704 GB)*

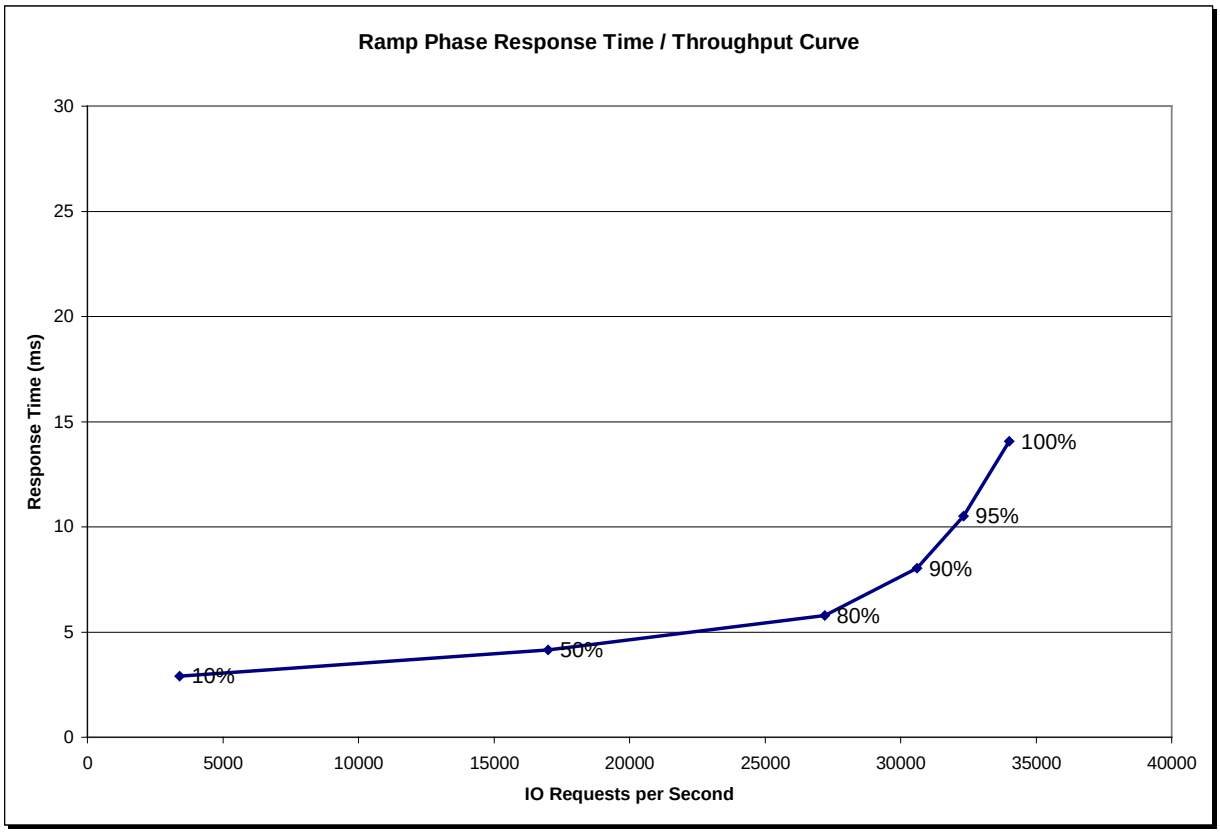
Unused Storage Ratio: Total Unused Capacity *(4,923.728 GB)* divided by Physical Storage Capacity *(19,397.704GB)* and may not exceed 45%.

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	3,402.11	17,001.25	27,206.46	30,606.79	32,318.73	34,002.20
Average Response Time (ms):						
All ASUs	2.91	4.16	5.78	8.03	10.51	14.07
ASU-1	3.83	5.31	7.00	9.04	11.21	14.29
ASU-2	3.43	5.56	7.88	10.54	13.13	16.84
ASU-3	0.72	1.10	2.28	4.77	7.88	12.39
Reads	6.29	8.91	11.27	13.21	14.82	17.00
Writes	0.70	1.06	2.20	4.65	7.71	12.17

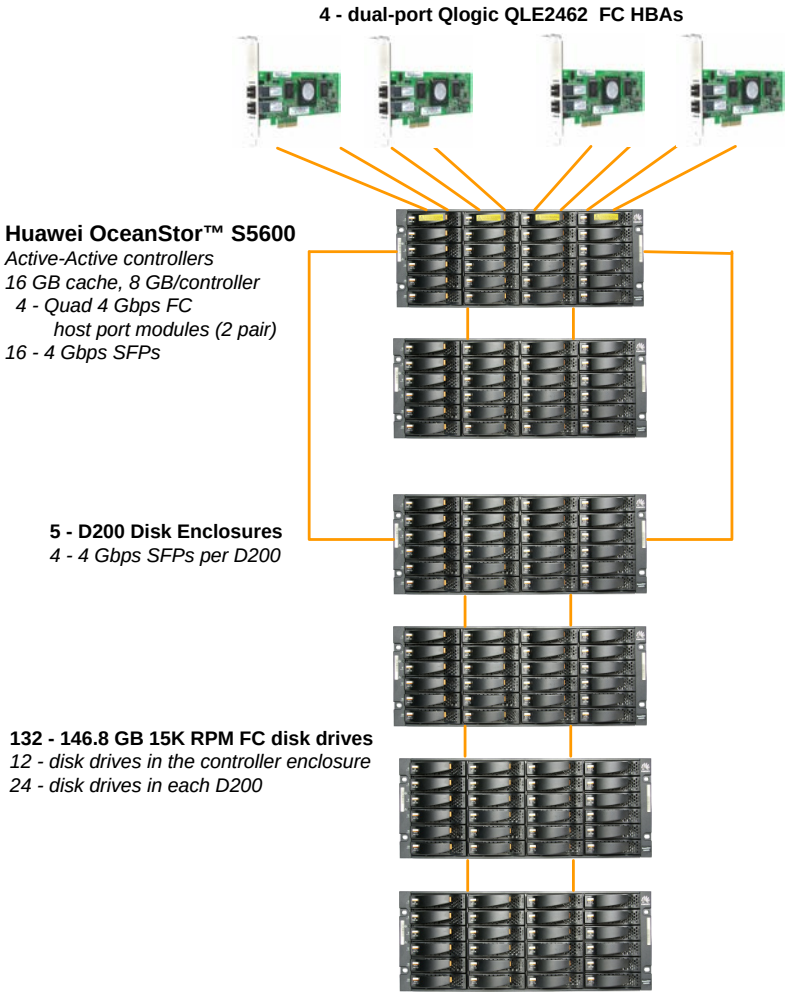
Priced Storage Configuration Pricing

Product Name	Quantity	Unit list Price in RMB	Total list Price in RMB	Discount	Unit price after discount in RMB	Total price after discount in RMB
OceanStor S5600 Controller subrack * Active-Active controllers ** 16 GB of memory, 8 GB per controller ** 4 - quad host port modules, 2 modules per controller ** 16 - 4 Gb SFPs	1	1,037,000.00	1,037,000.00	85.00%	155,550.00	155,550.00
D200 Disk Enclosure * 4 - 4Gb SFPs * 2 - 5-Meter Fiber Optic Cable	5	137,500.00	687,500.00	85.00%	20,625.00	103,125.00
146GB 15K RPM FC Disk Drive	132	21,500.00	2,838,000.00	85.00%	3,225.00	425,700.00
Blank panel	12	70.00	840.00	0.00%	70.00	840.00
Dual-port Qlogic QLE2462 Fiber Channel HBA	4	11,060.00	44,240.00	0.00%	11,060.00	44,240.00
5-Meter Fiber Optic Cable	8	90.00	720.00	0.00%	90.00	720.00
Maintenance/Support: 3 years, 24*7, with 4-hour acknowledgement and 4-hour onsite response	1	9,430.00	9,430.00	0.00%	9,430.00	9,430.00
Total			4,617,730.00			739,605.00

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:
4 – dual-port Qlogic 2462 FC HBAs
Huawei OceanStor™ S5600 **Active-Active controllers with:** 16 GB cache total *(8 GB per controller)* 4 – Quad 4 Gbps FC host port modules *(2 pair of modules, 1 pair per controller)* 16 – 4 Gbps Fibre Channel host ports *(8 per controller)* 4 – 4 Gbps Fibre Channel expander ports *(2 per controller)* 16 – 4 Gbps SFPs
5 – D200 Disk Enclosures each with four 4 Gbps SFPs
132 – 146.8 GB 15K RPM FC 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 17 *(*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 TSC did not utilize network storage.

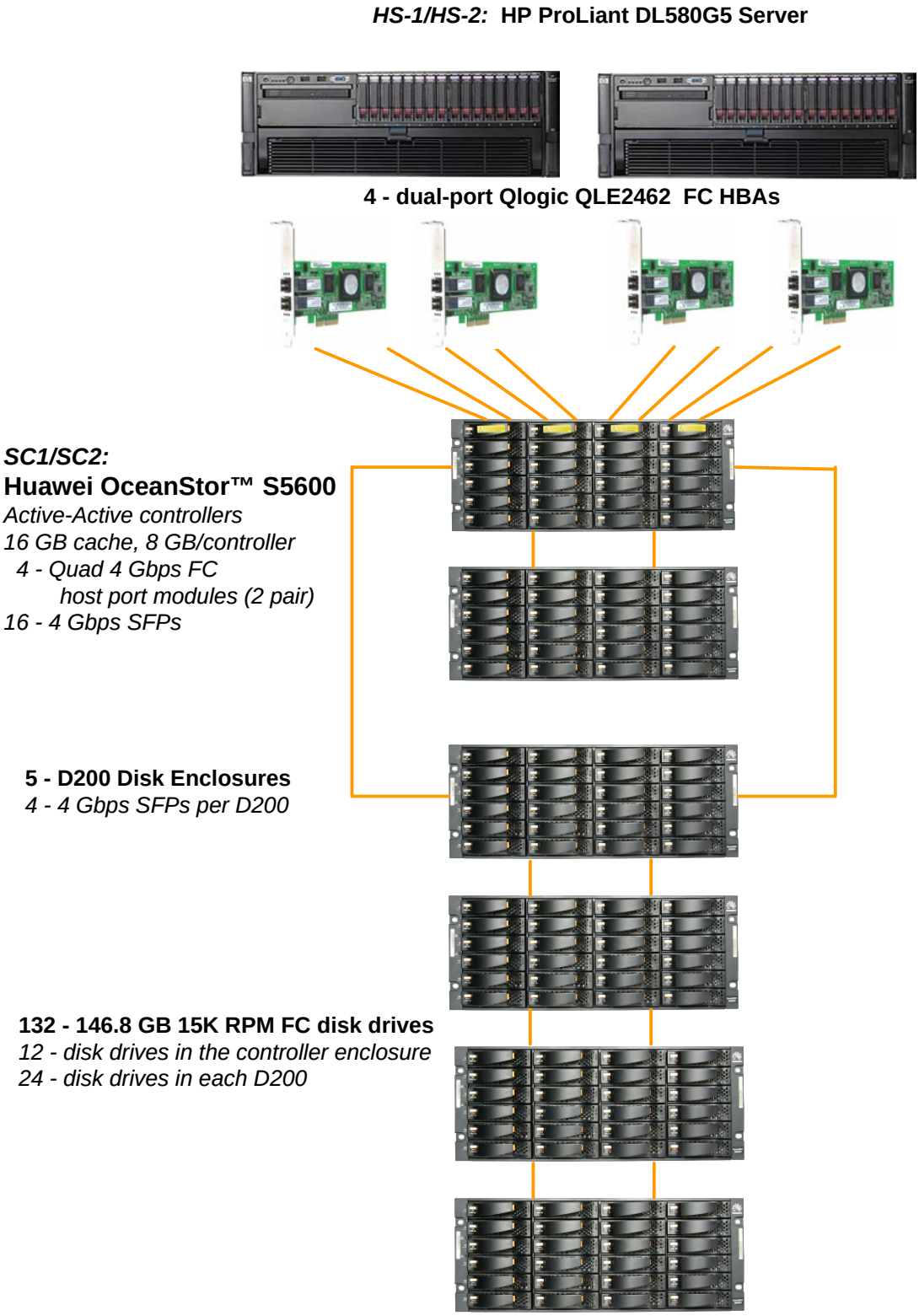
Host System and Tested Storage Configuration (TSC) Table of Components

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



Host System(s) and Tested Storage Configuration Components

Host Systems:	Tested Storage Configuration (TSC):
HS-1/HS-2: HP ProLiant DL580G5 Server	4 – dual-port Qlogic 2462 FC HBAs
Each Host System with: 4 – Intel Xeon E7330 2.4GHz Quad Processors with 6 MB L2 cache 16 GB main memory Windows Server 2003 Enterprise Edition 32-bit with SP2 UltraPath for Windows, version 01.01.14T01 PCIe: WG	**SC-1/SC-2:** **Huawei OceanStor™ S5600** **Active-Active controllers with:** 16 GB cache total *(8 GB per controller)* 4 – Quad 4 Gbps FC host port modules *(2 pair of modules, 1 pair per controller)* 16 – 4 Gbps Fibre Channel host ports *(8 per controller)* 4 – 4 Gbps Fibre Channel expander ports *(2 per controller)* 16 – 4 Gbps SFPs
	5 – D200 Disk Enclosures with four 4 Gbps SFPs per D200
	132 – 146.8 GB 15K RPM FC 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 67.

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)	7,200.000
Addressable Storage Capacity	Gigabytes (GB)	7,730.941
Configured Storage Capacity	Gigabytes (GB)	19,212.026
Physical Storage Capacity	Gigabytes (GB)	19,379.704
Data Protection *(Mirroring)*	Gigabytes (GB)	9,606.013
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	55.976
Total Unused Storage	Gigabytes (GB)	4,923,728

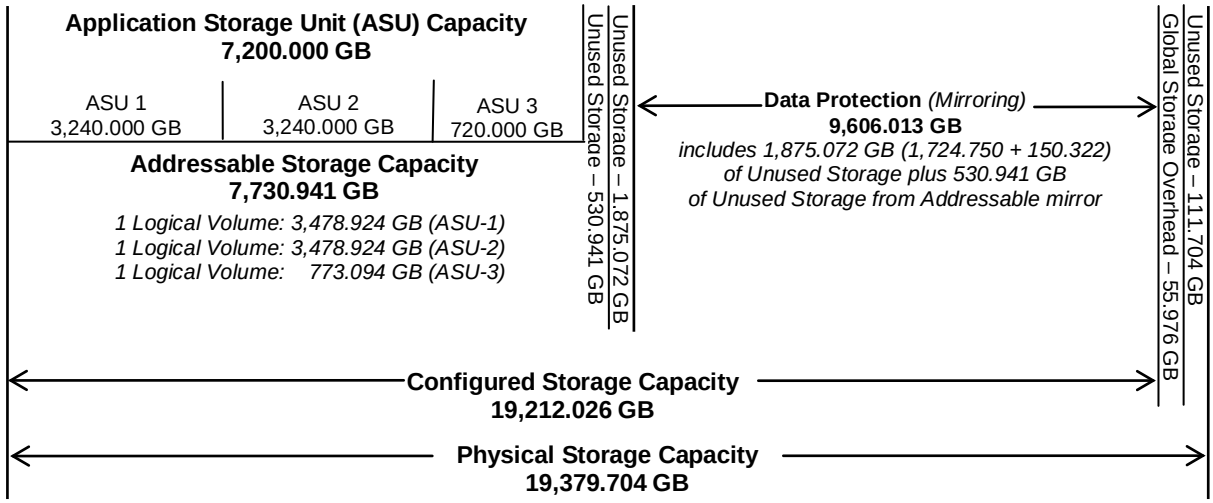
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	93.13%	37.48%	37.15%
Required for Data Protection *(Mirrored)*		50.00%	49.57%
Addressable Storage Capacity		40.24%	39.89%
Required Storage		0.00%	0.00%
Configured Storage Capacity			99.13%
Global Storage Overhead			0.29%
Unused Storage:			
Addressable	6.87%		
Configured		19.52%	
Physical			0.58%

The Physical Storage Capacity consisted of 19,379.704 GB distributed over 132 disk drives each with a formatted capacity of 146.816 GB. There was 11.70 GB (0.58%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 55.976 GB (0.29%) of Physical Storage Capacity. There was 3,750.144 GB (19.52%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 93.13% of the Addressable Storage Capacity resulting in 530.941 GB (6.87%) of Unused Storage within the Addressable Storage Capacity. The Data Protection *(mirroring)* capacity was 9,606.013 GB of which 7.881.263 GB was utilized. The total Unused Storage was 4,923.728 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 (3,240.000 GB)	**ASU-2 (3,240.000 GB)**	**ASU-3 (720.000 GB)**
1 Logical Volume 3,478.924 GB per Logical Volume (3,240.000 GB used per Logical Volume)	1 Logical Volume 3,478.924 GB per Logical Volume (3,240.000 GB used per Logical Volume)	1 Logical Volume 773.094 GB per Logical Volume (720.000 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	37.15%
Protected Application Utilization	74.30%
Unused Storage Ratio	25.41%

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 68.

