ORACLE

SPC BENCHMARK 1C™
FULL DISCLOSURE REPORT

ORACLE CORPORATION
SUN STORAGE F5100 FLASH ARRAY

SPC-1C™ V1.3

Submitted for Review: April 13, 2010
Submission Identifier: C00010

First Edition – April 2010

Trademarks

Table of Contents

AUDIT CERTIFICATION

Steven A. Johnson
Oracle Corporation
500 Eldorado Blvd. UBRM05-194
Broomfield, CO 80021

April 12, 2010

The SPC Benchmark 1C™ results listed below for the Sun Storage F5100 Flash Array were produced in compliance with the SPC Benchmark 1C™ V1.3 Audit requirements.

SPC Benchmark 1C™ V1.3 Results	
Tested Storage Product: Sun Storage F5100 Flash Array	
Metric	**Reported Result**
SPC-1C IOPS™	300,873.47
Total ASU Capacity	1,374.390 GB
Data Protection Level	Unprotected
Total Price – Priced Storage Configuration	$151,381

The following SPC Benchmark 1C™ Audit requirements were reviewed and found compliant with V1.3 of the SPC Benchmark 1C™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by information supplied by Oracle Corporation:
  - ✓ 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).
- Verification of the components to match the above diagram.
- 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
AuditService@storageperformance.org
650.556.9384

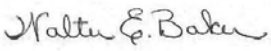
AUDIT CERTIFICATION *(CONT.)*

- SPC-1C Workload Generator commands and parameters used for the audited SPC-1C Test Runs.
- The following Host System requirements were verified by information supplied by Oracle Corporation:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the SPC-1C Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The Test Results Files and resultant Summary Results Files for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4, 5 and 6 of the SPC-1C 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 Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 9 of the SPC-1C Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 10 of the SPC-1C Benchmark Specification.
- This successfully audited SPC measurement is not subject to an SPC Confidential Review.

Audit Notes:

There were no audit notes or exceptions.

Respectfully,



Walter E. Baker
SPC Auditor

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LETTER OF GOOD FAITH

ORACLE

Date: April 5, 2010

From: Lisa Sieker

To: Walter Baker

Subject: SPC-1C Letter of Good Faith for Oracle's Sun Storage F5100 Flash Array

Oracle Corporation is the SPC-1C Test Sponsor of the above listed product. To the best of our knowledge and belief, the required SPC-1C benchmarks results and materials we have submitted for that product are complete, accurate and in full compliance with V1.3 of the SPC-1C benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark necessary to reproduce the reported results even if the items are not explicitly required to be disclosed by the above SPC-1C benchmark specification.

Signed

Lisa K. Sieker
VP, Systems Product Management

4/5/10
Date

Oracle Corporation
4150 Network Circle
Santa Clara, CA 95054

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Oracle Corporation – http://www.oracle.com Steven A. Johnson – steven.a.johnson@oracle.com 500 Eldorado Blvd. UBRM05-194 Broomfield, CO 80021 Phone: (303) 272-9476
Test Sponsor Alternate Contact	Oracle Corporation – http://www.oracle.com Jason Schaffer – Jason.schaffer@oracle.com 500 Eldorado Blvd. Broomfield, CO 80021 Phone: (303) 272-4743 FAX: (303) 272-9704
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-1C Specification revision number	V1.3
SPC-1C Workload Generator revision number	V1.0
Date Results were first used publicly	April 13, 2010
Date the FDR was submitted to the SPC	April 13, 2010
Date the TSC is available for shipment to customers	currently available
Date the TSC completed audit certification	April 12, 2010

Tested Storage Product (TSP) Description

Oracle's Sun Storage F5100 Flash Array is a high performance, high density, solid state flash array with up to 1.92TB of capacity in a single 1RU (1.25 inches) rack enclosure.

The F5100 is designed to accelerate IO-intensive applications, such as databases, in a 1 U space.It's based on enterprise-class SLC flash technology, with advanced wear-leveling, integrated power loss protection for write persistence, solid state robustness and 3M MTBF hour reliability.

Each F5100 can be configured with up to 80 - 24GB SATA enterprise-class Flash Modules.

Additionally, each F5100 comes with

- Four hard SAS domains
- Sixteen 4-wide mini SAS-1 ports

- Two 720W hot swappable power supplies
- Hot swappable cooling fans.
- Four SuperCap based Energy Storage Modules
- Two 3M SAS mini cables
- Rack Rail kit
- Downloadable Common Array Management software

Summary of Results

SPC-1C Results	
Tested Storage Product: Sun Storage F5100 Flash Array	
Metric	**Reported Result**
SPC-1C IOPS™	300,873.47
Total ASU Capacity	1,374.390 GB
Data Protection Level	Unprotected
Total Price – Priced Storage Configuration	$151,381

SPC-1C 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-1C benchmark.

A **Data Protection Level** of ***Unprotected*** provides no data protection in the event of a single point of failure.

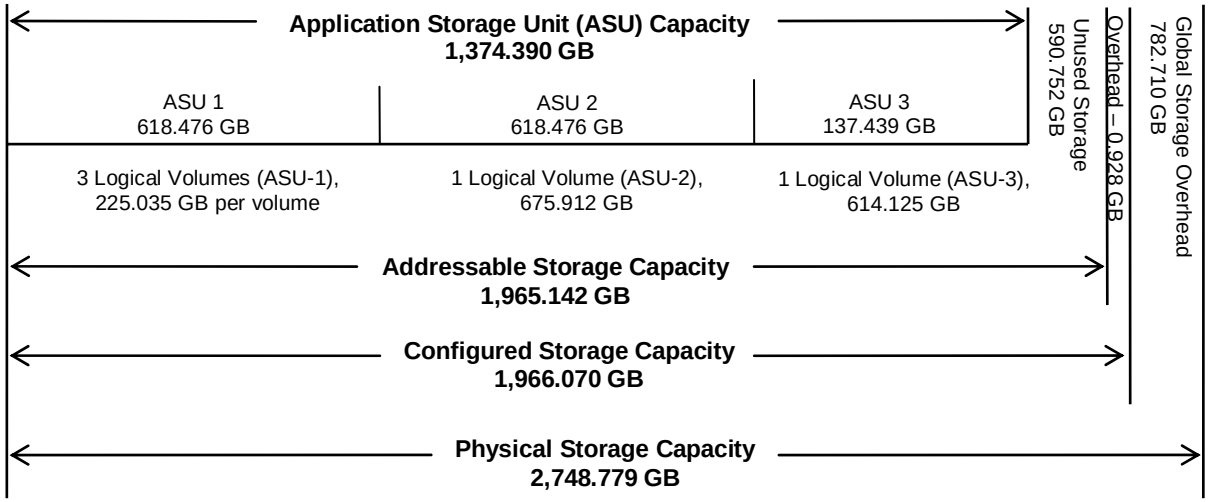
Storage Capacities and Relationships

The Tested Storage Configuration (TSC) must be configured so that there is either no Unused Storage or that the sum of Total ASU Capacity and storage required for data protection equals 50% (+-1 GiB) of the Physical Storage Capacity. This configuration meets the 50% requirement as documented below:

2,743.779 GB *(Physical Storage Capacity)* *** 0.5 = 1,374.390 GB**

1,374.390 GB *(Total ASU Capacity)* **+ 0.000 GB *(data protection)* = 1,374.390 GB**