Sustainability Test Results File

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

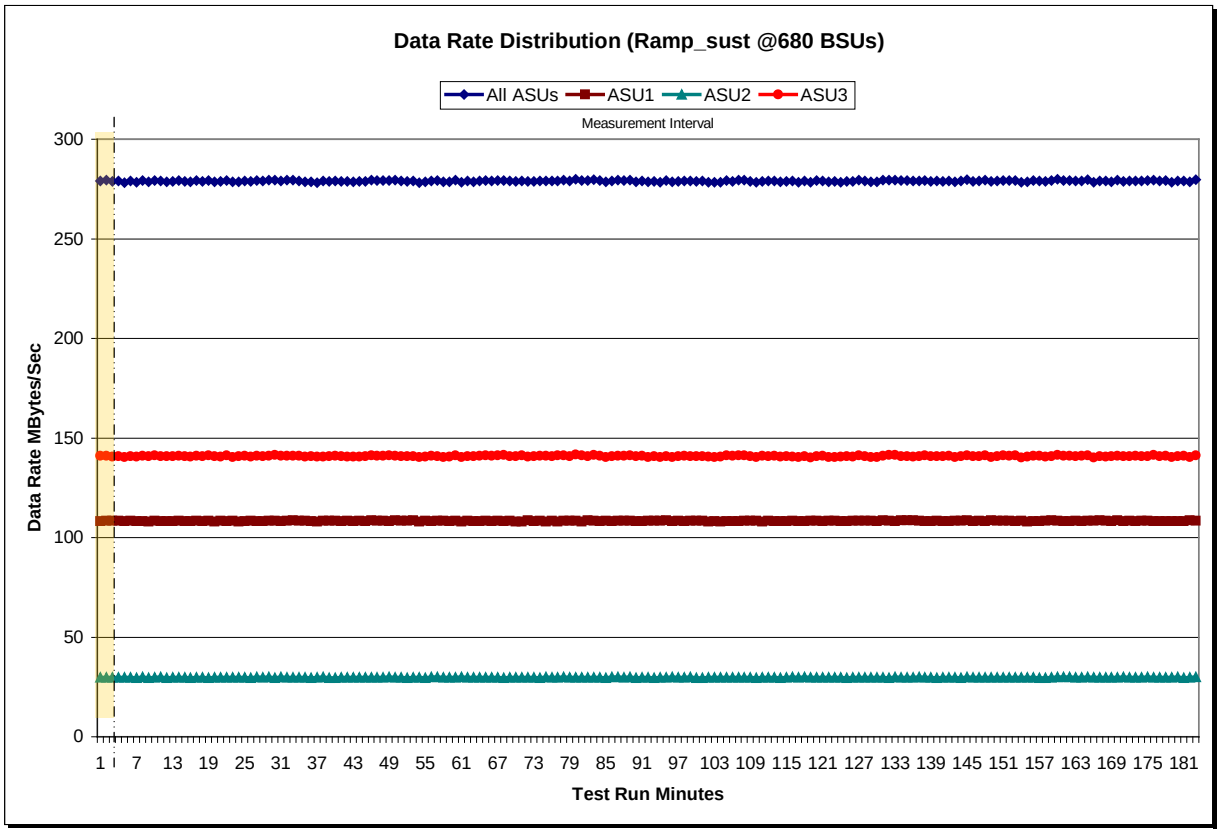
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	2:05:48	2:08:48	0-2	0:03:00
Measurement Interval	2:08:48	5:08:48	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	279.01	108.23	29.79	140.99	63	279.15	108.28	29.80	141.06	126	279.47	108.36	29.91	141.21
1	279.51	108.49	29.89	141.12	64	279.24	108.33	29.74	141.17	127	279.11	108.42	29.90	140.79
2	278.90	108.34	29.86	140.70	65	279.07	108.18	29.90	140.98	128	278.72	108.47	29.86	140.40
3	279.00	108.36	29.87	140.77	66	279.37	108.35	29.75	141.27	129	278.51	108.28	29.80	140.44
4	278.27	108.14	29.83	140.30	67	279.17	108.14	29.58	141.45	130	279.52	108.63	29.87	141.01
5	279.01	108.35	29.83	140.83	68	279.01	108.46	29.83	140.71	131	279.47	108.40	29.69	141.38
6	278.49	108.27	29.65	140.58	69	278.74	108.07	29.84	140.82	132	279.50	108.16	29.93	141.40
7	279.21	108.19	29.91	141.11	70	278.97	108.07	29.71	141.18	133	279.21	108.53	29.81	140.87
8	278.54	107.97	29.66	140.91	71	278.91	108.54	29.85	140.52	134	279.27	108.60	29.74	140.92
9	279.23	108.33	29.70	141.20	72	278.94	108.29	29.88	140.77	135	278.98	108.60	29.80	140.59
10	279.06	108.21	29.94	140.91	73	279.04	108.37	29.69	140.98	136	279.15	108.40	29.95	140.79
11	278.69	108.11	29.68	140.90	74	278.99	108.06	29.97	140.96	137	279.22	108.27	29.72	141.23
12	278.84	108.12	29.90	140.83	75	279.04	108.43	29.75	140.86	138	278.86	108.22	29.78	140.86
13	279.19	108.43	29.82	140.94	76	279.01	108.06	29.71	141.24	139	279.09	108.52	29.68	140.89
14	278.90	108.26	29.84	140.80	77	279.51	108.40	29.93	141.18	140	278.78	108.20	29.72	140.87
15	278.57	108.29	29.61	140.67	78	279.02	108.36	29.86	140.80	141	279.13	108.31	29.82	140.99
16	279.28	108.33	29.85	141.10	79	280.01	108.49	29.91	141.61	142	278.52	108.44	29.74	140.34
17	278.94	108.27	29.91	140.76	80	279.19	108.09	29.82	141.27	143	278.99	108.43	29.69	140.87
18	279.29	108.46	29.61	141.22	81	279.29	108.66	29.85	140.78	144	279.79	108.60	29.96	141.23
19	278.66	108.07	29.79	140.81	82	279.78	108.53	29.85	141.41	145	278.78	108.18	29.82	140.79
20	278.79	108.41	29.79	140.59	83	279.21	108.29	29.78	141.14	146	279.03	108.38	29.89	140.76
21	279.20	108.23	29.71	141.25	84	278.68	108.52	29.68	140.48	147	279.38	108.31	29.77	141.30
22	278.57	108.34	29.79	140.44	85	278.97	108.21	29.98	140.78	148	278.82	108.68	29.71	140.43
23	278.68	108.06	29.78	140.84	86	279.58	108.47	29.99	141.13	149	279.02	108.42	29.78	140.83
24	279.15	108.23	29.80	141.12	87	279.36	108.51	29.91	140.93	150	279.21	108.32	29.72	141.17
25	278.75	108.37	29.68	140.70	88	279.58	108.46	29.96	141.17	151	279.22	108.35	29.84	141.03
26	279.19	108.31	29.96	140.93	89	278.68	108.30	29.59	140.78	152	279.23	108.12	29.91	141.20
27	278.98	108.28	29.80	140.90	90	279.03	108.22	29.76	141.05	153	278.41	108.41	29.72	140.27
28	279.40	108.52	29.94	140.94	91	278.55	108.40	29.77	140.39	154	278.54	108.02	29.83	140.68
29	279.38	108.32	29.68	141.37	92	278.77	108.40	29.64	140.72	155	279.18	108.31	29.89	140.98
30	279.12	108.26	29.92	140.94	93	278.43	108.32	29.75	140.36	156	278.95	108.16	29.67	141.11
31	279.42	108.42	29.86	141.13	94	279.23	108.61	29.81	140.81	157	278.74	108.37	29.69	140.68
32	279.50	108.60	29.84	141.06	95	278.54	108.20	29.97	140.38	158	279.26	108.64	29.86	140.76
33	279.15	108.32	29.76	141.08	96	278.87	108.36	29.72	140.79	159	279.90	108.41	29.98	141.50
34	278.70	108.34	29.74	140.63	97	278.99	108.13	29.77	141.09	160	279.36	108.24	29.97	141.14
35	278.57	108.18	29.64	140.75	98	279.10	108.42	29.94	140.74	161	279.27	108.31	29.94	141.02
36	278.29	108.04	29.74	140.52	99	278.83	108.34	29.67	140.83	162	279.09	108.41	29.77	140.90
37	278.97	108.36	29.93	140.68	100	278.94	108.39	29.68	140.87	163	279.01	108.26	29.74	141.01
38	278.75	108.38	29.63	140.73	101	278.39	108.02	29.84	140.53	164	279.62	108.38	29.95	141.29
39	279.13	108.41	29.60	141.13	102	278.43	108.27	29.72	140.44	165	278.35	108.36	29.79	140.20
40	278.88	108.21	29.85	140.81	103	278.39	108.09	29.76	140.54	166	279.12	108.54	29.75	140.83
41	278.74	108.43	29.74	140.58	104	279.24	108.22	29.78	141.24	167	278.97	108.47	29.82	140.69
42	278.52	108.30	29.70	140.52	105	278.91	108.19	29.76	140.96	168	278.70	108.16	29.78	140.77
43	278.89	108.35	29.86	140.68	106	279.41	108.24	29.86	141.31	169	279.40	108.55	29.83	141.02
44	278.93	108.31	29.81	140.81	107	279.52	108.40	29.85	141.27	170	278.94	108.23	29.95	140.76
45	279.56	108.63	29.77	141.15	108	278.91	108.39	29.80	140.73	171	279.09	108.35	29.86	140.88
46	279.31	108.44	29.82	141.05	109	278.35	108.41	29.59	140.35	172	278.95	108.26	29.73	140.96
47	279.16	108.33	29.76	141.08	110	278.91	108.08	29.88	140.96	173	279.05	108.34	29.79	140.92
48	279.28	108.12	29.96	141.20	111	278.99	108.44	29.70	140.84	174	279.28	108.34	30.08	140.87
49	279.40	108.63	29.73	141.03	112	278.97	108.25	29.77	140.94	175	279.42	108.26	29.79	141.37
50	279.09	108.45	29.80	140.85	113	278.52	108.23	29.68	140.61	176	279.02	108.27	29.91	140.84
51	278.85	108.42	29.58	140.84	114	278.80	108.24	29.80	140.75	177	279.16	108.28	29.85	141.02
52	279.04	108.54	29.78	140.72	115	278.97	108.37	29.97	140.63	178	278.43	108.21	29.82	140.40
53	278.24	108.04	29.79	140.42	116	278.50	108.18	29.90	140.42	179	279.10	108.20	30.02	140.88
54	278.61	108.47	29.59	140.55	117	279.14	108.29	29.95	140.90	180	278.98	108.27	29.60	141.11
55	279.04	108.11	29.93	141.01	118	278.50	108.48	29.82	140.20	181	278.70	108.56	29.70	140.44
56	279.30	108.48	29.96	140.86	119	279.20	108.48	29.85	140.87	182	279.78	108.45	30.00	141.34
57	278.68	108.40	29.82	140.46	120	279.00	108.20	29.87	140.93					
58	278.66	108.10	29.91	140.65	121	278.70	108.42	29.81	140.47					
59	279.39	108.41	29.82	141.16	122	278.73	108.46	29.80	140.48					
60	278.35	108.04	29.94	140.37	123	278.50	108.14	29.87	140.50					
61	279.14	108.52	29.78	140.84	124	278.82	108.26	29.67	140.89					
62	278.69	108.15	29.83	140.71	125	278.86	108.47	29.75	140.63					