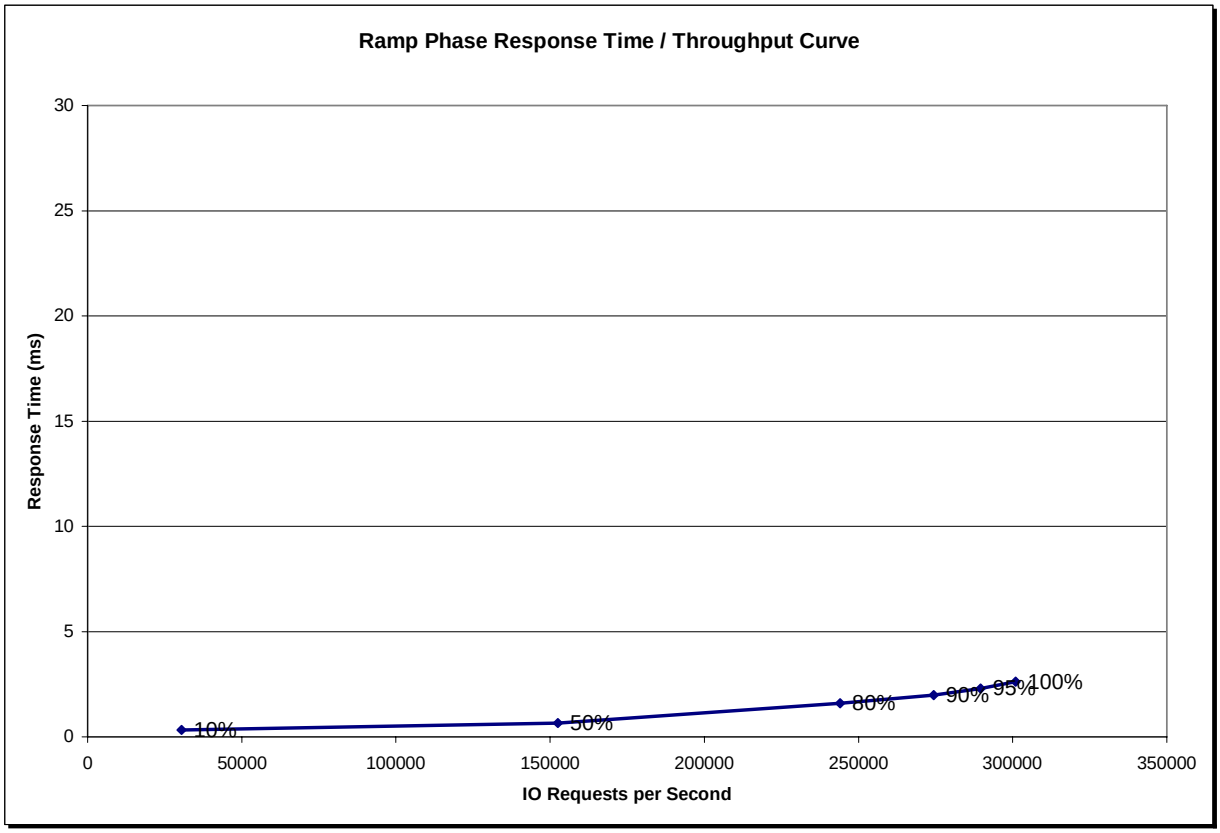
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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-1C 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	30,509.00	152,496.44	243,983.73	274,436.11	289,639.61	300,873.47
Average Response Time (ms):						
All ASUs	0.33	0.66	1.60	1.98	2.29	2.63
ASU-1	0.36	0.77	1.88	2.29	2.58	2.85
ASU-2	0.35	0.75	1.85	2.26	2.55	2.82
ASU-3	0.26	0.39	0.89	1.20	1.55	2.07
Reads	0.45	0.90	2.11	2.55	2.86	3.15
Writes	0.25	0.50	1.27	1.61	1.92	2.29

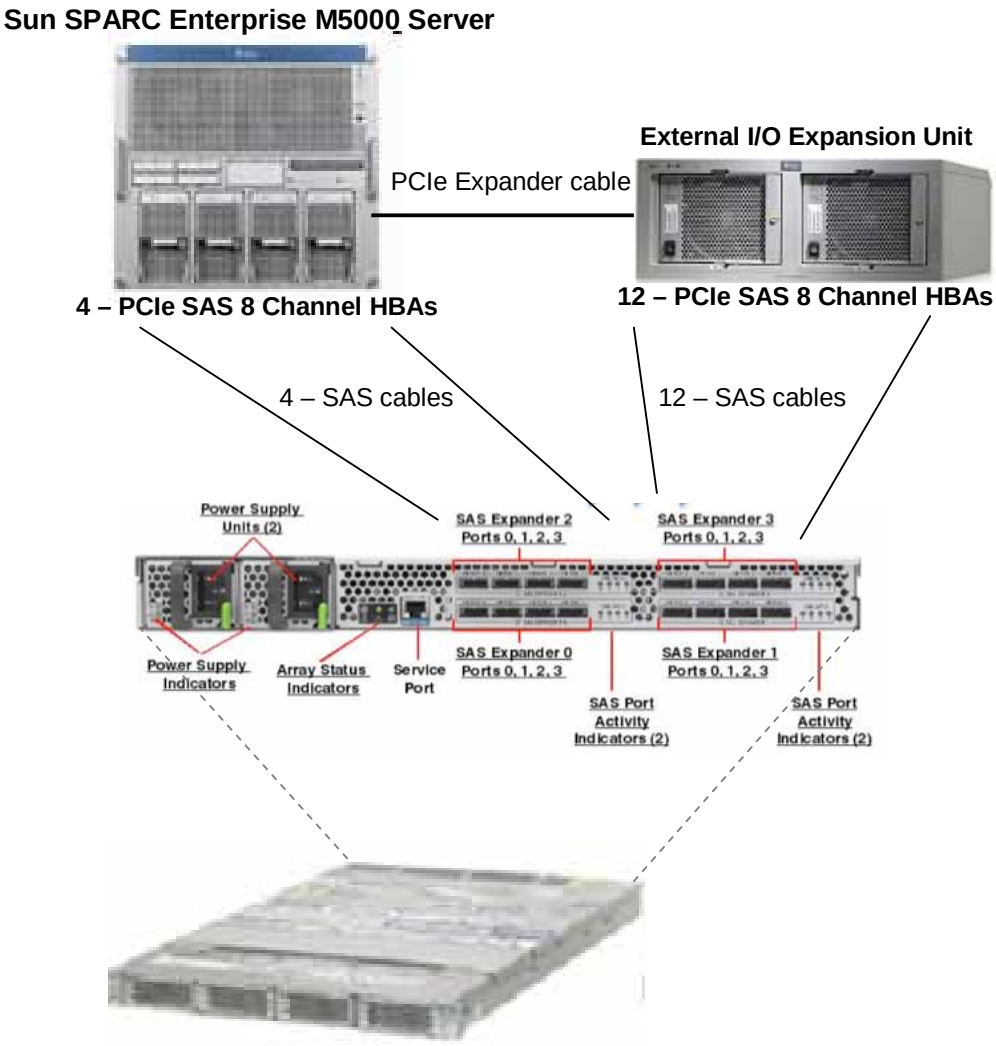
Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Part Number	Description	Quantity	US List	Total	discount	Ave. Price
TA5100RASA4-80AA-N	1.92TB solid state Flash array with 80 x 24GB SATA enterprise-class SLC Flash modules, 16 x 4-wide 3Gb/s SAS ports, 2 x 720W Power Supplies, rail kit, cable management arm, 2 x SAS cable (3m), 4 x Energy Storage Modules, Common Array Management software (download), ROHS-6 compliant	1	$159,995	$159,995	35%	$103,997
SG-XPCIE8SAS-E-Z-N	Sun StorageTek (TM) 8-Port external SAS PCI-Express Host Bus Adapter. RoHS 6.	16	$550	$8,800	35%	$5,720
XTA-3.0M-SAS-N	Sun Storage 3.0m, mini, shielded, SAS cable; For connection between array and host; RoHS-6	14	$175	$2,450	35%	$1,593
	Oracle Premium Bumper-Bumper Service: 1-Year 7/24, 2 hour response time.	3	$13,357.11	$40,071	0%	$40,071
				$211,316		**$151,381**

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

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

Benchmark Configuration/Tested Storage Configuration Diagram



Benchmark Configuration/Tested Storage Configuration Components

<table>
<tr><th>Host System:</th><th>Tested Storage Configuration (TSC):</th></tr>
<tr><td rowspan="2">Sun SPARC Enterprise M5000 Server
8 – 2.53 GHz SPARC64 VII Quad Core processors
4 – SPARC V9 cores per processor
ECC protected 5 MB shared L2 on chip cache per processor
64 K I-Cache and 64 KB D-Cache L1 per core</td><td>16 – Sun StorageTek™ PCI Express SAS 8-Channel HBAs</td></tr>
<tr><td>Sun Storage F5100 Flash Array
16 – 4-wide mini SAS-1 ports
2 – 3m mini SAS cables
80 – 24 GB SATA enterprise-class SLC Flash modules</td></tr>
<tr><td>64 GB – main memory</td><td>14 – 3.0m mini SAS cables</td></tr>
<tr><td>Solaris 10 10/09 s101s_u8wos__08a SPARC</td><td rowspan="3"></td></tr>
<tr><td>PCIe</td></tr>
<tr><td>External I/O Expansion Unit</td></tr>
</table>

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-1C 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 10.4.5.10

The Executive Summary will contain a one page BC/TSC diagram that illustrates all major components of the BC/TSC.

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 15 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Host System and Tested Storage Configuration

Clause 10.4.5.11

The Executive Summary will contain a table that lists the major components of each Host System and the Tested Storage Configuration (TSC).

The table listing the major components of each Host System and the Tested Storage Configuration may be found on page 15 *(Benchmark Configuration/Tested Storage Configuration Components).*

Customer Tunable Parameters and Options

Clause 10.4.6.1

All Benchmark Configuration (BC) components with customer tunable parameters and options that have been altered from their default values must be listed in the Full Disclosure Report (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 60 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

Tested Storage Configuration (TSC) Description

Clause 10.4.6.2

The Full Disclosure Report must include sufficient information to recreate the logical representation of the Tested Storage Configuration (TS)C. In addition to customer tunable parameters and options (Clause 10.4.6.1), 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 10.4.5.10.*

  - *The logical representation of the TSC, configured from the above components that will be presented to the SPC-1C Workload Generator.*
- *Listings of scripts used to create the logical representation of the TSC.*
- *If scripts were not used, a description of the process used with sufficient detail to recreate the logical representation of the TSC.*

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

SPC-1C Workload Generator Storage Configuration

Clause 10.4.6.3

The Full Disclosure Report will include all SPC-1C Workload Generator storage configuration commands and parameters used in the SPC-1C benchmark measurements.

The SPC-1C Workload Generator storage configuration commands and parameters for this measurement appear in "Appendix D: SPC-1C Workload Generator Storage Commands and Parameters" on page 91.

SPC-1C DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1C storage capacities and mappings used in the Tested Storage Configuration. "SPC-1C Data Repository Definitions" on page 56 contains definitions of terms specific to the SPC-1C Data Repository.

Storage Capacities and Relationships

Clause 10.4.7.1

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

SPC-1C Storage Capacities

SPC-1C Storage Capacities		
Storage Hierarchy Component	**Units**	**Capacity**
Total ASU Capacity	Gigabytes (GB)	1,374.390
Addressable Storage Capacity	Gigabytes (GB)	1,965.142
Configured Storage Capacity	Gigabytes (GB)	1,966.070
Physical Storage Capacity	Gigabytes (GB)	2,748.779
Data Protection *(Unprotected)*	Gigabytes (GB)	0.000
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	782.710
Total Unused Storage	Gigabytes (GB)	590.752

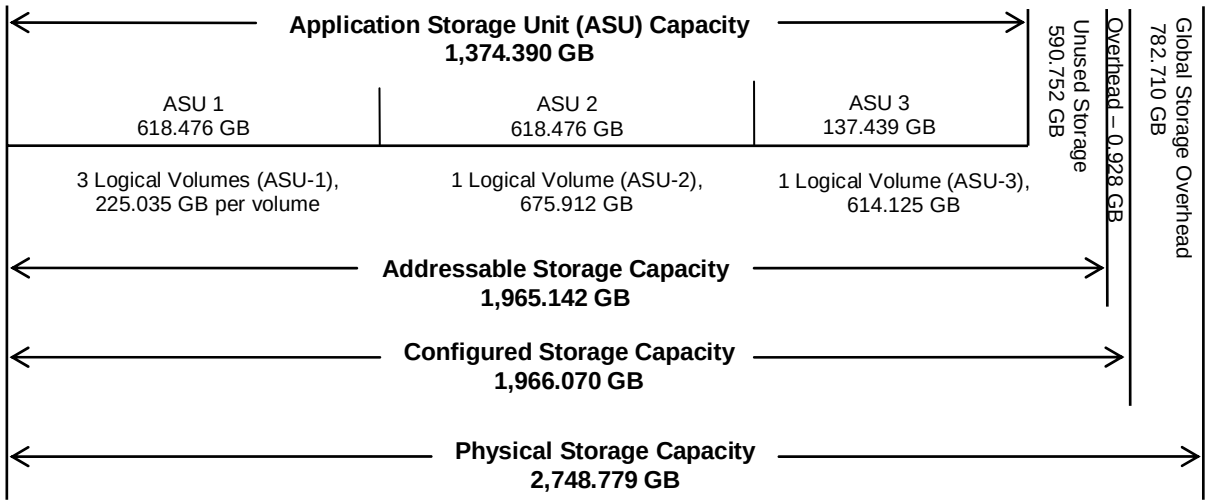
SPC-1C Storage Hierarchy Ratios

	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	69.94%	69.91%	50.00%
Required for Data Protection *(RAID-5 parity)*		0.00%	0.00%
Addressable Storage Capacity		99.95%	71.49%
Required Storage		0.00%	0.00%
Configured Storage Capacity			71.53%
Global Storage Overhead			28.47%
Unused Storage:			
Addressable	30.06%		
Configured		0.00%	
Physical			0.00%

The Physical Storage Capacity consisted of 2,748.779 GB distributed over 80 SATA enterprise-class SLC Flash modules each with a "raw" capacity of 34.360 GB. There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 782.710 GB (28.47%) of Physical Storage Capacity. There was 0.000 GB (0.00%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 69.94% of the Addressable Storage Capacity resulting in 590.752 GB (30.06%) of Unused Storage within the Addressable Storage Capacity.

SPC-1C 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 10.4.7.2

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 2.7) used on each Logical Volume.

Logical Volume Capacity and Mapping		
ASU-1 (618.476 GB)	**ASU-2 (618.476 GB)**	**ASU-3 (137.439 GB)**
3 Logical Volume 225.035 GB per Logical Volume (206.159 GB used per Logical Volume)	1 Logical Volume 675.912 GB per Logical Volume (618.476 GB used per Logical Volume)	1 Logical Volume 614.125 GB per Logical Volume (137.439 GB used per Logical Volume)

There was no data protection used for the Logical Volumes as described on page 12. See "ASU Configuration" in the **IOPS Test Results File** for more detailed configuration information.

SPC-1C BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1C Tests, Test Phases, and Test Runs. "SPC-1C Test Execution Definitions" on page 57 contains definitions of terms specific to the SPC-1C Tests, Test Phases, and Test Runs.

Clause 6.4.2

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 selected Test sequence. If the selected Test sequence is interrupted, the SPC-1C measurement is invalid. This does not apply to the interruption caused by the Host System / TSC power cycle between Persistence Test Run 1 and Persistence Test Run 2.

SPC-1C Tests, Test Phases, and Test Runs

The SPC-1C 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 6.4.3.2

The Sustainability Test Phase has exactly one Test Run and shall demonstrate the maximum sustainable I/O Request Throughput within a continuous one (1) hour Measurement Interval.

Clause 6.4.3.2.6

The computed I/O Request Throughput of the Sustainability Test Run must be no less than 95% of the reported SPC-1C IOPS™ result or the Test Run is invalid.

Clause 6.4.3.2.7

The Average Response Time, as defined in Clause 0, will be computed and reported for the Sustainability Test Run and cannot exceed 30 milliseconds. If the Average Response Time exceeds that 30-millisecond constraint, the Test Run is invalid.

Clause 10.4.8.1

The FDR shall contain the following for the single Test Run in the Sustainability/IOPS Test Phase:

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-1C Workload Generator Input Parameters

The SPC-1C Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1C Workload Generator Input Parameters" on Page 92.