Sustainability – Data Rate Distribution Graph

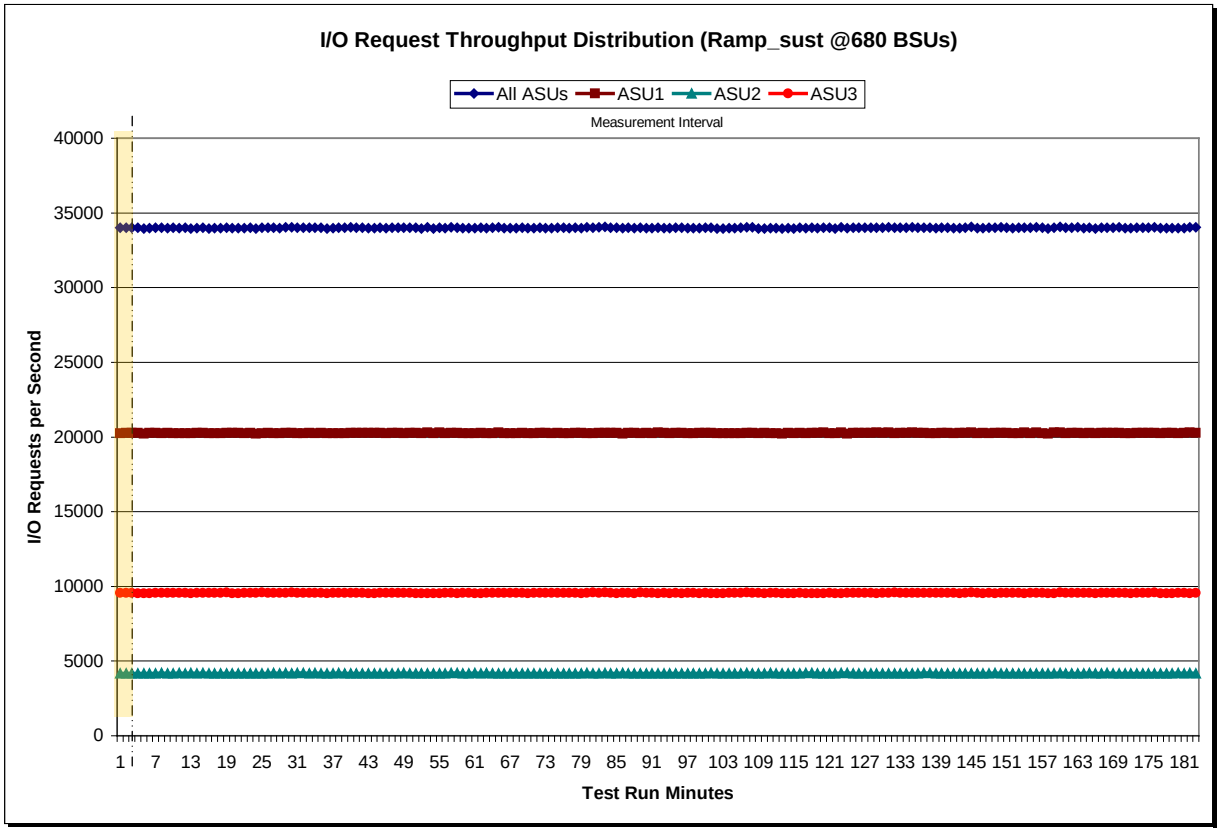


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	2:05:48	2:08:48	0-2	0:03:00
Measurement Interval	2:08:48	5:08:48	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	33,996.77	20,247.10	4,187.43	9,562.23	63	33,995.73	20,245.97	4,185.38	9,564.38	126	34,011.70	20,266.78	4,181.80	9,563.12
1	34,020.60	20,270.48	4,186.72	9,563.40	64	34,027.98	20,288.60	4,172.77	9,566.62	127	34,004.25	20,265.90	4,188.28	9,550.07
2	34,008.33	20,269.58	4,185.37	9,553.38	65	33,982.80	20,237.88	4,184.08	9,560.83	128	34,002.25	20,296.87	4,181.65	9,523.73
3	34,008.52	20,275.10	4,189.15	9,544.27	66	33,987.42	20,252.13	4,183.17	9,552.12	129	34,014.62	20,272.10	4,187.30	9,555.22
4	33,940.05	20,223.65	4,173.77	9,542.63	67	33,979.32	20,231.28	4,177.83	9,570.20	130	34,047.82	20,303.43	4,181.95	9,562.43
5	33,980.85	20,268.72	4,178.08	9,534.05	68	34,004.38	20,265.75	4,185.15	9,553.48	131	34,008.92	20,244.90	4,180.73	9,583.28
6	34,010.02	20,277.50	4,169.78	9,562.73	69	33,970.32	20,245.02	4,184.58	9,540.72	132	34,018.80	20,272.20	4,188.85	9,557.75
7	34,005.38	20,255.58	4,191.58	9,558.22	70	33,981.02	20,243.90	4,178.58	9,558.53	133	34,015.85	20,268.33	4,188.65	9,558.87
8	33,979.33	20,259.25	4,165.60	9,554.48	71	34,014.98	20,279.50	4,180.15	9,555.33	134	34,052.55	20,305.53	4,183.10	9,563.92
9	34,007.73	20,255.17	4,177.85	9,574.72	72	33,992.33	20,266.80	4,174.47	9,551.07	135	34,006.33	20,278.77	4,180.82	9,546.75
10	33,990.67	20,241.88	4,190.22	9,558.57	73	33,989.48	20,246.12	4,185.23	9,558.13	136	33,999.27	20,261.28	4,190.30	9,547.68
11	34,006.00	20,257.03	4,182.65	9,566.32	74	34,004.28	20,259.33	4,171.60	9,573.35	137	34,016.63	20,257.90	4,191.35	9,567.38
12	33,963.62	20,240.03	4,191.60	9,531.98	75	33,997.63	20,255.32	4,179.28	9,563.03	138	33,993.72	20,256.45	4,175.15	9,562.12
13	33,994.65	20,264.28	4,183.17	9,547.20	76	33,984.67	20,249.50	4,174.95	9,560.22	139	34,003.37	20,272.98	4,172.32	9,558.07
14	34,014.10	20,272.90	4,190.70	9,550.50	77	34,015.38	20,271.05	4,186.80	9,557.53	140	34,019.18	20,273.42	4,181.03	9,564.73
15	33,959.75	20,240.87	4,170.95	9,547.93	78	33,985.07	20,275.15	4,171.52	9,538.40	141	33,983.40	20,247.35	4,179.72	9,556.33
16	33,995.67	20,240.62	4,189.58	9,565.47	79	34,035.22	20,257.65	4,204.43	9,573.13	142	33,983.52	20,271.23	4,171.87	9,540.42
17	33,981.77	20,245.93	4,184.12	9,551.72	80	34,014.15	20,250.00	4,178.18	9,585.97	143	34,012.03	20,279.23	4,168.47	9,564.33
18	34,019.43	20,264.75	4,176.73	9,577.95	81	34,025.12	20,279.40	4,185.63	9,560.08	144	34,063.53	20,300.50	4,185.42	9,577.62
19	33,993.00	20,273.30	4,174.68	9,545.02	82	34,058.17	20,275.62	4,195.40	9,587.15	145	33,976.17	20,236.77	4,187.07	9,552.33
20	33,984.55	20,285.85	4,175.90	9,522.80	83	34,018.15	20,265.92	4,184.88	9,567.35	146	33,979.38	20,260.75	4,183.23	9,535.40
21	33,974.83	20,239.85	4,175.22	9,559.77	84	34,010.55	20,286.52	4,181.02	9,543.02	147	33,996.67	20,253.87	4,181.85	9,560.95
22	34,005.75	20,277.50	4,176.32	9,551.93	85	33,994.22	20,230.17	4,203.32	9,560.73	148	33,997.45	20,269.38	4,191.05	9,537.02
23	33,962.33	20,227.53	4,176.12	9,558.68	86	34,023.28	20,265.93	4,185.10	9,572.25	149	34,026.97	20,280.78	4,187.00	9,559.18
24	34,017.92	20,256.38	4,177.65	9,583.88	87	33,994.83	20,274.27	4,182.77	9,537.80	150	33,998.60	20,259.95	4,186.92	9,551.73
25	34,009.50	20,284.63	4,167.28	9,557.58	88	33,996.40	20,235.70	4,182.40	9,578.30	151	33,989.47	20,257.65	4,164.30	9,567.52
26	34,004.92	20,250.97	4,191.12	9,562.83	89	33,992.77	20,271.47	4,164.82	9,556.48	152	33,995.68	20,231.08	4,189.82	9,574.78
27	33,995.27	20,258.72	4,174.88	9,561.67	90	33,991.85	20,250.32	4,179.08	9,562.45	153	34,001.92	20,289.63	4,184.02	9,528.27
28	34,042.57	20,282.52	4,195.52	9,564.53	91	34,008.78	20,288.97	4,178.28	9,541.53	154	33,996.63	20,258.03	4,177.22	9,561.38
29	34,029.32	20,266.97	4,184.03	9,578.32	92	33,993.50	20,265.00	4,171.42	9,557.08	155	34,040.77	20,299.82	4,177.50	9,563.45
30	34,008.73	20,252.65	4,197.67	9,558.42	93	33,984.47	20,256.88	4,185.77	9,541.82	156	33,998.63	20,250.15	4,179.65	9,568.83
31	34,015.40	20,257.17	4,195.40	9,562.83	94	34,015.73	20,282.20	4,179.22	9,554.32	157	33,951.63	20,221.25	4,189.75	9,540.63
32	34,012.43	20,276.68	4,182.83	9,552.92	95	34,007.27	20,274.80	4,189.48	9,542.98	158	34,014.58	20,287.98	4,186.98	9,539.62
33	33,998.28	20,242.32	4,193.57	9,562.40	96	33,986.12	20,251.92	4,187.45	9,546.75	159	34,066.97	20,293.40	4,194.63	9,578.93
34	33,997.28	20,272.67	4,175.75	9,548.87	97	33,992.18	20,246.10	4,179.88	9,566.20	160	33,996.88	20,244.18	4,180.95	9,571.75
35	33,964.83	20,247.58	4,171.03	9,546.22	98	33,982.97	20,265.38	4,184.57	9,533.02	161	34,022.33	20,267.22	4,182.80	9,572.32
36	33,977.33	20,250.67	4,176.32	9,550.35	99	34,004.25	20,263.53	4,178.22	9,562.50	162	34,032.75	20,279.08	4,188.05	9,565.62
37	34,005.10	20,254.93	4,191.00	9,559.17	100	34,012.55	20,282.85	4,194.43	9,535.27	163	33,973.52	20,237.80	4,178.18	9,557.53
38	34,001.35	20,257.95	4,179.03	9,564.37	101	33,962.08	20,234.95	4,184.67	9,542.47	164	34,019.83	20,264.50	4,198.30	9,557.03
39	34,037.05	20,280.70	4,183.75	9,572.60	102	33,964.07	20,246.18	4,188.58	9,529.30	165	33,958.50	20,247.52	4,182.07	9,528.92
40	33,996.72	20,271.13	4,175.67	9,549.92	103	33,991.85	20,253.08	4,187.25	9,551.52	166	34,010.68	20,285.40	4,163.60	9,561.68
41	34,021.03	20,275.88	4,179.62	9,565.53	104	33,979.92	20,245.55	4,182.38	9,551.98	167	34,019.98	20,265.07	4,191.03	9,563.88
42	33,980.70	20,270.80	4,172.67	9,537.23	105	33,996.27	20,255.60	4,189.87	9,550.80	168	34,008.58	20,260.85	4,185.43	9,562.30
43	33,995.12	20,265.03	4,185.32	9,544.77	106	34,042.15	20,269.08	4,190.45	9,582.62	169	34,029.10	20,282.38	4,186.48	9,560.23
44	34,001.92	20,269.90	4,182.33	9,549.68	107	34,032.38	20,277.63	4,189.68	9,565.07	170	33,972.97	20,240.28	4,178.68	9,554.00
45	33,993.20	20,256.92	4,172.22	9,564.07	108	33,963.95	20,246.02	4,170.77	9,547.17	171	33,972.72	20,250.57	4,183.65	9,538.50
46	34,023.68	20,273.30	4,179.83	9,570.55	109	33,963.85	20,263.92	4,163.20	9,536.73	172	34,001.77	20,260.70	4,177.60	9,563.47
47	34,023.48	20,276.23	4,179.38	9,567.87	110	33,981.60	20,234.00	4,190.62	9,556.98	173	34,017.18	20,279.03	4,183.48	9,554.67
48	34,005.03	20,247.00	4,190.42	9,567.62	111	33,981.33	20,251.97	4,174.67	9,554.70	174	33,997.57	20,259.67	4,186.22	9,551.68
49	34,003.30	20,269.17	4,169.35	9,564.78	112	33,959.45	20,229.58	4,185.95	9,543.92	175	34,031.63	20,281.03	4,173.85	9,576.75
50	33,997.57	20,275.92	4,176.97	9,544.68	113	33,978.55	20,262.73	4,176.40	9,539.42	176	33,970.27	20,247.97	4,182.47	9,539.83
51	33,964.00	20,249.93	4,169.87	9,544.20	114	33,964.85	20,248.22	4,178.22	9,538.42	177	33,989.80	20,275.62	4,184.15	9,530.03
52	34,026.70	20,301.72	4,181.27	9,543.72	115	34,018.72	20,272.55	4,187.97	9,558.20	178	33,978.53	20,266.50	4,181.78	9,530.25
53	33,954.97	20,236.83	4,184.17	9,533.97	116	33,974.58	20,253.77	4,192.67	9,528.15	179	33,984.02	20,234.10	4,199.50	9,550.42
54	34,008.98	20,301.92	4,170.37	9,536.70	117	33,999.73	20,266.08	4,193.45	9,540.20	180	33,993.93	20,261.07	4,178.37	9,554.50
55	33,983.60	20,243.57	4,185.68	9,554.35	118	33,993.05	20,279.30	4,172.58	9,541.17	181	34,028.68	20,297.65	4,192.62	9,538.42
56	34,026.40	20,279.17	4,194.62	9,552.62	119	34,010.90	20,289.57	4,188.27	9,533.07	182	34,031.48	20,273.23	4,184.45	9,573.80
57	34,002.20	20,283.67	4,200.08	9,518.45	120	33,996.00	20,247.73	4,189.17	9,559.10	Average	33,999.80	20,262.65	4,182.61	9,554.54
58	33,988.68	20,247.35	4,188.68	9,552.65	121	33,940.55	20,238.02	4,177.42	9,525.12					
59	33,988.70	20,251.40	4,178.78	9,558.52	122	34,043.77	20,307.02	4,192.92	9,543.83					
60	33,975.80	20,241.52	4,195.98	9,538.30	123	33,967.12	20,220.12	4,194.13	9,552.87					
61	33,999.73	20,282.32	4,176.72	9,540.70	124	34,014.98	20,264.78	4,176.00	9,574.20					
62	33,990.13	20,250.52	4,190.47	9,549.15	125	34,008.02	20,276.20	4,177.22	9,554.60					

Sustainability – I/O Request Throughput Distribution Graph

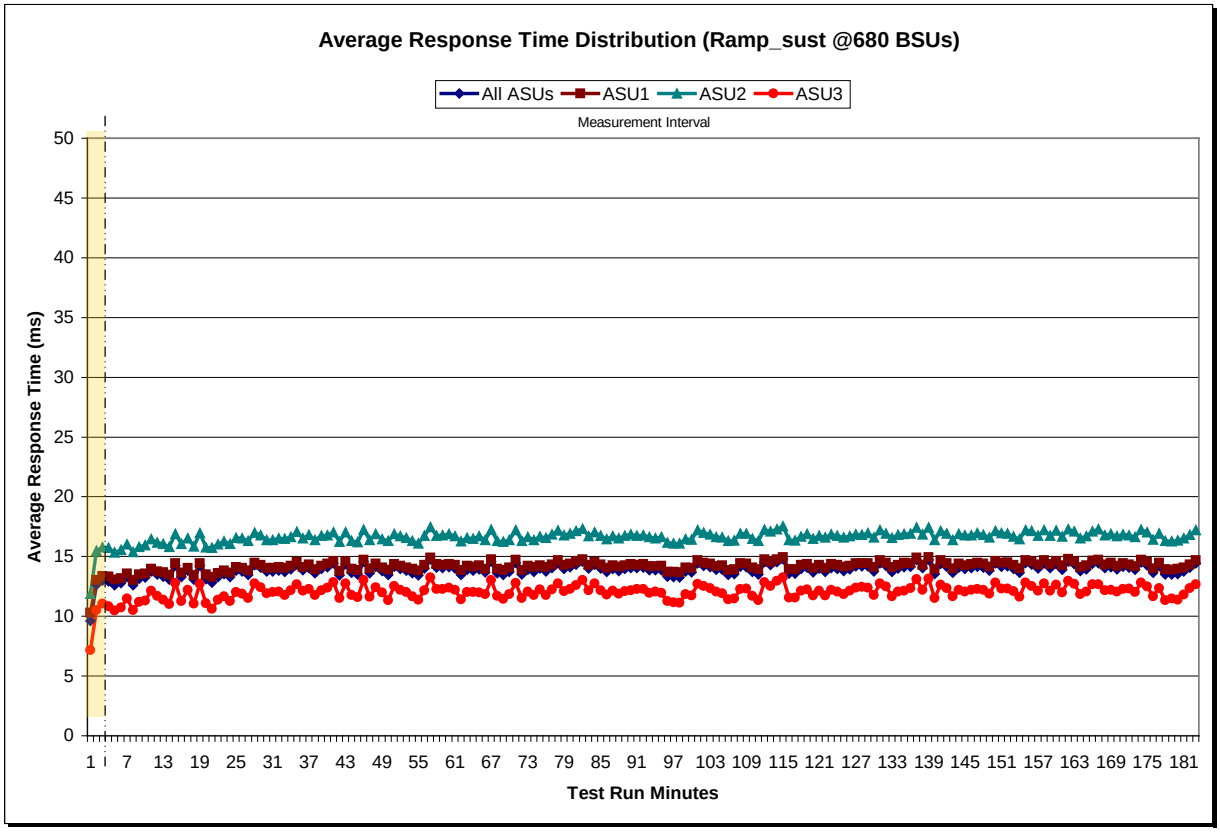


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	2:05:48	2:08:48	0-2	0:03:00
Measurement Interval	2:08:48	5:08:48	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	9.61	10.30	11.88	7.17	63	13.83	14.13	16.50	12.02	126	14.17	14.44	16.85	12.40
1	12.62	13.03	15.49	10.50	64	13.92	14.25	16.72	12.00	127	14.17	14.42	16.81	12.46
2	12.99	13.34	15.76	11.04	65	13.68	13.98	16.38	11.84	128	14.18	14.45	16.94	12.40
3	12.93	13.33	15.74	10.84	66	14.58	14.76	17.25	13.03	129	13.75	14.10	16.58	11.78
4	12.61	13.05	15.35	10.48	67	13.61	13.97	16.30	11.69	130	14.44	14.67	17.19	12.75
5	12.77	13.17	15.54	10.71	68	13.47	13.86	16.22	11.43	131	14.22	14.48	16.90	12.49
6	13.28	13.57	16.00	11.47	69	13.73	14.07	16.39	11.83	132	13.73	14.12	16.54	11.67
7	12.60	13.02	15.36	10.50	70	14.48	14.71	17.22	12.79	133	13.98	14.30	16.83	12.08
8	13.13	13.50	15.81	11.20	71	13.51	13.87	16.31	11.51	134	14.10	14.46	16.87	12.14
9	13.23	13.59	15.94	11.31	72	13.91	14.21	16.64	12.07	135	14.15	14.43	16.92	12.34
10	13.76	13.97	16.45	12.13	73	13.72	14.10	16.36	11.77	136	14.72	14.92	17.41	13.11
11	13.48	13.76	16.16	11.72	74	13.99	14.27	16.67	12.24	137	14.02	14.30	16.86	12.20
12	13.31	13.66	16.07	11.37	75	13.74	14.10	16.55	11.77	138	14.73	14.93	17.43	13.13
13	13.05	13.45	15.80	11.01	76	14.06	14.34	16.86	12.22	139	13.54	13.92	16.37	11.52
14	14.26	14.43	16.87	12.76	77	14.44	14.68	17.18	12.73	140	14.41	14.68	17.14	12.64
15	13.27	13.64	16.07	11.27	78	13.98	14.28	16.79	12.10	141	14.16	14.45	16.92	12.33
16	13.84	14.06	16.52	12.20	79	14.11	14.39	16.92	12.28	142	13.64	14.01	16.39	11.66
17	13.05	13.42	15.82	11.06	80	14.34	14.57	17.14	12.62	143	14.08	14.39	16.88	12.21
18	14.25	14.42	16.96	12.70	81	14.59	14.77	17.32	13.02	144	13.96	14.27	16.79	12.06
19	13.09	13.50	15.75	11.07	82	13.99	14.28	16.71	12.17	145	14.05	14.36	16.78	12.21
20	12.83	13.27	15.72	10.64	83	14.34	14.53	17.02	12.75	146	14.16	14.47	16.96	12.26
21	13.27	13.60	16.02	11.36	84	14.01	14.31	16.75	12.17	147	14.07	14.39	16.80	12.19
22	13.52	13.83	16.27	11.65	85	13.70	14.03	16.46	11.79	148	13.81	14.15	16.59	11.87
23	13.27	13.65	16.05	11.26	86	13.96	14.26	16.69	12.14	149	14.42	14.62	17.15	12.81
24	13.82	14.11	16.56	12.03	87	13.79	14.14	16.52	11.86	150	14.16	14.46	16.94	12.31
25	13.74	14.06	16.51	11.87	88	13.95	14.25	16.73	12.11	151	14.18	14.50	16.93	12.30
26	13.48	13.82	16.31	11.52	89	14.05	14.36	16.86	12.17	152	13.95	14.27	16.66	12.08
27	14.29	14.46	17.01	12.74	90	14.03	14.31	16.75	12.28	153	13.65	14.01	16.46	11.64
28	14.07	14.29	16.78	12.41	91	14.06	14.35	16.78	12.26	154	14.47	14.69	17.21	12.81
29	13.74	14.05	16.39	11.92	92	13.85	14.18	16.62	11.93	155	14.32	14.58	17.13	12.54
30	13.76	14.02	16.38	12.04	93	13.88	14.18	16.51	12.07	156	14.01	14.34	16.73	12.14
31	13.83	14.11	16.52	12.06	94	13.86	14.20	16.61	11.93	157	14.45	14.69	17.20	12.75
32	13.71	14.05	16.47	11.78	95	13.32	13.71	16.15	11.26	158	14.02	14.36	16.75	12.12
33	13.95	14.23	16.64	12.17	96	13.28	13.70	16.10	11.14	159	14.38	14.62	17.17	12.64
34	14.33	14.54	17.07	12.67	97	13.26	13.68	16.09	11.14	160	13.91	14.25	16.66	11.99
35	13.84	14.10	16.54	12.13	98	13.74	14.08	16.46	11.83	161	14.59	14.80	17.30	12.96
36	14.05	14.31	16.81	12.29	99	13.67	14.02	16.42	11.74	162	14.37	14.59	17.08	12.72
37	13.62	13.92	16.37	11.77	100	14.43	14.67	17.21	12.70	163	13.78	14.12	16.52	11.85
38	13.96	14.22	16.73	12.18	101	14.23	14.47	16.98	12.54	164	13.94	14.25	16.72	12.05
39	14.12	14.39	16.79	12.39	102	14.12	14.38	16.86	12.36	165	14.40	14.66	17.11	12.67
40	14.42	14.61	17.04	12.86	103	13.89	14.18	16.64	12.07	166	14.45	14.71	17.27	12.68
41	13.44	13.77	16.23	11.53	104	13.88	14.24	16.59	11.91	167	14.02	14.33	16.78	12.15
42	14.36	14.57	17.04	12.76	105	13.47	13.86	16.30	11.40	168	14.12	14.47	16.87	12.20
43	13.64	13.96	16.32	11.78	106	13.52	13.92	16.33	11.47	169	13.92	14.23	16.70	12.06
44	13.51	13.85	16.21	11.59	107	14.13	14.43	16.90	12.28	170	14.13	14.44	16.85	12.29
45	14.57	14.73	17.24	13.05	108	14.12	14.40	16.91	12.31	171	14.06	14.32	16.76	12.31
46	13.62	14.00	16.37	11.63	109	13.71	14.07	16.50	11.70	172	13.88	14.20	16.62	12.01
47	14.16	14.41	16.90	12.42	110	13.49	13.92	16.30	11.35	173	14.49	14.71	17.24	12.83
48	13.77	14.06	16.47	11.98	111	14.53	14.76	17.24	12.86	174	14.27	14.54	17.02	12.49
49	13.47	13.88	16.30	11.35	112	14.30	14.55	17.09	12.53	175	13.65	14.02	16.43	11.66
50	14.15	14.35	16.87	12.52	113	14.56	14.76	17.26	12.94	176	14.18	14.47	16.93	12.35
51	13.96	14.22	16.69	12.21	114	14.78	14.93	17.51	13.26	177	13.51	13.94	16.32	11.35
52	13.82	14.09	16.56	12.04	115	13.56	13.93	16.39	11.54	178	13.51	13.90	16.26	11.47
53	13.60	13.95	16.30	11.66	116	13.57	13.95	16.33	11.54	179	13.53	13.95	16.35	11.38
54	13.42	13.82	16.10	11.38	117	13.98	14.29	16.68	12.13	180	13.74	14.08	16.51	11.82
55	14.01	14.30	16.75	12.18	118	14.08	14.37	16.87	12.25	181	14.08	14.33	16.80	12.36
56	14.75	14.89	17.46	13.25	119	13.68	14.03	16.47	11.73	182	14.43	14.68	17.21	12.68
57	14.08	14.36	16.74	12.29	120	13.99	14.30	16.75	12.14	Average	13.90	14.21	16.65	12.06
58	14.04	14.31	16.78	12.29	121	13.71	14.06	16.58	11.72					
59	14.12	14.37	16.89	12.37	122	14.06	14.35	16.83	12.20					
60	14.01	14.30	16.71	12.21	123	13.97	14.30	16.73	12.05					
61	13.46	13.85	16.26	11.42	124	13.80	14.16	16.58	11.84					
62	13.89	14.22	16.57	12.04	125	13.94	14.22	16.69	12.14					