Sustainability Test Results File

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

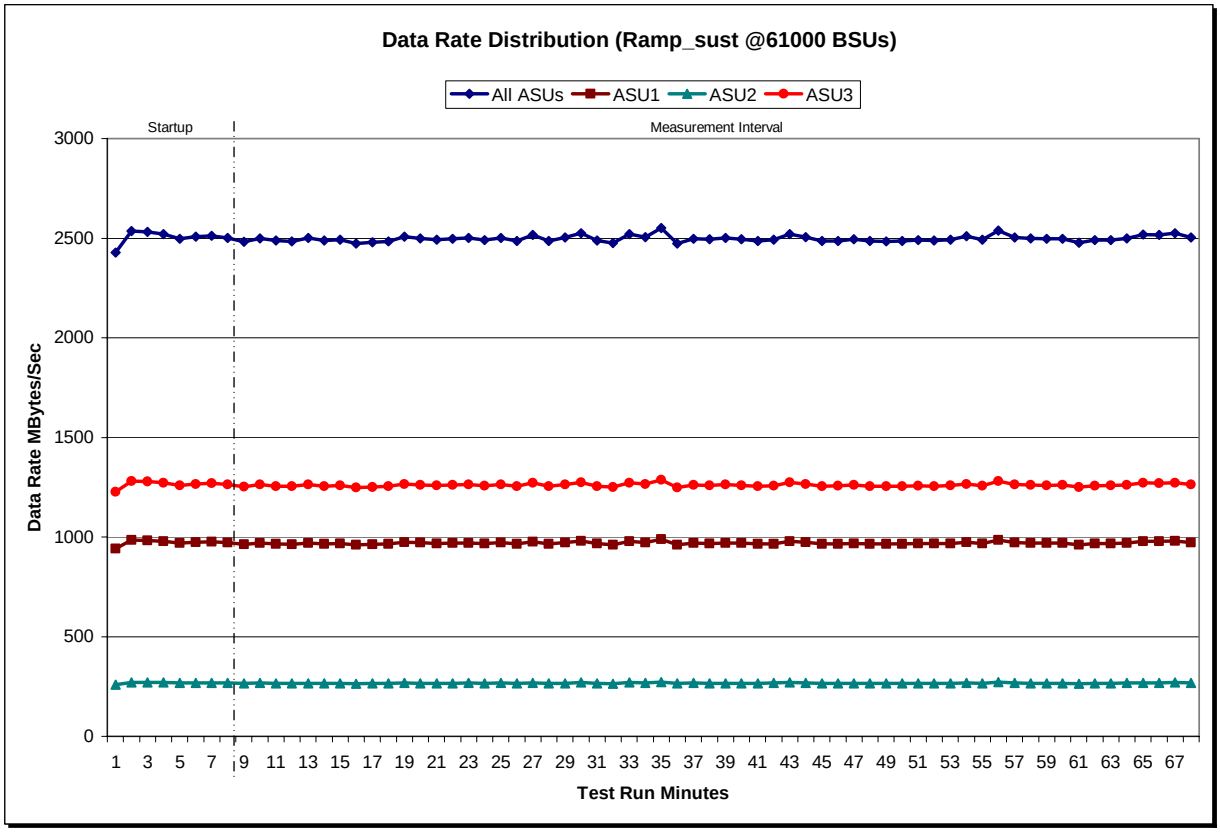
Sustainability Test Results File

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

Ramp-Up/Start-Up	19:07:57	19:15:57	0-7	0:08:00
Measurement Interval	19:15:57	20:15:58	8-67	1:00:01

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	2,426.66	941.42	259.28	1,225.97	34	2,550.09	990.09	272.80	1,287.20
1	2,535.00	984.39	270.76	1,279.85	35	2,473.53	960.15	264.63	1,248.75
2	2,531.54	983.38	270.22	1,277.94	36	2,497.62	970.12	267.19	1,260.31
3	2,519.72	979.06	269.21	1,271.46	37	2,494.26	968.12	266.36	1,259.79
4	2,496.42	969.96	266.75	1,259.71	38	2,500.14	970.34	266.57	1,263.22
5	2,507.40	973.79	267.75	1,265.87	39	2,494.67	969.36	266.73	1,258.58
6	2,512.84	975.34	268.06	1,269.44	40	2,485.25	965.90	264.92	1,254.43
7	2,501.68	971.70	266.80	1,263.18	41	2,491.39	966.41	267.02	1,257.96
8	2,482.36	964.03	265.39	1,252.94	42	2,520.81	977.90	269.22	1,273.69
9	2,499.20	969.89	266.88	1,262.44	43	2,506.16	973.01	267.39	1,265.76
10	2,487.61	966.31	265.74	1,255.57	44	2,485.80	965.21	265.83	1,254.77
11	2,483.92	964.34	265.60	1,253.98	45	2,486.64	964.99	265.25	1,256.40
12	2,500.26	969.88	266.42	1,263.96	46	2,494.82	967.93	266.51	1,260.38
13	2,487.20	966.02	265.36	1,255.81	47	2,486.82	966.32	265.59	1,254.91
14	2,492.94	967.83	266.07	1,259.05	48	2,484.47	964.37	265.44	1,254.66
15	2,472.16	960.52	264.17	1,247.47	49	2,486.89	965.85	265.73	1,255.31
16	2,479.60	964.18	265.14	1,250.28	50	2,489.61	967.64	265.82	1,256.15
17	2,483.80	964.60	265.37	1,253.83	51	2,488.52	966.85	265.96	1,255.71
18	2,506.84	973.82	267.51	1,265.51	52	2,491.93	967.60	265.81	1,258.51
19	2,499.82	970.89	266.65	1,262.28	53	2,508.69	974.42	268.18	1,266.10
20	2,492.86	968.47	265.90	1,258.48	54	2,491.61	967.53	266.63	1,257.44
21	2,497.11	969.97	266.68	1,260.46	55	2,538.08	985.27	271.62	1,281.19
22	2,500.18	970.12	266.93	1,263.12	56	2,502.49	971.23	267.38	1,263.88
23	2,489.56	966.84	265.54	1,257.18	57	2,497.93	970.45	266.66	1,260.83
24	2,501.81	971.60	267.56	1,262.66	58	2,496.14	969.91	266.73	1,259.51
25	2,485.86	965.67	265.65	1,254.55	59	2,497.69	970.04	266.63	1,261.02
26	2,517.18	977.24	268.81	1,271.12	60	2,477.19	961.99	264.19	1,251.00
27	2,485.13	964.58	265.19	1,255.36	61	2,491.17	968.10	265.90	1,257.18
28	2,503.68	972.88	266.59	1,264.21	62	2,491.14	966.57	265.96	1,258.61
29	2,523.96	979.77	269.36	1,274.83	63	2,498.26	969.69	267.03	1,261.54
30	2,487.93	966.93	265.70	1,255.29	64	2,518.31	978.28	268.81	1,271.23
31	2,475.94	961.68	264.07	1,250.18	65	2,516.34	978.02	268.85	1,269.47
32	2,520.08	978.14	268.91	1,273.03	66	2,523.90	980.79	270.51	1,272.60
33	2,505.92	972.78	267.38	1,265.76	67	2,502.27	971.19	267.15	1,263.93

Sustainability – Data Rate Distribution Graph

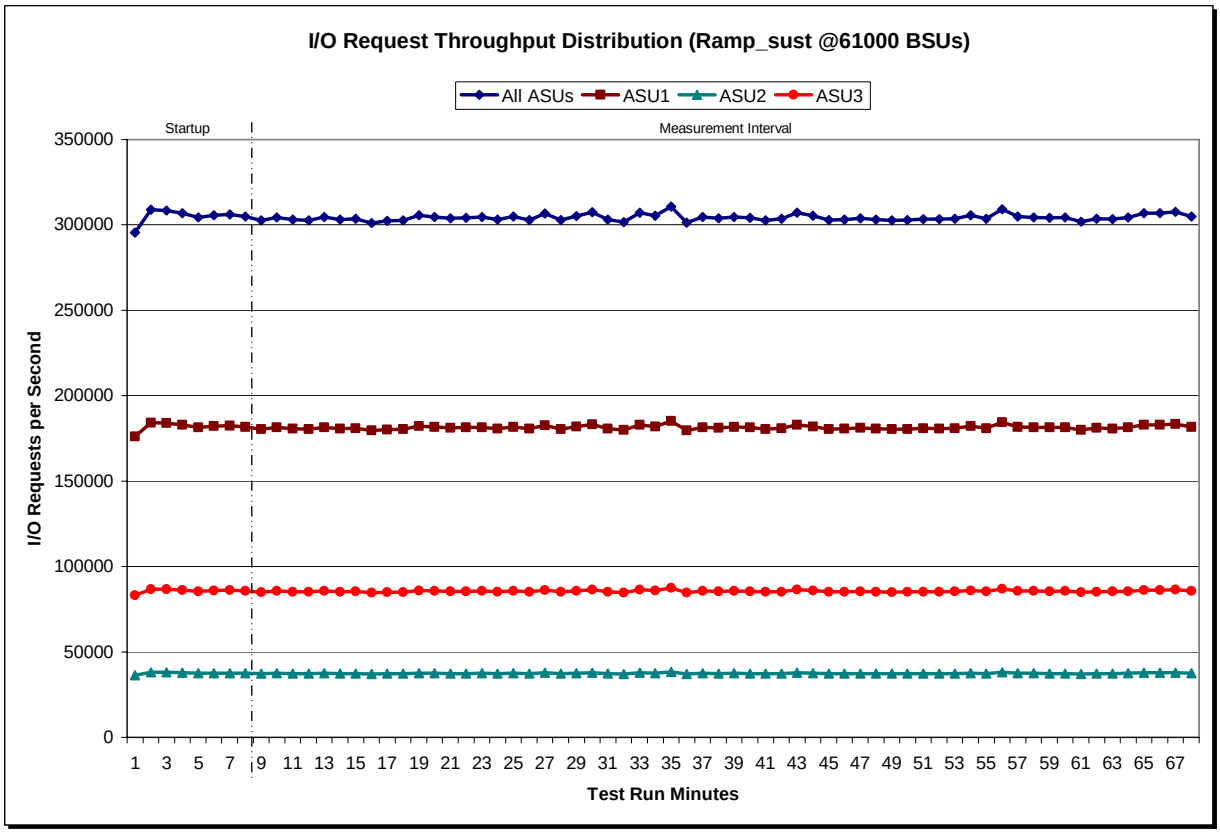


Sustainability – I/O Request Throughput Distribution Data

Ramp-Up/Start-Up	19:07:57	19:15:57	0-7	0:08:00
Measurement Interval	19:15:57	20:15:58	8-67	1:00:01

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	295,621.77	176,136.97	36,349.07	83,135.73	34	310,711.55	185,161.65	38,238.57	87,311.33
1	308,895.35	184,134.70	37,970.15	86,790.50	35	301,309.53	179,572.10	37,052.30	84,685.13
2	308,534.85	183,936.53	37,945.43	86,652.88	36	304,537.52	181,494.67	37,479.45	85,563.40
3	306,873.10	182,892.75	37,751.77	86,228.58	37	303,964.75	181,167.45	37,407.63	85,389.67
4	304,310.98	181,358.05	37,437.22	85,515.72	38	304,674.33	181,631.10	37,464.47	85,578.77
5	305,525.87	182,104.88	37,563.57	85,857.42	39	304,211.13	181,379.93	37,391.25	85,439.95
6	306,186.65	182,429.68	37,664.32	86,092.65	40	302,661.37	180,370.92	37,218.58	85,071.87
7	304,894.43	181,713.60	37,485.12	85,695.72	41	303,521.35	180,855.05	37,380.63	85,285.67
8	302,591.13	180,354.08	37,237.53	84,999.52	42	307,135.42	183,000.08	37,791.30	86,344.03
9	304,439.08	181,422.08	37,449.75	85,567.25	43	305,413.43	182,020.90	37,585.07	85,807.47
10	303,204.53	180,729.05	37,295.33	85,180.15	44	302,811.78	180,482.88	37,283.12	85,045.78
11	302,713.10	180,380.88	37,257.02	85,075.20	45	303,061.05	180,597.57	37,271.05	85,192.43
12	304,600.07	181,475.08	37,454.77	85,670.22	46	303,937.38	181,161.52	37,345.83	85,430.03
13	303,235.82	180,713.20	37,292.17	85,230.45	47	303,060.27	180,647.02	37,279.80	85,133.45
14	303,741.68	180,988.70	37,360.02	85,392.97	48	302,627.83	180,353.68	37,231.43	85,042.72
15	301,224.35	179,538.77	37,029.73	84,655.85	49	302,917.65	180,540.05	37,262.98	85,114.62
16	302,315.58	180,237.97	37,187.17	84,890.45	50	303,422.93	180,876.25	37,322.12	85,224.57
17	302,529.82	180,341.47	37,196.67	84,991.68	51	303,317.03	180,794.12	37,297.35	85,225.57
18	305,528.80	182,081.17	37,576.80	85,870.83	52	303,516.35	180,888.10	37,319.58	85,308.67
19	304,598.10	181,585.78	37,425.92	85,586.40	53	305,690.70	182,179.40	37,595.15	85,916.15
20	303,863.17	181,128.88	37,376.30	85,357.98	54	303,568.15	180,906.72	37,351.57	85,309.87
21	304,260.63	181,351.88	37,418.60	85,490.15	55	309,297.55	184,333.43	38,066.95	86,897.17
22	304,583.68	181,478.73	37,462.62	85,642.33	56	304,849.70	181,676.23	37,523.68	85,649.78
23	303,188.92	180,694.27	37,264.43	85,230.22	57	304,376.42	181,390.93	37,422.47	85,563.02
24	304,856.10	181,708.58	37,531.25	85,616.27	58	304,216.32	181,371.98	37,392.13	85,452.20
25	302,933.22	180,559.27	37,262.70	85,111.25	59	304,480.55	181,481.45	37,403.18	85,595.92
26	306,782.28	182,800.93	37,770.20	86,211.15	60	301,761.50	179,889.78	37,079.75	84,791.97
27	302,787.68	180,452.73	37,223.40	85,111.55	61	303,754.63	181,106.52	37,356.18	85,291.93
28	305,204.65	181,920.75	37,509.22	85,774.68	62	303,358.08	180,747.48	37,301.72	85,308.88
29	307,503.02	183,283.90	37,800.60	86,418.52	63	304,359.83	181,356.10	37,465.97	85,537.77
30	303,104.98	180,678.73	37,282.15	85,144.10	64	306,799.60	182,907.67	37,690.78	86,201.15
31	301,667.35	179,825.30	37,060.63	84,781.42	65	306,965.85	183,012.58	37,774.65	86,178.62
32	307,067.82	182,983.22	37,724.87	86,359.73	66	307,604.30	183,335.10	37,917.35	86,351.85
33	305,345.37	181,976.60	37,524.40	85,844.37	67	304,955.22	181,712.18	37,540.00	85,703.03
					Average	***304,278.70***	***181,351.58***	***37,424.64***	***85,502.49***