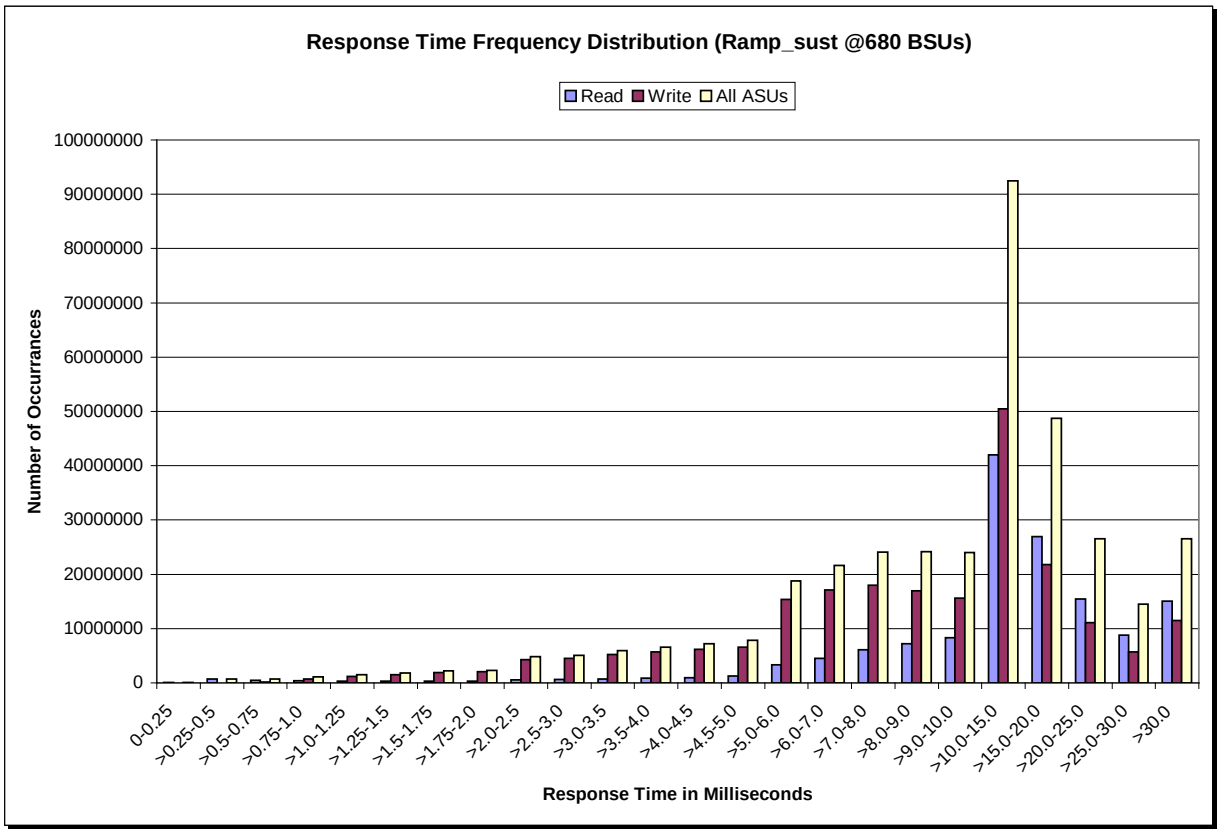
Sustainability – Average Response Time (ms) Distribution Graph



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	75,102	688,257	512,205	392,001	345,526	314,402	300,840	280,962
Write	-	2,758	175,710	722,627	1,160,047	1,489,864	1,878,653	2,029,621
All ASUs	75,102	691,015	687,915	1,114,628	1,505,573	1,804,266	2,179,493	2,310,583
ASU1	71,521	656,051	571,788	705,936	854,151	971,104	1,126,424	1,165,929
ASU2	3,581	34,108	44,798	99,291	145,197	182,484	225,156	242,137
ASU3	-	856	71,329	309,401	506,225	650,678	827,913	902,517
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	564,965	617,239	717,710	865,389	974,193	1,248,592	3,339,875	4,502,493
Write	4,264,682	4,482,779	5,244,204	5,744,830	6,208,623	6,563,332	15,410,421	17,108,282
All ASUs	4,829,647	5,100,018	5,961,914	6,610,219	7,182,816	7,811,924	18,750,296	21,610,775
ASU1	2,414,991	2,545,307	2,961,003	3,309,099	3,623,761	4,032,765	9,856,963	11,668,744
ASU2	510,452	544,625	642,373	711,799	765,686	821,386	1,923,733	2,178,592
ASU3	1,904,204	2,010,086	2,358,538	2,589,321	2,793,369	2,957,773	6,969,600	7,763,439
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	6,102,142	7,197,609	8,345,645	42,031,840	26,927,842	15,456,253	8,759,475	15,062,344
Write	18,009,304	16,931,673	15,635,975	50,461,741	21,811,290	11,090,840	5,733,510	11,453,035
All ASUs	24,111,446	24,129,282	23,981,620	92,493,581	48,739,132	26,547,093	14,492,985	26,515,379
ASU1	13,454,115	13,873,901	14,206,027	57,973,997	31,784,409	17,330,853	9,388,750	15,504,696
ASU2	2,408,264	2,442,437	2,500,840	10,807,501	6,600,373	3,893,417	2,325,230	5,369,076
ASU3	8,249,067	7,812,944	7,274,753	23,712,083	10,354,350	5,322,823	2,779,005	5,641,607

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	0.004	0.001	0.003	0.001	0.005	0.002	0.004	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 68.

IOPS Test Results File

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

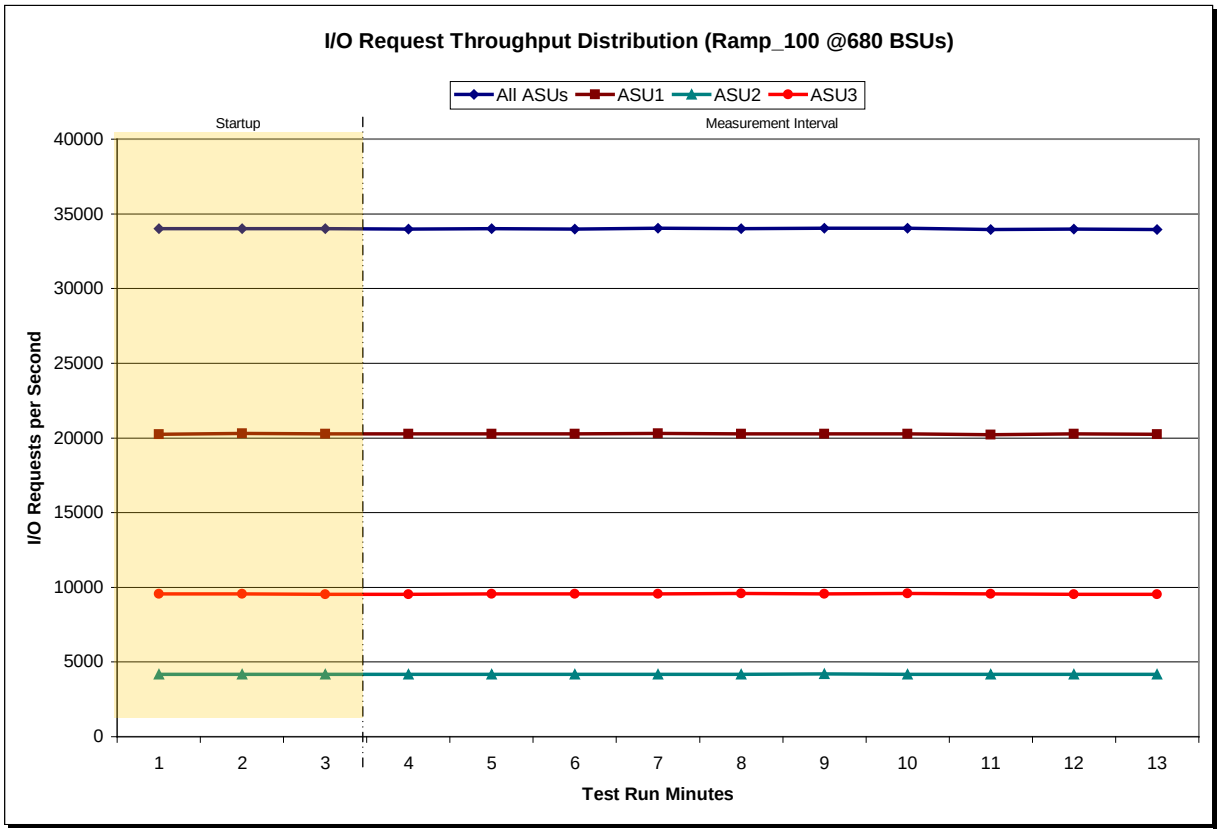
IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	5:09:54	5:12:55	0-2	0:03:01
Measurement Interval	5:12:55	5:22:55	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	34,005.03	20,250.42	4,187.23	9,567.38
1	34,023.77	20,301.42	4,167.77	9,554.58
2	34,007.47	20,286.87	4,187.52	9,533.08
3	33,990.00	20,265.45	4,181.40	9,543.15
4	34,009.02	20,284.00	4,170.60	9,554.42
5	33,979.12	20,267.73	4,162.77	9,548.62
6	34,041.82	20,305.42	4,179.82	9,556.58
7	34,022.42	20,274.17	4,172.13	9,576.12
8	34,043.97	20,285.65	4,197.10	9,561.22
9	34,028.68	20,259.35	4,187.00	9,582.33
10	33,962.60	20,220.80	4,182.68	9,559.12
11	33,990.10	20,273.47	4,173.58	9,543.05
12	33,954.30	20,248.70	4,170.07	9,535.53
Average	***34,002.20***	***20,268.47***	***4,177.72***	***9,556.01***

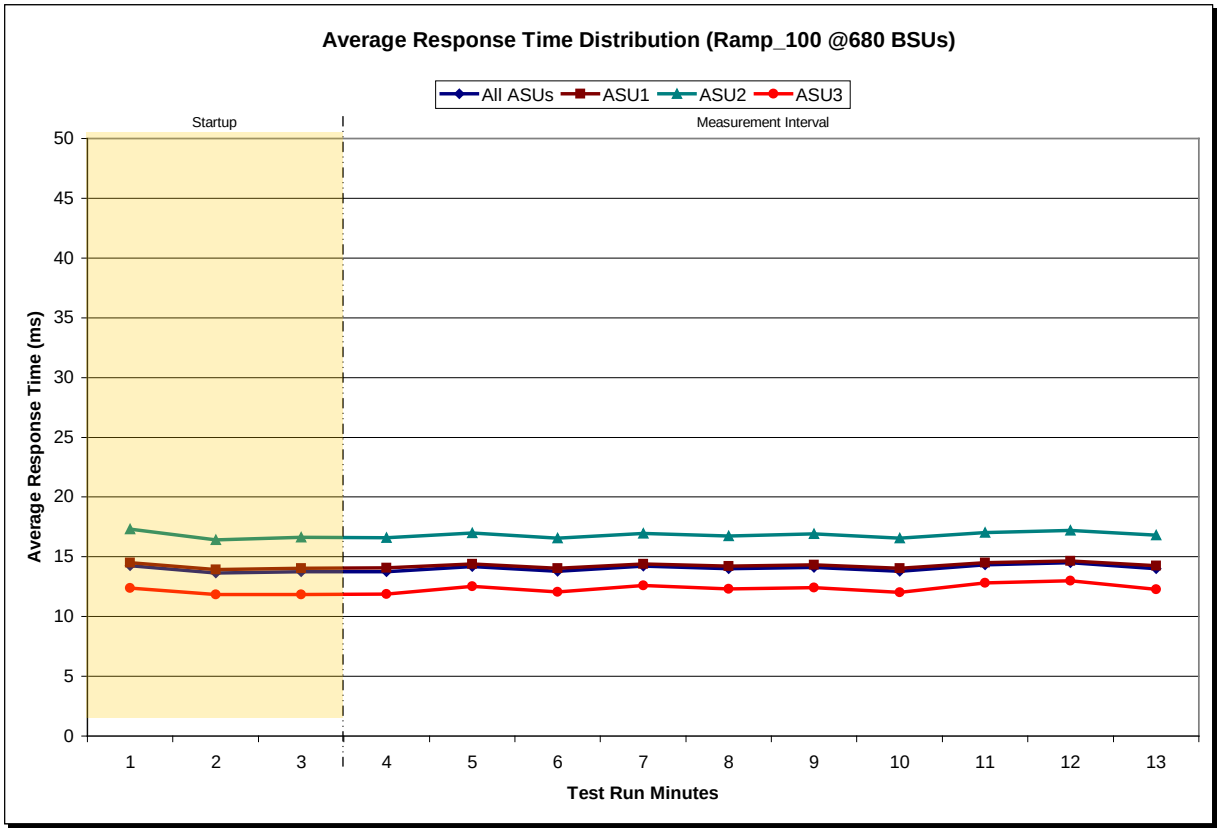
IOPS Test Run – I/O Request Throughput Distribution Graph