Sustainability – I/O Request Throughput Distribution Graph

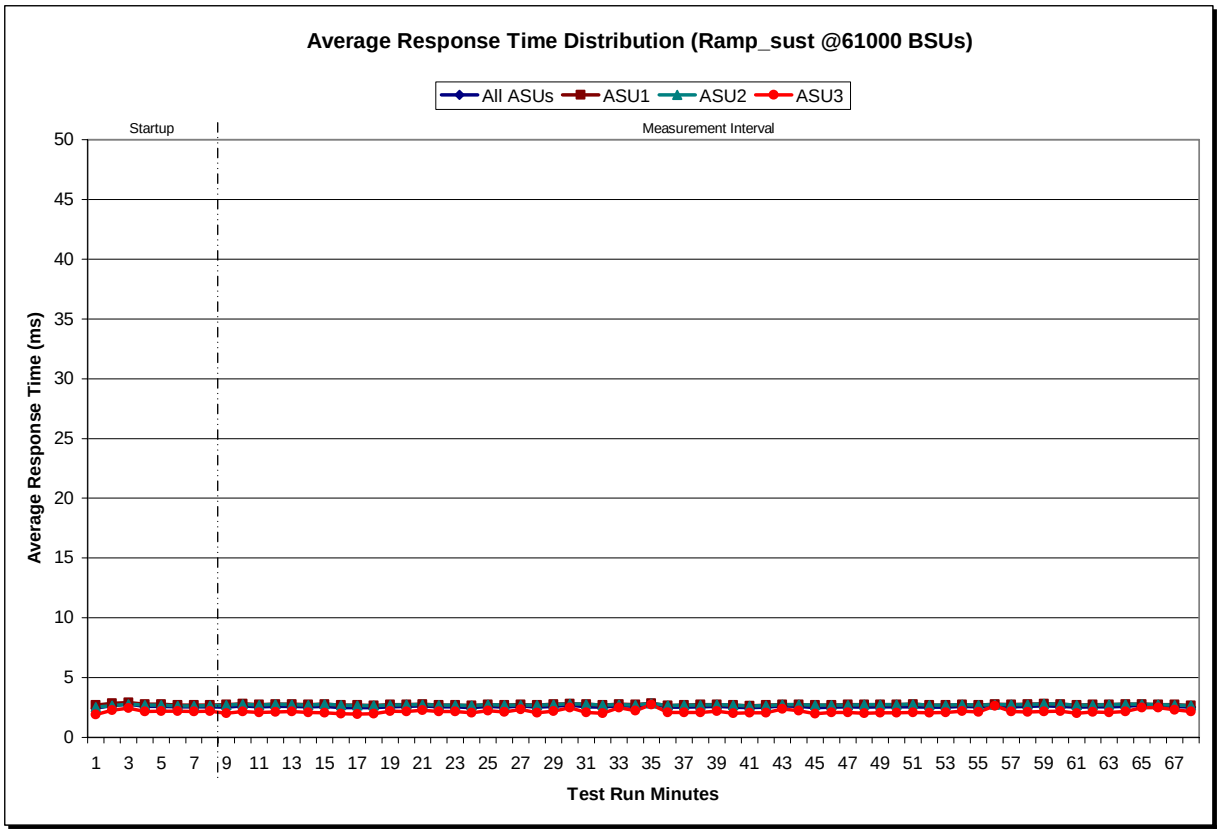


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	19:07:57	19:15:57	0-7	0:08:00
Measurement Interval	19:15:57	20:15:58	8-67	1:00:01

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	2.46	2.70	2.53	1.91	34	2.81	2.85	2.84	2.72
1	2.65	2.83	2.68	2.26	35	2.51	2.68	2.67	2.08
2	2.76	2.91	2.78	2.44	36	2.53	2.71	2.70	2.09
3	2.60	2.79	2.68	2.17	37	2.55	2.73	2.71	2.08
4	2.59	2.77	2.68	2.18	38	2.58	2.74	2.73	2.19
5	2.55	2.69	2.63	2.21	39	2.52	2.71	2.71	2.03
6	2.55	2.70	2.63	2.18	40	2.47	2.64	2.63	2.04
7	2.55	2.71	2.66	2.18	41	2.50	2.68	2.68	2.04
8	2.53	2.75	2.71	2.00	42	2.64	2.75	2.75	2.37
9	2.62	2.80	2.77	2.17	43	2.60	2.74	2.72	2.23
10	2.55	2.73	2.70	2.09	44	2.49	2.69	2.68	1.98
11	2.60	2.78	2.76	2.13	45	2.53	2.70	2.68	2.08
12	2.61	2.78	2.75	2.17	46	2.55	2.73	2.72	2.09
13	2.54	2.73	2.70	2.07	47	2.53	2.74	2.73	2.01
14	2.58	2.78	2.76	2.06	48	2.55	2.74	2.73	2.06
15	2.49	2.70	2.69	1.97	49	2.54	2.74	2.73	2.04
16	2.48	2.69	2.68	1.96	50	2.57	2.77	2.76	2.07
17	2.48	2.68	2.66	1.99	51	2.52	2.71	2.69	2.06
18	2.57	2.72	2.71	2.19	52	2.54	2.71	2.71	2.09
19	2.58	2.74	2.73	2.17	53	2.59	2.75	2.74	2.20
20	2.62	2.76	2.74	2.26	54	2.55	2.72	2.71	2.12
21	2.56	2.71	2.70	2.16	55	2.71	2.76	2.73	2.61
22	2.55	2.71	2.69	2.17	56	2.57	2.74	2.73	2.14
23	2.49	2.67	2.66	2.04	57	2.58	2.76	2.75	2.12
24	2.60	2.75	2.75	2.22	58	2.62	2.80	2.79	2.17
25	2.54	2.70	2.69	2.13	59	2.61	2.77	2.76	2.20
26	2.61	2.72	2.70	2.34	60	2.51	2.71	2.69	2.01
27	2.52	2.71	2.70	2.04	61	2.55	2.73	2.72	2.11
28	2.60	2.76	2.75	2.19	62	2.55	2.74	2.73	2.08
29	2.71	2.80	2.79	2.47	63	2.60	2.78	2.77	2.15
30	2.57	2.76	2.76	2.08	64	2.69	2.77	2.76	2.47
31	2.51	2.71	2.70	2.00	65	2.68	2.75	2.73	2.50
32	2.68	2.76	2.74	2.48	66	2.61	2.73	2.71	2.30
33	2.59	2.73	2.72	2.24	67	2.53	2.68	2.66	2.17
					Average	***2.57***	***2.73***	***2.72***	***2.16***

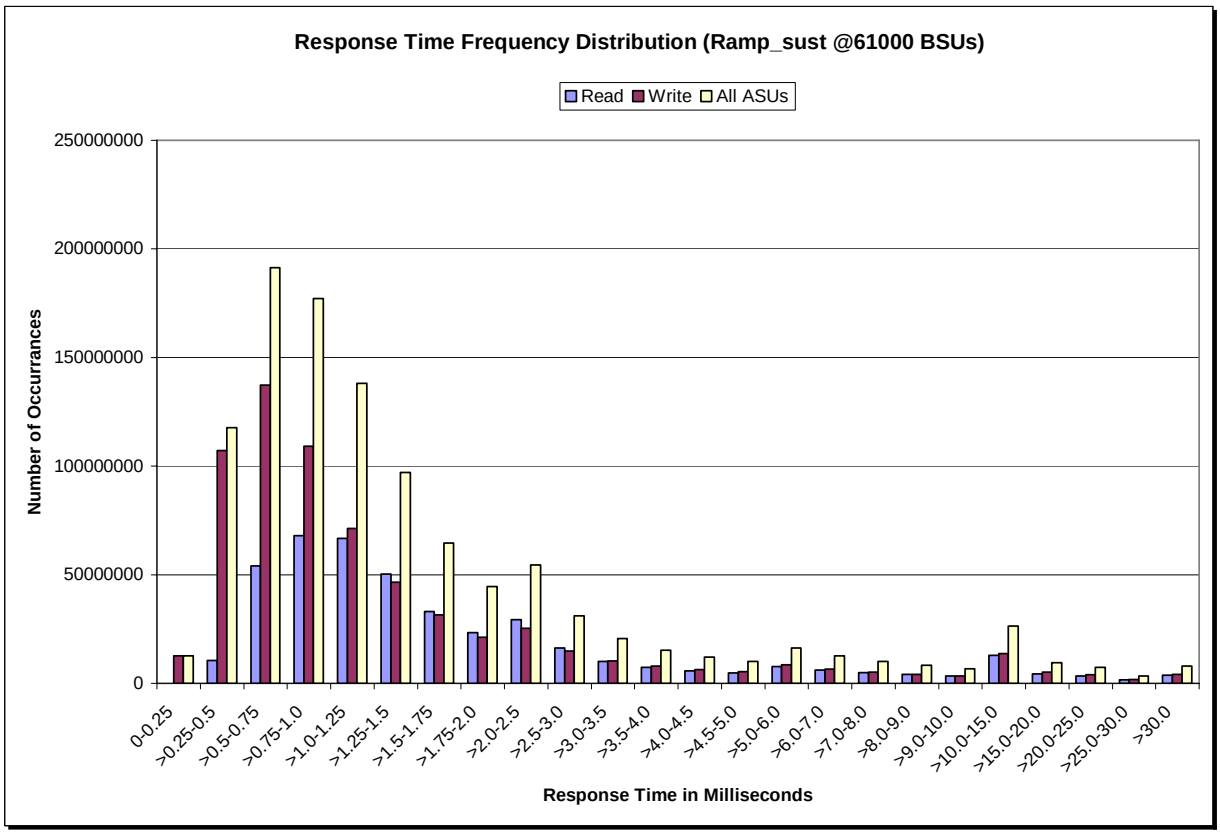
Sustainability – Average Response Time (ms) Distribution Graph