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

680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	5:09:54	5:12:55	0-2	0:03:01
Measurement Interval	5:12:55	5:22:55	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.26	14.51	17.31	12.39
1	13.65	13.94	16.40	11.84
2	13.74	14.04	16.63	11.84
3	13.76	14.06	16.58	11.89
4	14.20	14.40	16.99	12.53
5	13.80	14.05	16.56	12.05
6	14.21	14.40	16.97	12.61
7	14.00	14.23	16.73	12.31
8	14.12	14.33	16.93	12.43
9	13.78	14.04	16.56	12.02
10	14.34	14.50	17.03	12.83
11	14.51	14.66	17.21	12.99
12	14.02	14.25	16.82	12.29
Average	***14.07***	***14.29***	***16.84***	***12.39***

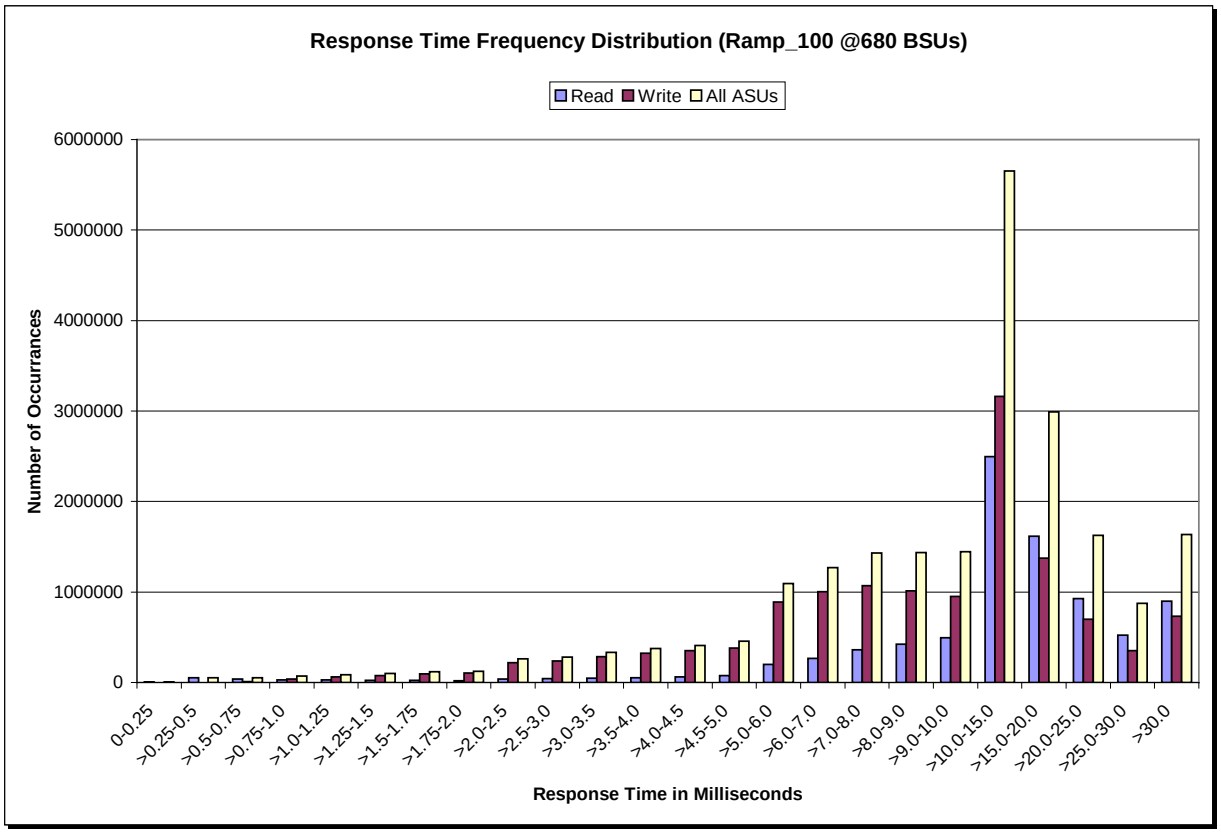
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	6,055	53,522	39,976	30,609	26,375	24,187	22,352	20,528
Write	0	170	10,778	40,097	61,568	76,045	95,624	103,954
All ASUs	6,055	53,692	50,754	70,706	87,943	100,232	117,976	124,482
ASU1	5,811	51,458	43,489	47,726	53,031	57,380	64,051	65,554
ASU2	244	2,178	2,784	5,619	8,069	9,562	11,819	12,818
ASU3	0	56	4,481	17,361	26,843	33,290	42,106	46,110
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	40,112	42,145	46,480	54,613	60,045	76,083	200,252	266,382
Write	219,662	238,598	286,193	322,218	351,113	378,723	891,024	1,002,115
All ASUs	259,774	280,743	332,673	376,831	411,158	454,806	1,091,276	1,268,497
ASU1	134,636	144,160	168,937	191,489	208,982	236,125	576,268	685,761
ASU2	26,886	29,511	35,985	40,152	43,630	47,648	112,048	127,594
ASU3	98,252	107,072	127,751	145,190	158,546	171,033	402,960	455,142
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	360,543	422,427	492,762	2,494,317	1,618,075	926,792	525,016	900,745
Write	1,070,313	1,013,100	953,029	3,159,778	1,372,432	699,084	350,458	733,716
All ASUs	1,430,856	1,435,527	1,445,791	5,654,095	2,990,507	1,625,876	875,474	1,634,461
ASU1	797,226	822,173	852,207	3,511,803	1,936,144	1,053,248	566,070	947,881
ASU2	143,803	146,239	150,881	658,979	403,535	237,795	139,688	327,032
ASU3	489,827	467,115	442,703	1,483,313	650,828	334,833	169,716	359,548

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
22,180,185	20,545,724	1,634,461

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	0.0349	0.2812	0.0700	0.2099	0.0179	0.0700	0.0350	0.2810
COV	0.003	0.001	0.003	0.002	0.004	0.002	0.004	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 68.

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 - 680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	5:09:54	5:12:55	0-2	0:03:01
Measurement Interval	5:12:55	5:22:55	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	34,005.03	20,250.42	4,187.23	9,567.38
1	34,023.77	20,301.42	4,167.77	9,554.58
2	34,007.47	20,286.87	4,187.52	9,533.08
3	33,990.00	20,265.45	4,181.40	9,543.15
4	34,009.02	20,284.00	4,170.60	9,554.42
5	33,979.12	20,267.73	4,162.77	9,548.62
6	34,041.82	20,305.42	4,179.82	9,556.58
7	34,022.42	20,274.17	4,172.13	9,576.12
8	34,043.97	20,285.65	4,197.10	9,561.22
9	34,028.68	20,259.35	4,187.00	9,582.33
10	33,962.60	20,220.80	4,182.68	9,559.12
11	33,990.10	20,273.47	4,173.58	9,543.05
12	33,954.30	20,248.70	4,170.07	9,535.53
Average	34,002.20	20,268.47	4,177.72	9,556.01

95% Load Level - 646 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	5:23:59	5:27:00	0-2	0:03:01
Measurement Interval	5:27:00	5:37:00	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	32,321.23	19,259.17	3,974.30	9,087.77
1	32,316.22	19,263.13	3,983.27	9,069.82
2	32,298.15	19,232.67	3,979.92	9,085.57
3	32,321.88	19,262.43	3,994.18	9,065.27
4	32,326.65	19,272.25	3,975.13	9,079.27
5	32,283.83	19,241.98	3,971.67	9,070.18
6	32,336.65	19,277.17	3,975.53	9,083.95
7	32,345.95	19,287.90	3,978.53	9,079.52
8	32,312.47	19,234.90	3,986.43	9,091.13
9	32,334.82	19,281.43	3,975.43	9,077.95
10	32,284.15	19,256.32	3,963.43	9,064.40
11	32,352.77	19,264.40	3,991.07	9,097.30
12	32,288.17	19,232.82	3,977.77	9,077.58
Average	32,318.73	19,261.16	3,978.92	9,078.66

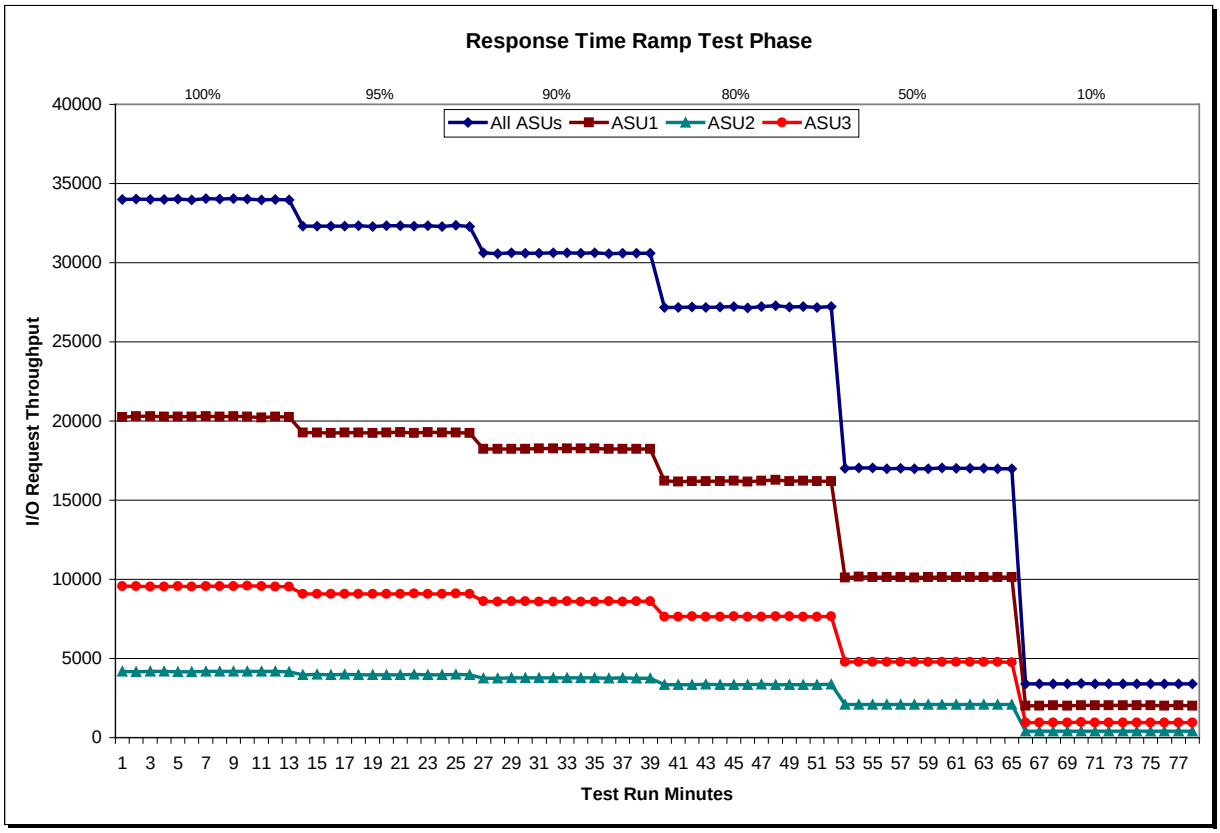
90% Load Level - 612 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	5:38:04	5:41:05	0-2	0:03:01
Measurement Interval	5:41:05	5:51:05	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	30,626.68	18,245.13	3,761.93	8,619.62
1	30,575.47	18,221.40	3,758.00	8,596.07
2	30,625.15	18,243.75	3,771.68	8,609.72
3	30,611.07	18,233.78	3,767.92	8,609.37
4	30,603.00	18,250.73	3,770.37	8,581.90
5	30,616.72	18,264.78	3,765.18	8,586.75
6	30,629.02	18,247.53	3,767.92	8,613.57
7	30,610.60	18,260.47	3,764.12	8,586.02
8	30,616.20	18,260.72	3,769.75	8,585.73
9	30,582.35	18,225.02	3,748.73	8,608.60
10	30,601.00	18,234.75	3,768.37	8,597.88
11	30,596.95	18,228.13	3,760.60	8,608.22
12	30,600.98	18,236.15	3,756.65	8,608.18
Average	30,606.79	18,244.21	3,763.96	8,598.62

80% Load Level - 544 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	5:52:09	5:55:10	0-2	0:03:01
Measurement Interval	5:55:10	6:05:10	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	27,183.50	16,209.73	3,332.15	7,641.62
1	27,175.55	16,179.90	3,348.13	7,647.52
2	27,201.48	16,195.57	3,343.25	7,662.67
3	27,184.23	16,202.15	3,356.53	7,625.55
4	27,196.53	16,205.53	3,347.80	7,643.20
5	27,229.43	16,234.30	3,342.78	7,652.35
6	27,158.07	16,175.47	3,343.23	7,639.37
7	27,217.78	16,212.92	3,363.55	7,641.32
8	27,272.58	16,269.35	3,349.20	7,654.03
9	27,202.33	16,208.28	3,343.35	7,650.70
10	27,217.02	16,219.80	3,352.52	7,644.70
11	27,166.25	16,186.68	3,354.27	7,625.30
12	27,220.38	16,206.80	3,360.17	7,653.42
Average	27,206.46	16,212.13	3,351.34	7,642.99

50% Load Level - 340 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:06:14	6:09:15	0-2	0:03:01
Measurement Interval	6:09:15	6:19:15	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	17,002.02	10,120.82	2,092.43	4,788.77
1	17,025.47	10,152.85	2,092.47	4,780.15
2	17,027.62	10,145.52	2,095.10	4,787.00
3	16,981.65	10,124.45	2,085.88	4,771.32
4	17,010.27	10,134.42	2,091.65	4,784.20
5	16,985.07	10,121.80	2,089.12	4,774.15
6	16,991.80	10,128.40	2,092.00	4,771.40
7	17,040.22	10,148.42	2,097.47	4,794.33
8	17,022.67	10,146.73	2,099.88	4,776.05
9	17,000.57	10,128.90	2,088.17	4,783.50
10	16,997.65	10,137.25	2,084.58	4,775.82
11	16,992.75	10,125.92	2,082.75	4,784.08
12	16,989.82	10,133.00	2,093.57	4,763.25
Average	17,001.25	10,132.93	2,090.51	4,777.81

10% Load Level - 68 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:20:19	6:23:20	0-2	0:03:01
Measurement Interval	6:23:20	6:33:20	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	3,390.10	2,022.88	419.05	948.17
1	3,400.10	2,023.65	416.32	960.13
2	3,406.90	2,032.35	415.67	958.88
3	3,390.17	2,015.47	417.50	957.20
4	3,415.77	2,030.17	419.13	966.47
5	3,409.92	2,030.03	419.25	960.63
6	3,401.48	2,027.90	419.22	954.37
7	3,406.82	2,029.25	419.17	958.40
8	3,406.73	2,035.47	417.20	954.07
9	3,402.68	2,027.50	418.20	956.98
10	3,387.42	2,016.53	418.13	952.75
11	3,405.52	2,030.52	419.92	955.08
12	3,394.62	2,017.75	419.57	957.30
Average	3,402.11	2,026.06	418.73	957.33

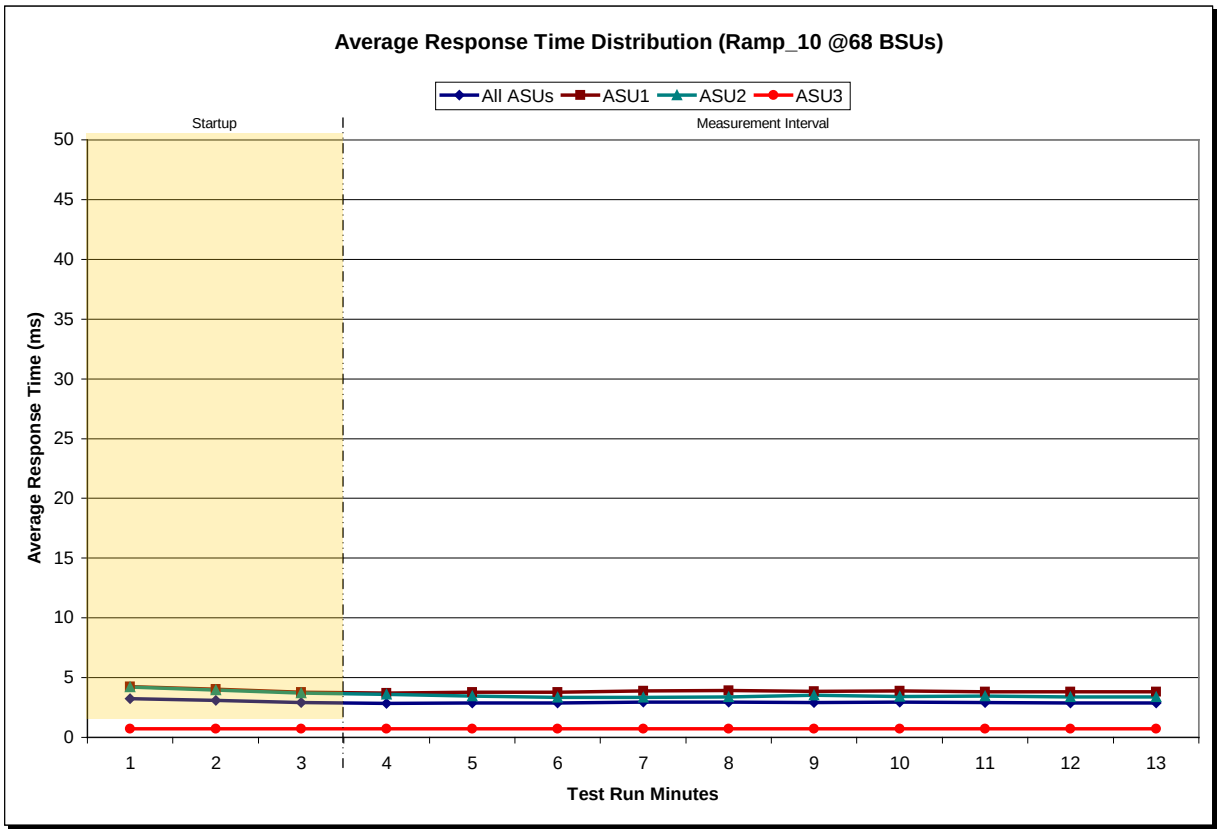
Response Time Ramp Distribution (IOPS) Graph



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

68 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:20:19	6:23:20	0-2	0:03:01
Measurement Interval	6:23:20	6:33:20	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3.25	4.24	4.20	0.73
1	3.09	4.04	3.94	0.73
2	2.92	3.79	3.70	0.73
3	2.86	3.73	3.60	0.72
4	2.87	3.78	3.46	0.71
5	2.86	3.78	3.34	0.72
6	2.94	3.90	3.33	0.71
7	2.97	3.94	3.38	0.72
8	2.93	3.84	3.54	0.73
9	2.94	3.88	3.41	0.74
10	2.90	3.82	3.45	0.72
11	2.89	3.81	3.40	0.73
12	2.89	3.82	3.40	0.72
Average	***2.91***	***3.83***	***3.43***	***0.72***

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	0.0351	0.2811	0.0698	0.2095	0.0181	0.0700	0.0350	0.2814
COV	0.010	0.002	0.008	0.003	0.014	0.005	0.012	0.003

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 68.

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	***34,002.20***
Repeatability Test Phase 1	33,995.17
Repeatability Test Phase 2	34,007.29

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

	SPC-1 LRT™
Primary Metrics	***2.91 ms***
Repeatability Test Phase 1	2.90 ms
Repeatability Test Phase 2	2.90 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)..

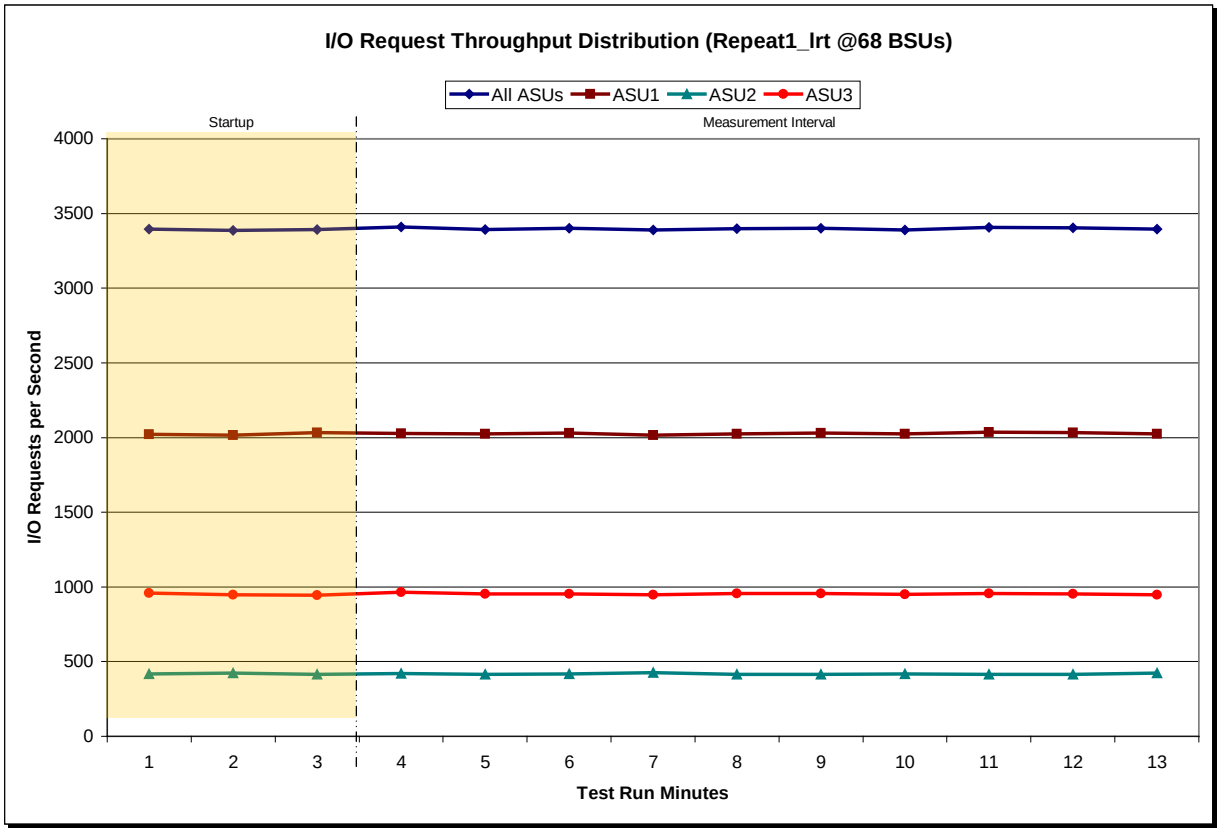
A link to the test result file generated from each Repeatability Test Run is listed below.

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

68 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:34:28	6:37:28	0-2	0:03:00
Measurement Interval	6:37:28	6:47:28	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3,395.80	2,020.25	416.87	958.68
1	3,385.60	2,016.93	422.17	946.50
2	3,393.23	2,032.53	414.97	945.73
3	3,409.90	2,026.13	419.08	964.68
4	3,391.10	2,024.38	414.82	951.90
5	3,401.83	2,030.02	417.30	954.52
6	3,388.55	2,016.50	425.12	946.93
7	3,397.10	2,024.33	415.80	956.97
8	3,400.18	2,030.33	415.13	954.72
9	3,390.08	2,023.07	417.88	949.13
10	3,405.45	2,034.88	414.95	955.62
11	3,402.95	2,034.17	415.32	953.47
12	3,394.70	2,023.63	423.18	947.88
Average	***3,398.19***	***2,026.75***	***417.86***	***953.58***

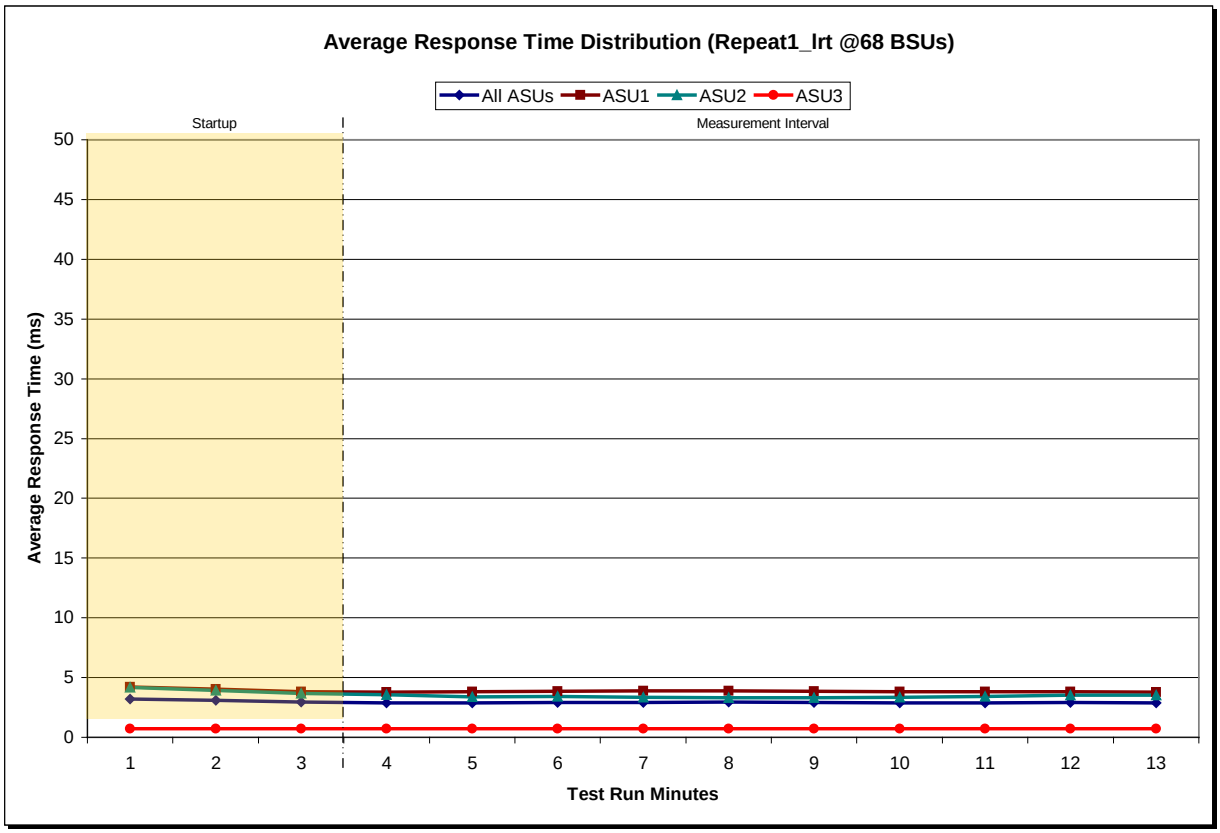
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

68 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:34:28	6:37:28	0-2	0:03:00
Measurement Interval	6:37:28	6:47:28	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3.21	4.20	4.18	0.72
1	3.09	4.03	3.92	0.72
2	2.94	3.83	3.67	0.72
3	2.88	3.77	3.55	0.72
4	2.89	3.81	3.37	0.72
5	2.91	3.84	3.42	0.72
6	2.93	3.88	3.34	0.71
7	2.94	3.90	3.33	0.73
8	2.90	3.84	3.32	0.71
9	2.89	3.81	3.34	0.73
10	2.90	3.81	3.42	0.73
11	2.91	3.82	3.53	0.72
12	2.90	3.79	3.53	0.71
Average	***2.90***	***3.83***	***3.42***	***0.72***

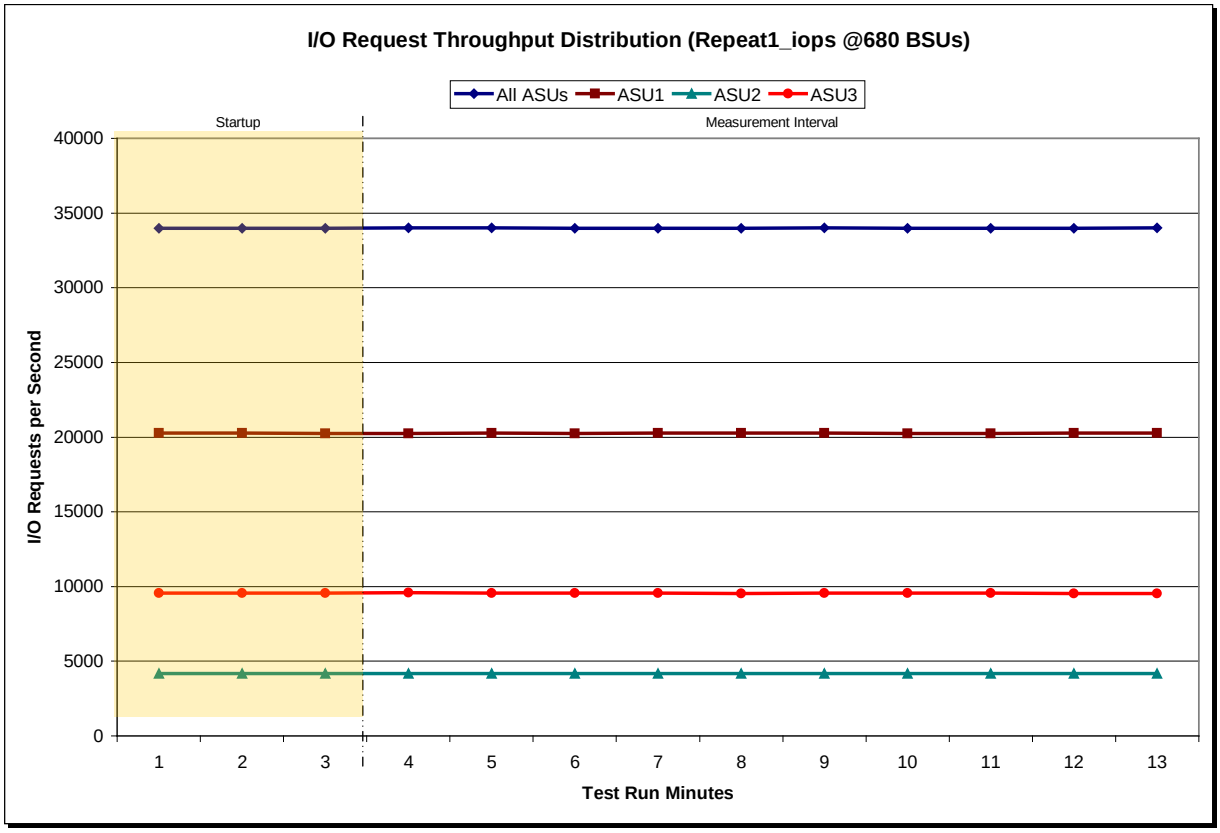
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:48:32	6:51:33	0-2	0:03:01
Measurement Interval	6:51:33	7:01:33	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	33,990.23	20,266.57	4,171.30	9,552.37
1	33,994.78	20,267.98	4,174.88	9,551.92
2	33,978.72	20,238.78	4,183.53	9,556.40
3	34,003.20	20,246.33	4,179.00	9,577.87
4	34,005.13	20,278.78	4,177.30	9,549.05
5	33,971.42	20,235.47	4,178.23	9,557.72
6	33,985.60	20,259.52	4,171.32	9,554.77
7	33,994.22	20,265.47	4,182.52	9,546.23
8	34,009.13	20,261.32	4,176.28	9,571.53
9	33,991.07	20,256.97	4,178.75	9,555.35
10	33,995.27	20,258.62	4,181.15	9,555.50
11	33,982.48	20,261.80	4,178.72	9,541.97
12	34,014.13	20,281.60	4,188.52	9,544.02
Average	***33,995.17***	***20,260.59***	***4,179.18***	***9,555.40***