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	-	10,464,109	54,133,540	67,962,457	66,788,697	50,351,695	33,119,721	23,357,821
Write	12,592,803	107,175,238	137,251,895	109,229,360	71,358,674	46,636,853	31,414,437	21,129,563
All ASUs	12,592,803	117,639,347	191,385,435	177,191,817	138,147,371	96,988,548	64,534,158	44,487,384
ASU1	3,744,690	47,817,577	101,757,000	106,546,162	91,055,223	65,802,266	43,657,722	29,876,608
ASU2	987,571	10,884,128	21,349,822	21,856,240	18,334,705	13,219,654	8,801,860	6,002,933
ASU3	7,860,542	58,937,642	68,278,613	48,789,415	28,757,443	17,966,628	12,074,576	8,607,843
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	29,266,619	16,150,722	10,187,374	7,363,475	5,792,650	4,802,440	7,744,918	6,108,168
Write	25,259,307	14,923,439	10,374,022	7,928,272	6,384,051	5,317,813	8,449,785	6,471,596
All ASUs	54,525,926	31,074,161	20,561,396	15,291,747	12,176,701	10,120,253	16,194,703	12,579,764
ASU1	35,883,316	19,809,381	12,882,519	9,577,167	7,689,968	6,460,278	10,508,379	8,317,718
ASU2	7,224,811	4,031,884	2,645,293	1,973,900	1,582,840	1,329,906	2,164,218	1,715,259
ASU3	11,417,799	7,232,896	5,033,584	3,740,680	2,903,893	2,330,069	3,522,106	2,546,787
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	4,976,772	4,103,229	3,384,313	12,817,726	4,368,949	3,390,410	1,593,267	3,717,636
Write	5,119,839	4,129,192	3,350,659	13,589,598	5,238,275	4,014,362	1,858,640	4,258,056
All ASUs	10,096,611	8,232,421	6,734,972	26,407,324	9,607,224	7,404,772	3,451,907	7,975,692
ASU1	6,767,177	5,561,335	4,558,938	17,072,328	5,816,648	4,546,737	2,137,757	5,018,205
ASU2	1,396,964	1,147,346	942,289	3,525,424	1,197,521	936,666	440,187	1,037,162
ASU3	1,932,470	1,523,740	1,233,745	5,809,572	2,593,055	1,921,369	873,963	1,920,325

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 6.1.0

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).*

Clause 6.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.5.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.001	0.000	0.002	0.001	0.001	0.000

Primary Metrics Test – IOPS Test Phase

Clause 6.4.3.3

The IOPS Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of five (5) minutes. The IOPS Test Phase immediately follows the Sustainability Test Phase without any interruption or manual intervention.

The IOPS Test Run generates the SPC-1C 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 10.4.8.2

For the IOPS Test Phase the FDR shall contain:

1. *I/O Request Throughput Distribution (data and graph).*
2. *Response Time Frequency Distribution (data and graph).*
3. *Average Response Time Distribution (data and graph).*
4. *The human readable SPC-1C Test Run Results File produced by the SPC-1C Workload Generator.*
5. *A listing of all input parameters supplied to the SPC-1C Workload Generator.*
6. *The Measured Intensity Multiplier for each I/O Stream.*
7. *The variability of the Measured Intensity Multiplier, as defined in Clause 6.3.13.3.*
8. *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-1C Workload Generator Input Parameters

The SPC-1C Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in “Appendix E: SPC-1C Workload Generator Input Parameters” on Page 92.

IOPS Test Results File

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

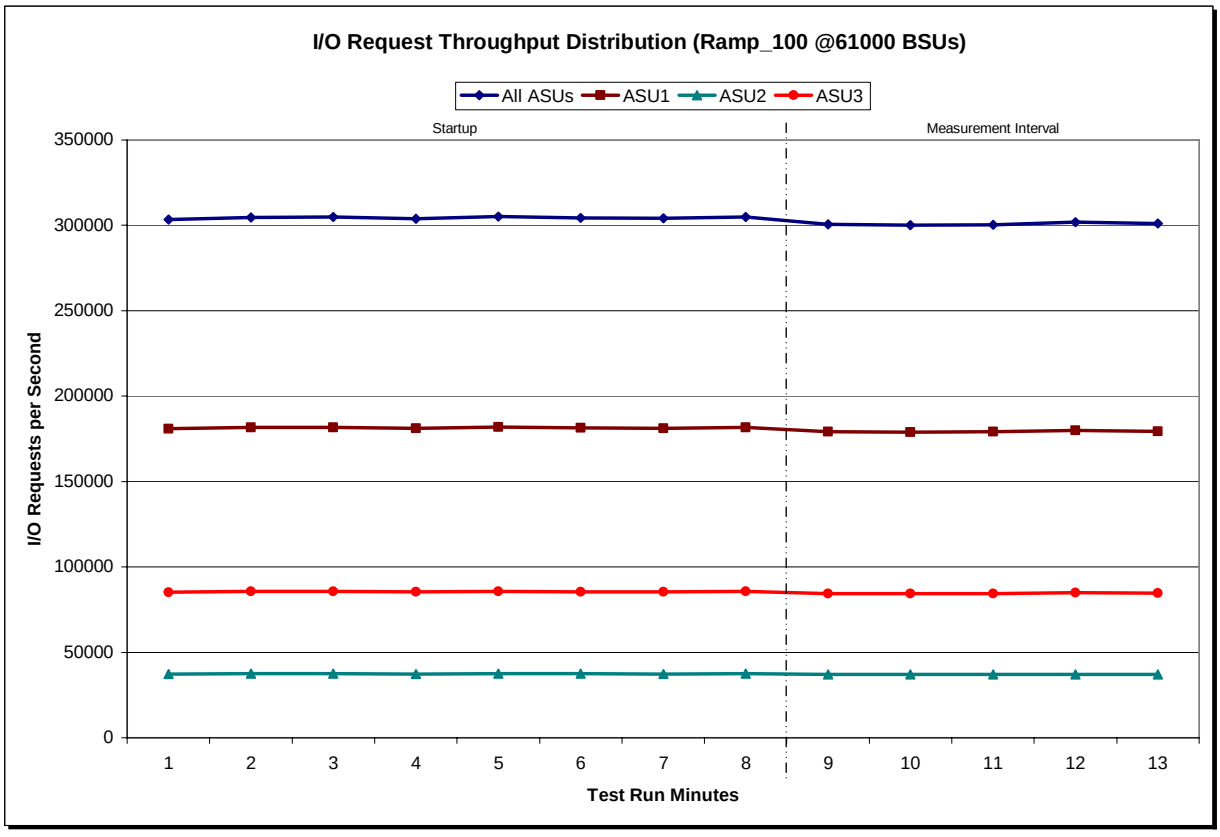
IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	20:34:36	20:42:37	0-7	0:08:01
Measurement Interval	20:42:37	20:47:37	8-12	0:05:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	303,405.05	180,809.23	37,379.65	85,216.17
1	304,673.90	181,556.28	37,486.45	85,631.17
2	304,847.50	181,674.33	37,495.22	85,677.95
3	303,990.08	181,194.37	37,416.43	85,379.28
4	305,138.17	181,890.13	37,534.22	85,713.82
5	304,346.58	181,371.42	37,462.93	85,512.23
6	304,149.73	181,270.50	37,405.80	85,473.43
7	304,880.30	181,729.77	37,498.08	85,652.45
8	300,566.60	179,142.87	36,944.08	84,479.65
9	300,209.30	178,899.42	36,947.53	84,362.35
10	300,469.35	179,046.27	36,955.10	84,467.98
11	301,924.98	179,923.05	37,098.10	84,903.83
12	301,197.13	179,504.13	37,052.43	84,640.57
Average	300,873.47	179,303.15	36,999.45	84,570.88