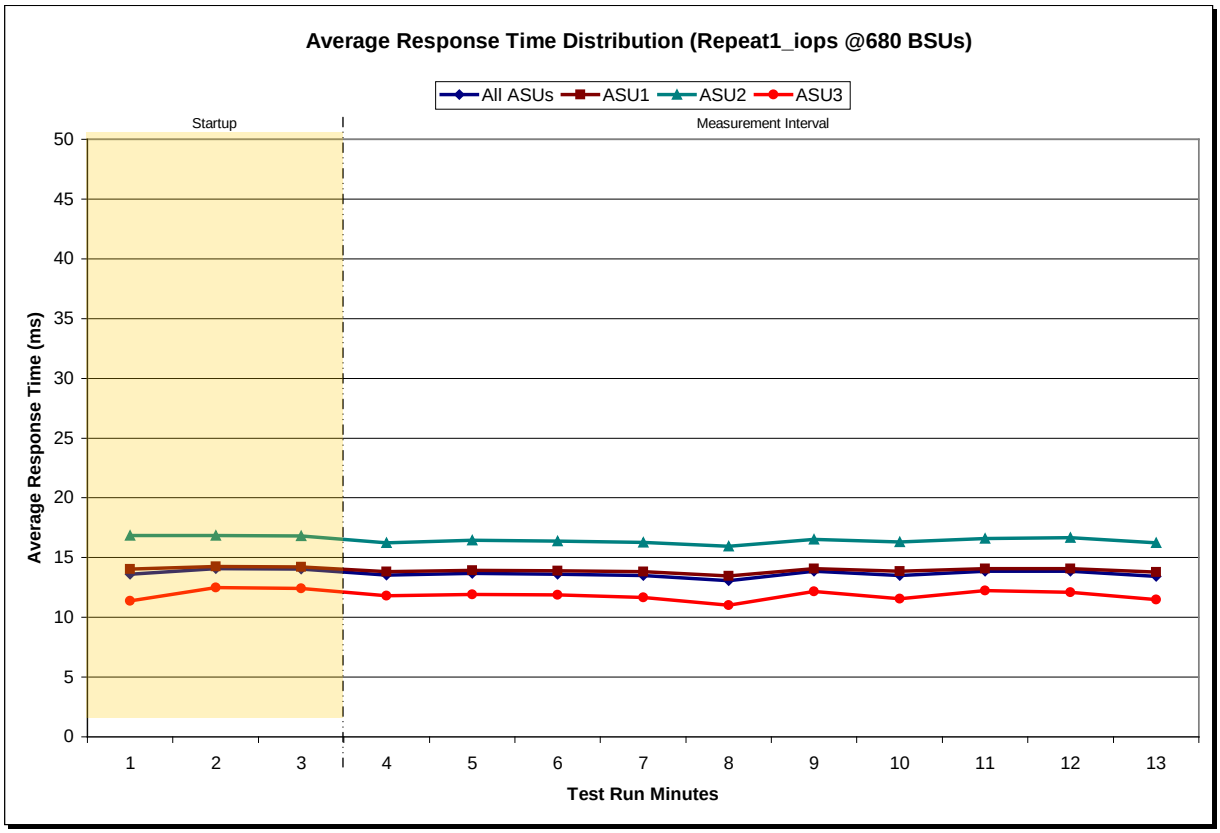
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	6:48:32	6:51:33	0-2	0:03:01
Measurement Interval	6:51:33	7:01:33	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	13.62	14.03	16.84	11.36
1	14.07	14.24	16.85	12.51
2	14.04	14.23	16.83	12.44
3	13.54	13.81	16.23	11.80
4	13.67	13.92	16.44	11.90
5	13.62	13.88	16.39	11.87
6	13.50	13.81	16.26	11.65
7	13.08	13.45	15.94	11.03
8	13.84	14.09	16.53	12.16
9	13.51	13.85	16.29	11.57
10	13.87	14.08	16.60	12.24
11	13.85	14.09	16.67	12.09
12	13.43	13.78	16.22	11.47
Average	***13.59***	***13.88***	***16.36***	***11.78***

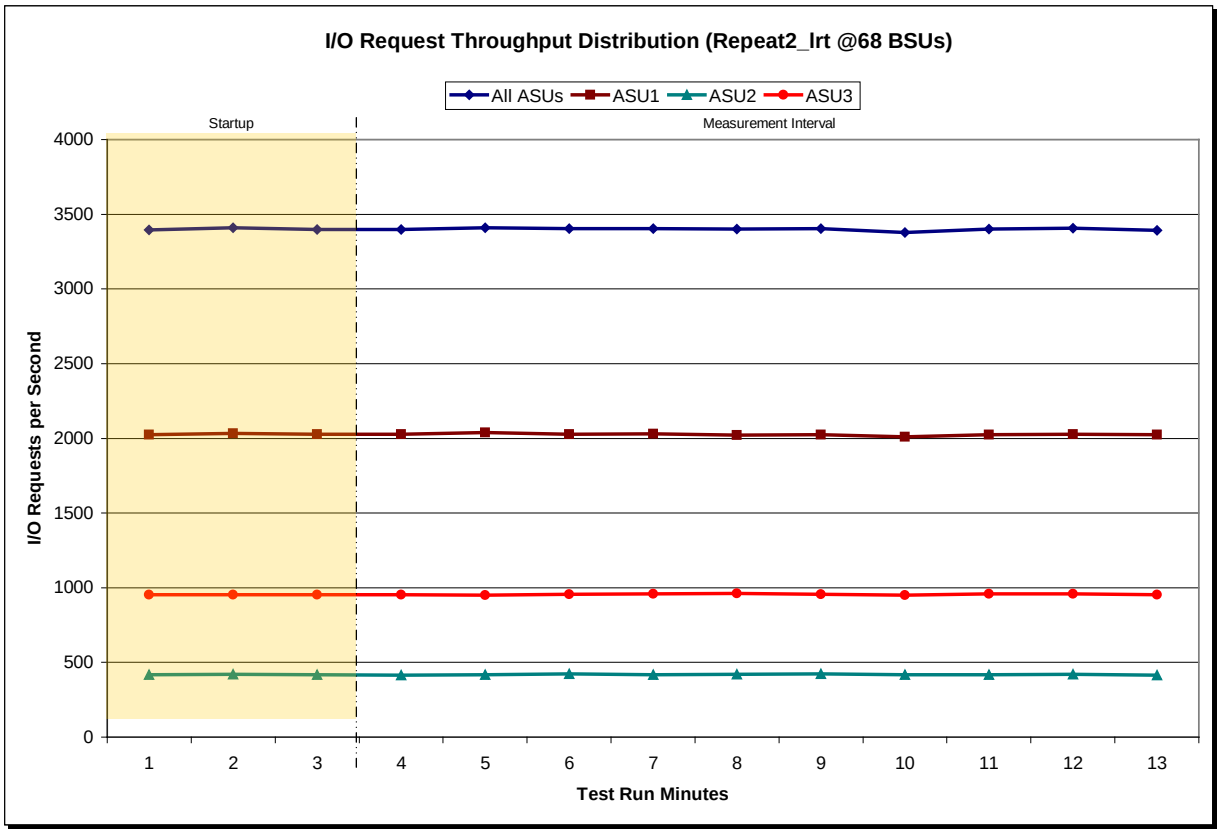
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

68 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	7:02:41	7:05:41	0-2	0:03:00
Measurement Interval	7:05:41	7:15:41	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3,394.18	2,025.33	416.93	951.92
1	3,408.70	2,033.13	421.43	954.13
2	3,397.22	2,027.48	416.60	953.13
3	3,397.50	2,027.57	415.78	954.15
4	3,408.92	2,040.28	417.52	951.12
5	3,403.53	2,026.87	421.98	954.68
6	3,404.87	2,030.02	417.18	957.67
7	3,400.45	2,020.57	419.35	960.53
8	3,403.60	2,023.88	422.77	956.95
9	3,378.78	2,009.58	418.43	950.77
10	3,399.88	2,023.97	417.45	958.47
11	3,406.92	2,027.22	420.18	959.52
12	3,392.62	2,024.45	414.23	953.93
Average	***3,399.71***	***2,025.44***	***418.49***	***955.78***

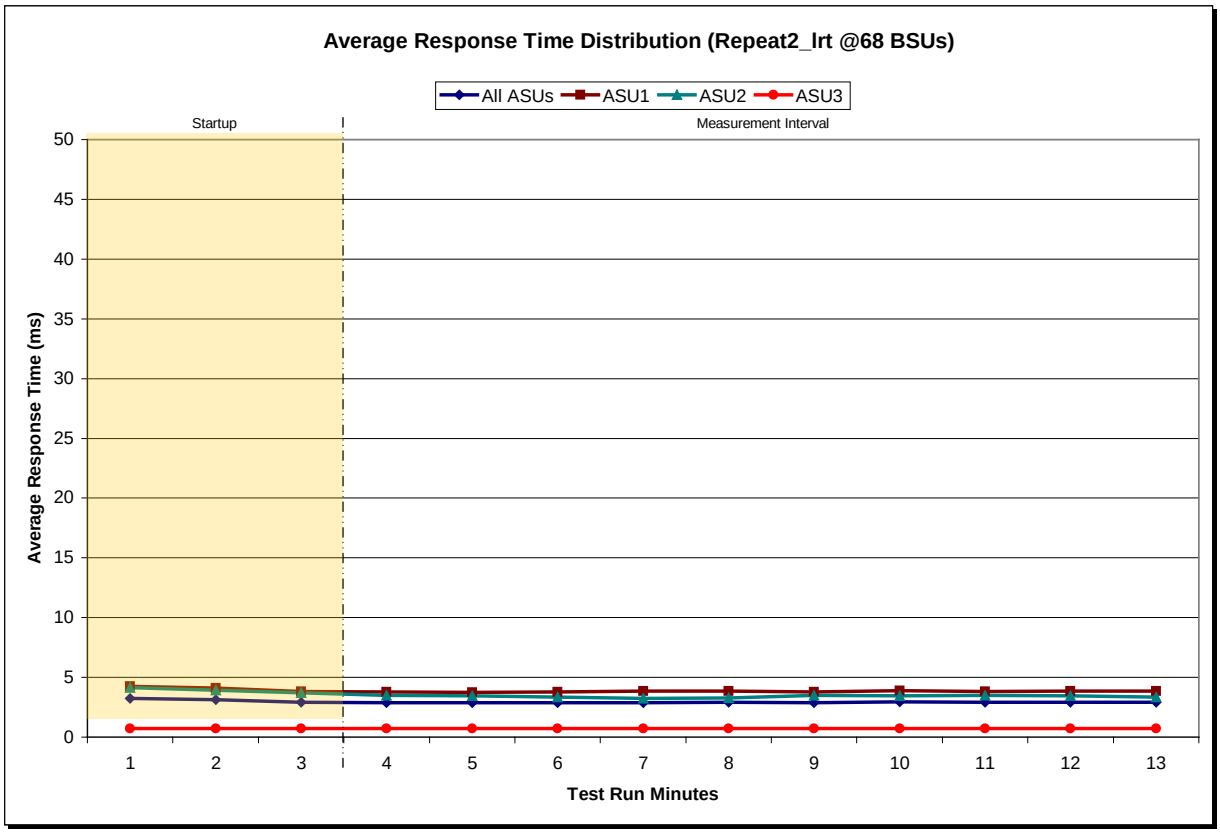
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

68 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	7:02:41	7:05:41	0-2	0:03:00
Measurement Interval	7:05:41	7:15:41	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3.25	4.25	4.14	0.72
1	3.13	4.09	3.92	0.72
2	2.92	3.80	3.71	0.71
3	2.88	3.78	3.48	0.72
4	2.87	3.76	3.46	0.71
5	2.88	3.79	3.34	0.73
6	2.90	3.85	3.24	0.72
7	2.90	3.85	3.29	0.72
8	2.88	3.78	3.50	0.72
9	2.95	3.89	3.47	0.73
10	2.90	3.81	3.48	0.72
11	2.93	3.86	3.47	0.71
12	2.92	3.87	3.33	0.72
Average	***2.90***	***3.82***	***3.41***	***0.72***

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

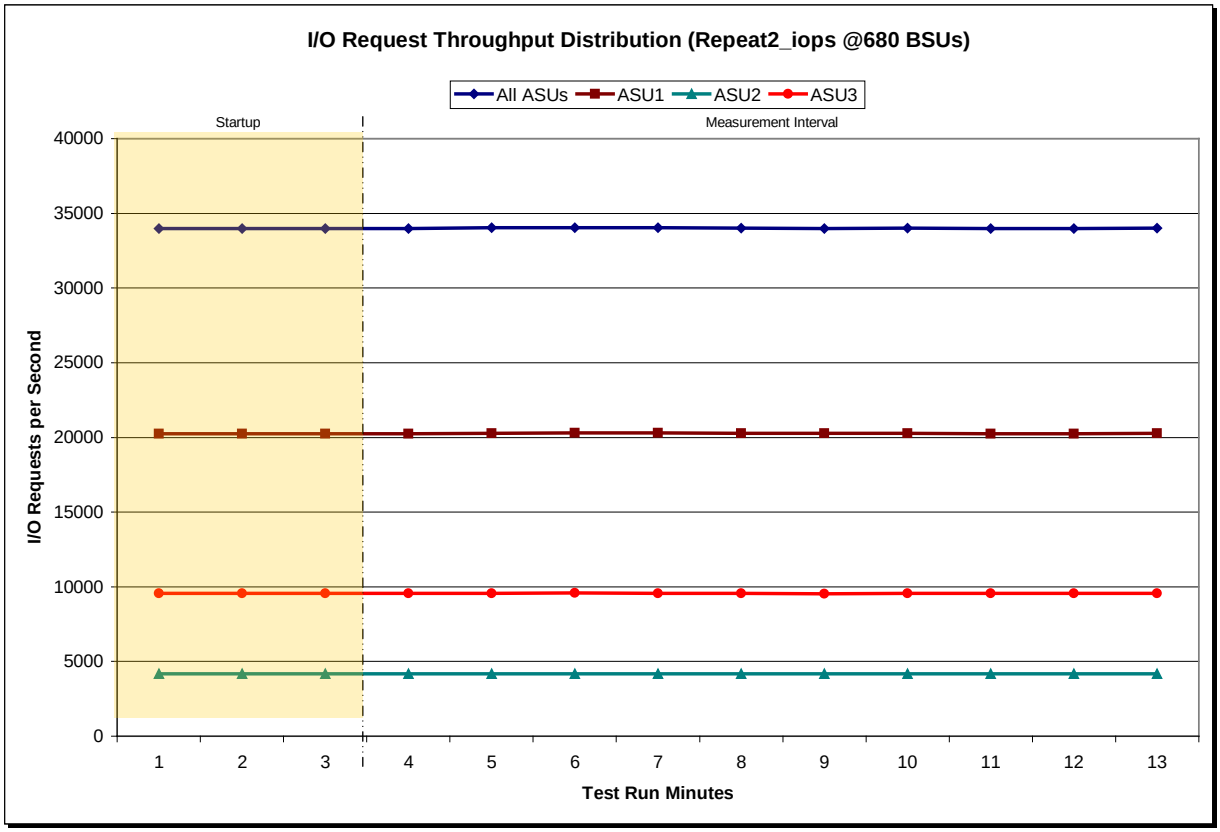


Repeatability 2 IOPS – I/O Request Throughput Distribution Data

680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	7:16:45	7:19:46	0-2	0:03:01
Measurement Interval	7:19:46	7:29:46	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	33,983.47	20,240.93	4,172.97	9,569.57
1	33,991.80	20,255.63	4,187.53	9,548.63
2	33,989.28	20,254.32	4,174.65	9,560.32
3	33,990.05	20,243.48	4,178.23	9,568.33
4	34,031.48	20,286.52	4,186.27	9,558.70
5	34,039.70	20,294.25	4,169.58	9,575.87
6	34,045.02	20,293.33	4,180.20	9,571.48
7	33,996.78	20,271.23	4,174.00	9,551.55
8	33,995.48	20,281.75	4,174.97	9,538.77
9	34,010.72	20,262.92	4,188.13	9,559.67
10	33,968.13	20,231.63	4,179.92	9,556.58
11	33,992.52	20,251.08	4,185.33	9,556.10
12	34,003.05	20,267.18	4,172.70	9,563.17
Average	***34,007.29***	***20,268.34***	***4,178.93***	***9,560.02***

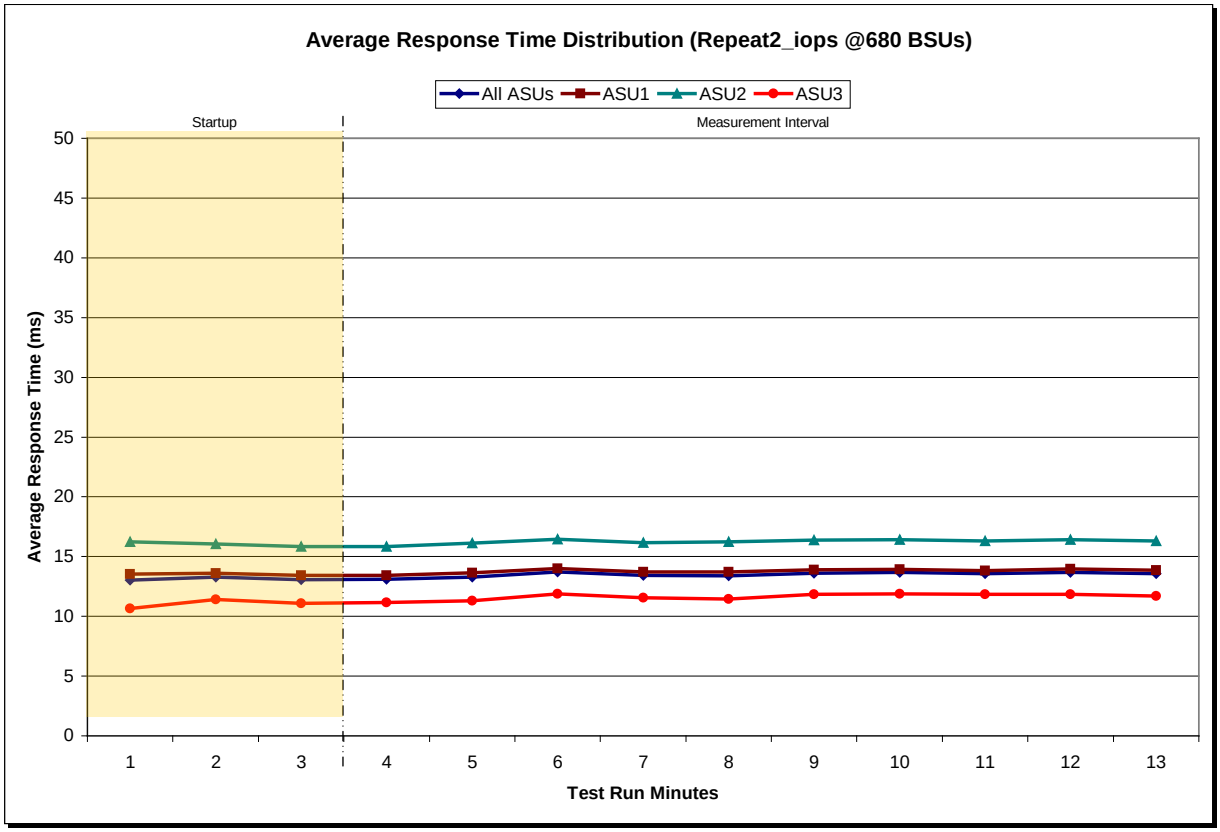
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

680 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	7:16:45	7:19:46	0-2	0:03:01
Measurement Interval	7:19:46	7:29:46	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	13.04	13.52	16.24	10.64
1	13.29	13.60	16.05	11.43
2	13.06	13.42	15.83	11.07
3	13.10	13.44	15.85	11.16
4	13.30	13.66	16.11	11.29
5	13.70	13.99	16.45	11.89
6	13.41	13.72	16.18	11.55
7	13.38	13.71	16.22	11.43
8	13.61	13.88	16.36	11.84
9	13.66	13.94	16.42	11.88
10	13.56	13.82	16.31	11.83
11	13.67	13.97	16.40	11.83
12	13.55	13.87	16.29	11.69
Average	***13.49***	***13.80***	***16.26***	***11.64***

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	0.0352	0.2811	0.0701	0.2100	0.0181	0.0699	0.0350	0.2806
COV	0.012	0.003	0.007	0.005	0.023	0.013	0.005	0.004

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2099	0.0180	0.0700	0.0349	0.2811
COV	0.003	0.001	0.003	0.001	0.006	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	0.2811	0.0694	0.2101	0.0179	0.0701	0.0351	0.2811
COV	0.013	0.003	0.011	0.005	0.014	0.010	0.011	0.003

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0699	0.2100	0.0180	0.0699	0.0349	0.2811
COV	0.005	0.001	0.003	0.001	0.005	0.002	0.003	0.001

Data Persistence Test

Clause 6

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

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

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

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

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

Clause 9.4.3.8

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

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

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 68.

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	77,139,584
Total Number of Logical Blocks Verified	47,495,104
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	10 minutes
Size in Bytes of each Logical Block	512
Number of Failed I/O Requests in the process of the Test	0

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

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 9.2.4.9

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™ S5600 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™ S5600 .

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.

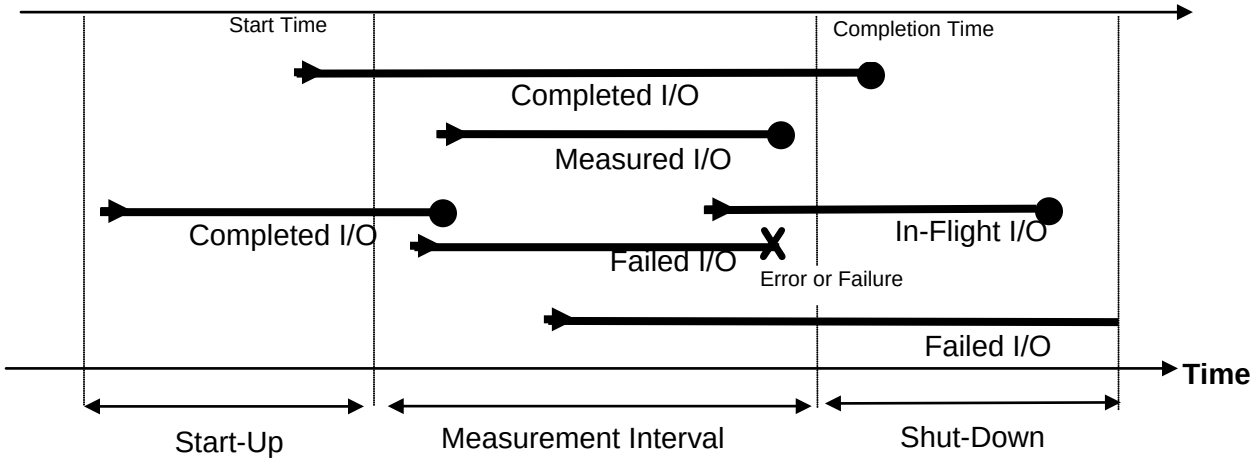
Test: A collection of Test Phases and or Test Runs sharing a common objective.

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

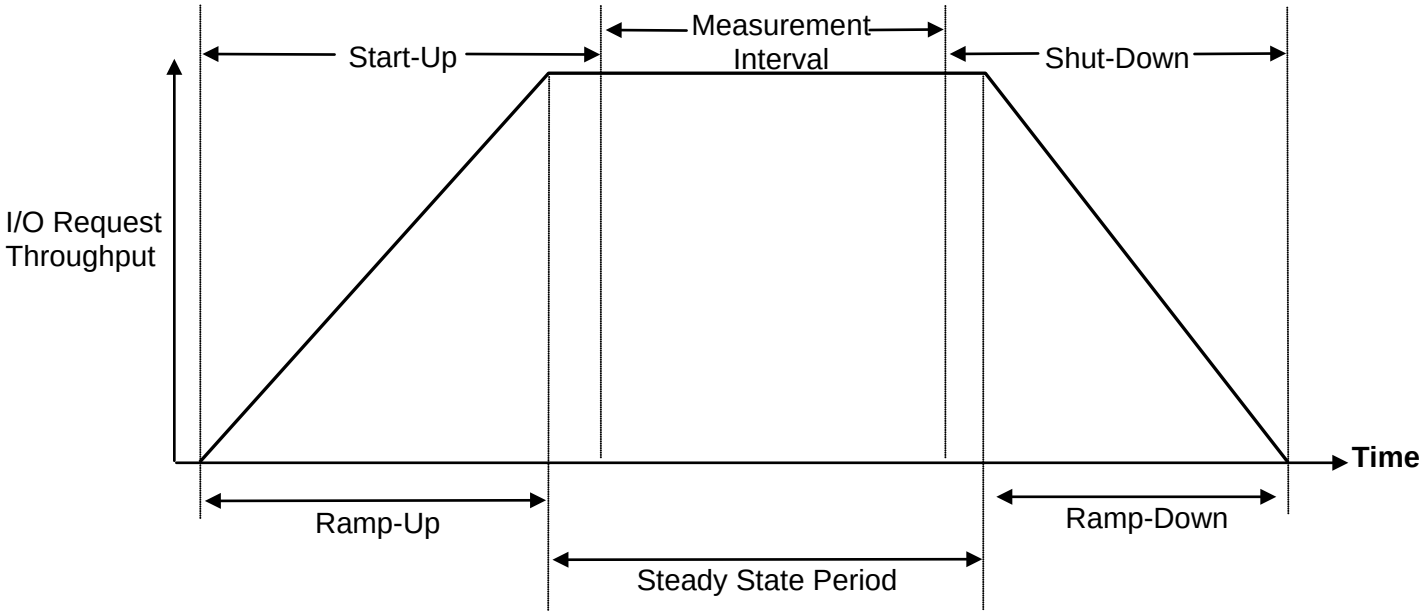
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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

Windows 2003 Server

The execution throttle, **queue depth**, was changed from a default value of 16 to 256 for each HBA in the configuration.

S5600 Storage System

Enable **write cache with mirroring** for all of the SPC-1 Logical Volumes

Set the cache high-low watermarks: **low watermark** is 70% and **high watermark** is 90%

Set the read cache policy to **intelligent prefetch**

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

Create RAID10 LUNs

The **makelun.script** script creates twelve (12) RAID10 groups with one (1) LUN in each group. The twelve LUNs are mapped to the two Host Systems.

makelun.script

```
createrg -n RAID10_1 -l 10 -m 2 -d 0,0:0,1:0,4:0,5:0,6:0,7:
createrg -n RAID10_2 -l 10 -m 2 -d 0,2:0,3:0,8:0,9:0,10:0,11:
createrg -n RAID10_3 -l 10 -m 2 -d 1,0:1,1:1,2:1,3:1,4:1,5:1,6:1,7:1,8:1,9:1,10:1,11:
createrg -n RAID10_4 -l 10 -m 2 -d 1,12:1,13:1,14:1,15:1,16:1,17:1,18:1,19:1,20:1,21:1,22:1,23:
createrg -n RAID10_5 -l 10 -m 2 -d 2,0:2,1:2,2:2,3:2,4:2,5:2,6:2,7:2,8:2,9:2,10:2,11:
createrg -n RAID10_6 -l 10 -m 2 -d 2,12:2,13:2,14:2,15:2,16:2,17:2,18:2,19:2,20:2,21:2,22:2,23:
createrg -n RAID10_7 -l 10 -m 2 -d 3,0:3,1:3,2:3,3:3,4:3,5:3,6:3,7:3,8:3,9:3,10:3,11:
createrg -n RAID10_8 -l 10 -m 2 -d 3,12:3,13:3,14:3,15:3,16:3,17:3,18:3,19:3,20:3,21:3,22:3,23:
createrg -n RAID10_9 -l 10 -m 2 -d 4,0:4,1:4,2:4,3:4,4:4,5:4,6:4,7:4,8:4,9:4,10:4,11:
createrg -n RAID10_10 -l 10 -m 2 -d 4,12:4,13:4,14:4,15:4,16:4,17:4,18:4,19:4,20:4,21:4,22:4,23:
createrg -n RAID10_11 -l 10 -m 2 -d 5,0:5,1:5,2:5,3:5,4:5,5:5,6:5,7:5,8:5,9:5,10:5,11:
createrg -n RAID10_12 -l 10 -m 2 -d 5,12:5,13:5,14:5,15:5,16:5,17:5,18:5,19:5,20:5,21:5,22:5,23:

createlun -i 0 -n LUN_1 -s 378880 -u 256 -c A -w 1 -m 1 -p 3
createlun -i 1 -n LUN_2 -s 378880 -u 256 -c B -w 1 -m 1 -p 3
createlun -i 2 -n LUN_3 -s 675840 -u 512 -c A -w 1 -m 1 -p 3
createlun -i 3 -n LUN_4 -s 675840 -u 512 -c B -w 1 -m 1 -p 3
createlun -i 4 -n LUN_5 -s 675840 -u 512 -c A -w 1 -m 1 -p 3
createlun -i 5 -n LUN_6 -s 675840 -u 512 -c B -w 1 -m 1 -p 3
createlun -i 6 -n LUN_7 -s 675840 -u 512 -c A -w 1 -m 1 -p 3
createlun -i 7 -n LUN_8 -s 675840 -u 512 -c B -w 1 -m 1 -p 3
createlun -i 8 -n LUN_9 -s 675840 -u 512 -c A -w 1 -m 1 -p 3
createlun -i 9 -n LUN_10 -s 675840 -u 512 -c B -w 1 -m 1 -p 3
createlun -i 10 -n LUN_11 -s 675840 -u 512 -c A -w 1 -m 1 -p 3
createlun -i 11 -n LUN_12 -s 675840 -u 512 -c B -w 1 -m 1 -p 3

addmap -gi 0 -dl 0
addmap -gi 0 -dl 1
addmap -gi 0 -dl 2
addmap -gi 0 -dl 3
addmap -gi 0 -dl 4
addmap -gi 0 -dl 5
addmap -gi 0 -dl 6
addmap -gi 0 -dl 7
addmap -gi 0 -dl 8
addmap -gi 0 -dl 9
addmap -gi 0 -dl 10
addmap -gi 0 -dl 11
```

Create the SPC-1 Logical Volumes

The following steps define the Windows partitions, volumes, and stripe sets used in this SPC-1 configuration.

1. Execute **doSPC.bat**, which performs the following steps:

- Create twelve primary partitions, one per RAID10 LUN, using **align.script**. Each partition will have a starting offset of 32768 and utilize all of the remaining capacity in the LUN.
- Convert the RAID10 LUNs to Dynamic Disks using **convertDynamic.script**.
- Perform the following using **createVolumes.script**:
  - Create a Windows striped (RAID 0) volume using all twelve 32 MB volumes.
  - Delete the large volume on each of the Dynamic Disks.
  - Create a Windows striped (RAID 0) volume for ASU3
    - Select the following disks: disk1, disk2
    - Set capacity to 368640MB
    - Assign drive letter "E" to the volume and do not format.
  - Create a Windows striped (RAID 0) volume for ASU1
    - Select the following disks: disk3, disk4, disk5, disk6, disk7, disk8, disk9, disk10, disk11, disk12
    - Set capacity to 331776MB
    - Assign drive letter "F" to the volume and do not format.
  - Create a Windows striped (RAID 0) volume for ASU2
    - Select the following disks: disk3, disk4, disk5, disk6, disk7, disk8, disk9, disk10, disk11, disk12
    - Set capacity to 331776MB
    - Assign drive letter "G" to the volume and do not format.

2. Reboot the two Host Systems.
3. Using the Windows Disk Administrator on each Host System, import foreign disks or reactivate the Windows stripe sets as necessary.
4. On the second Host System , assign drive letters to the stripe sets as documented above (**createVolumes.script**).

doSPC.bat

```
@echo ********************************************************
@echo * Warning make sure your boot device is PhysicalDrive 0 *
@echo ********************************************************

timeout /t 15 /NOBREAK
diskpart /s align.script
timeout /t 15 /NOBREAK
diskpart /s convertDynamic.script
timeout /t 15 /NOBREAK
diskpart /s createVolumes.script
```

align.script

```
select disk 1
create partition primary align=32768
select disk 2
create partition primary align=32768
select disk 3
create partition primary align=32768
select disk 4
create partition primary align=32768
select disk 5
create partition primary align=32768
select disk 6
create partition primary align=32768
select disk 7
create partition primary align=32768
select disk 8
create partition primary align=32768
select disk 9
create partition primary align=32768
select disk 10
create partition primary align=32768
select disk 11
create partition primary align=32768
select disk 12
create partition primary align=32768
```

convertDynamic.script

```
select disk 1
convert dynamic noerr
select disk 2
convert dynamic noerr
select disk 3
convert dynamic noerr
select disk 4
convert dynamic noerr
select disk 5
convert dynamic noerr
select disk 6
convert dynamic noerr
select disk 7
convert dynamic noerr
select disk 8
convert dynamic noerr
select disk 9
convert dynamic noerr
select disk 10
convert dynamic noerr
select disk 11
convert dynamic noerr
select disk 12
convert dynamic noerr
```

createVolumes.script

```
create volume stripe disk=1,2,3,4,5,6,7,8,9,10,11,12
assign letter=D

list volume

select volume 0
delete volume noerr
select volume 1
delete volume noerr
select volume 2
delete volume noerr
select volume 3
delete volume noerr
select volume 4
delete volume noerr
select volume 5
delete volume noerr
select volume 6
delete volume noerr
select volume 7
delete volume noerr
select volume 8
delete volume noerr
select volume 9
delete volume noerr
select volume 10
delete volume noerr
select volume 11
delete volume noerr

create volume stripe size=368640 disk=1,2
assign letter=E
create volume stripe size=331776 disk=3,4,5,6,7,8,9,10,11,12
assign letter=F
create volume stripe size=331776 disk=3,4,5,6,7,8,9,10,11,12
assign letter=G
```

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

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

```
host=master
slaves=(slave1,slave2,slave3,slave4,slave5,slave6,slave7)
sd=asu1_1,lun=\\.\F:,size=3240g
sd=asu2_1,lun=\\.\G:,size=3240g
sd=asu3_1,lun=\\.\E:,size=720g
```

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

```
sd=asu1_1,lun=\\.\F:,size=3240g
sd=asu2_1,lun=\\.\G:,size=3240g
sd=asu3_1,lun=\\.\E:,size=720g
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

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

The following script 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.

```
cd "c:\spc\spc1"
copy /Y c:\spc\spc1\spc1_metrics.cfg c:\spc\spc1\spc1.cfg
java -Xmx1024m -Xss256k metrics -b 680 -t 10860 -r 660
java -Xmx1024m -Xss256k repeat1 -b 680 -t 660
java -Xmx1024m -Xss256k repeat2 -b 680 -t 660
copy /Y c:\spc\spc1\spc1_persist.cfg c:\spc\spc1\spc1.cfg
java -Xmx1024m -Xss256k persist1 -b 680
```

Persistence Test Run 2

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

```
cd "c:\spc\spc1"
java -Xmx1024m -Xss256k persist2
```

Slave JVM Initiation

Each of the Slave JVMs on each Host System was initiated by a command and corresponding parameter file. An example of the command and corresponding parameter file appear below.

Slave1.bat

```
cd "c:\spc\spc1"
java -Xmx1024m -Xss256k spc1 -f c:\spc\spc1\slave1.txt
```

Slave1.txt

```
master=localhost
host=slave1
sd=asu1_1,lun=\\.\F:,size=3240g
sd=asu2_1,lun=\\.\G:,size=3240g
sd=asu3_1,lun=\\.\E:,size=720g
```