IOPS Test Run – I/O Request Throughput Distribution Graph

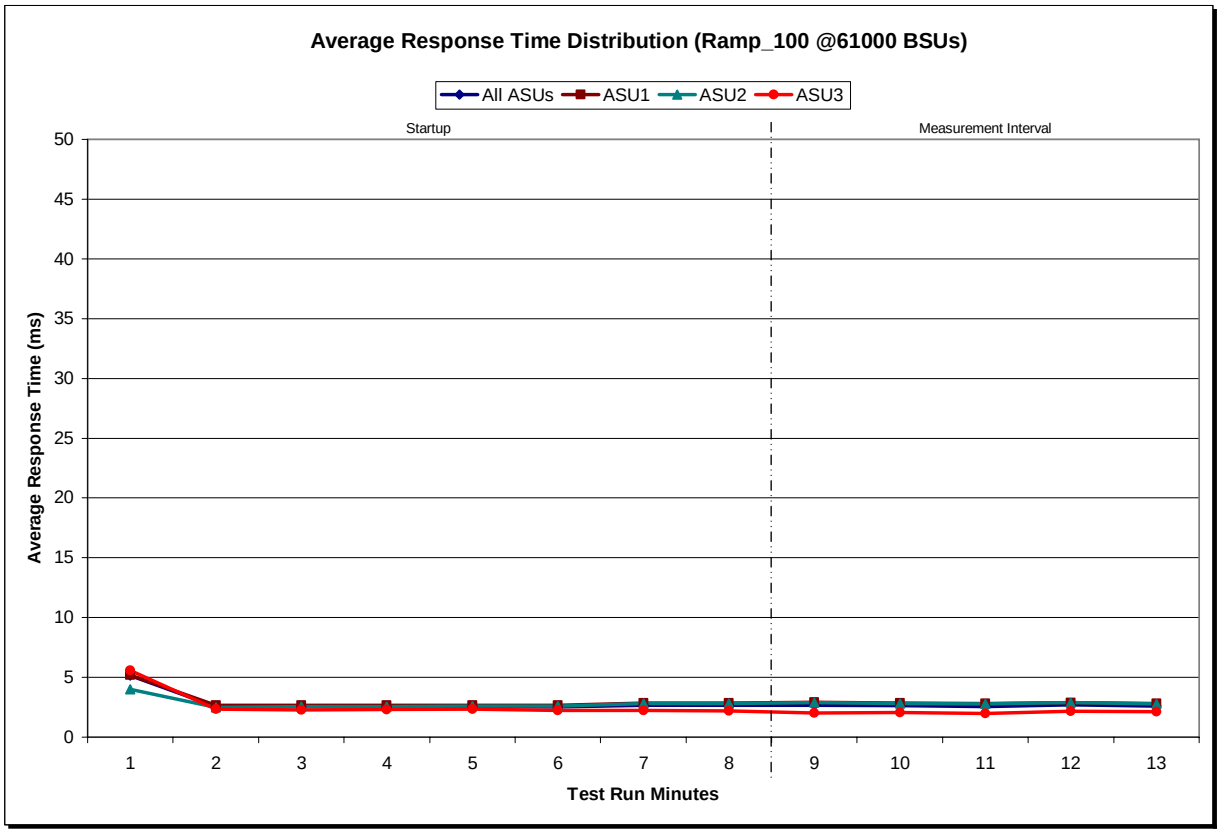


IOPS Test Run – Average Response Time (ms) Distribution Data

61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	20:34:36	20:42:37	0-7	0:08:01
Measurement Interval	20:42:37	20:47:37	8-12	0:05:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	5.15	5.19	3.98	5.58
1	2.55	2.65	2.50	2.35
2	2.55	2.68	2.56	2.27
3	2.55	2.65	2.55	2.32
4	2.57	2.67	2.59	2.33
5	2.52	2.65	2.58	2.23
6	2.67	2.85	2.79	2.23
7	2.67	2.86	2.81	2.21
8	2.66	2.93	2.88	2.00
9	2.61	2.84	2.79	2.06
10	2.57	2.81	2.78	1.98
11	2.68	2.89	2.87	2.16
12	2.61	2.80	2.77	2.13
Average	2.63	2.85	2.82	2.07

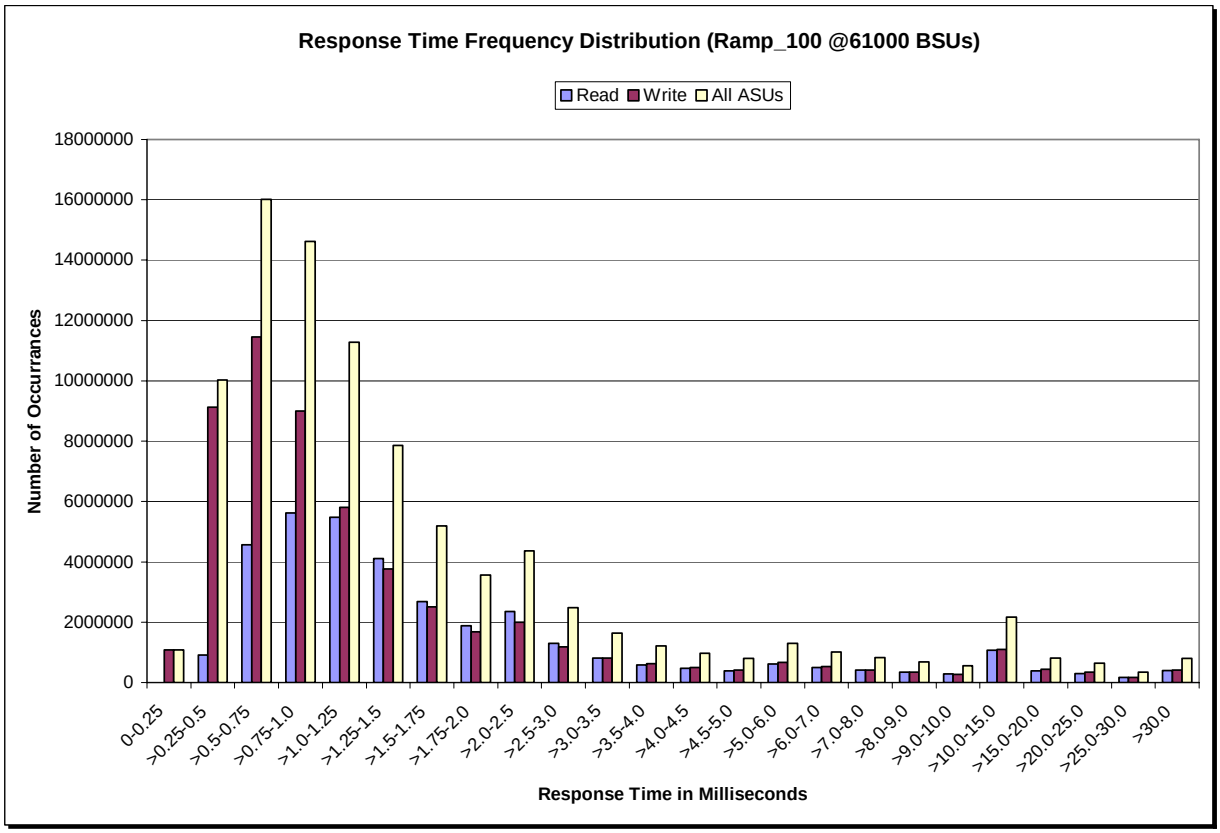
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	0	906,299	4,558,601	5,619,789	5,478,791	4,102,826	2,675,965	1,881,081
Write	1088485	9,123,217	11,452,091	8,998,319	5,802,820	3,760,154	2,514,805	1,685,994
All ASUs	1088485	10,029,516	16,010,692	14,618,108	11,281,611	7,862,980	5,190,770	3,567,075
ASU1	324618	4,077,336	8,507,880	8,779,442	7,436,891	5,336,708	3,515,080	2,395,634
ASU2	85129	925,355	1,788,069	1,805,974	1,504,361	1,075,108	709,988	482,841
ASU3	678738	5,026,825	5,714,743	4,032,692	2,340,359	1,451,164	965,702	688,600
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	2,358,141	1,301,536	817,111	589,817	464,374	383,692	620,378	495,056
Write	2,003,330	1,178,331	817,286	626,271	505,227	420,178	673,078	521,989
All ASUs	4,361,471	2,479,867	1,634,397	1,216,088	969,601	803,870	1,293,456	1,017,045
ASU1	2,876,784	1,584,706	1,027,083	764,098	613,099	514,076	840,019	674,227
ASU2	576,855	320,474	209,426	156,083	125,814	105,101	172,299	138,004
ASU3	907,832	574,687	397,888	295,907	230,688	184,693	281,138	204,814
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	408,237	342,098	284,401	1,062,688	378,568	301,530	165,872	396,433
Write	416,110	339,823	277,980	1,100,961	437,015	340,716	175,729	408,221
All ASUs	824,347	681,921	562,381	2,163,649	815,583	642,246	341,601	804,654
ASU1	555,900	464,667	384,421	1,420,033	512,002	411,542	228,091	546,205
ASU2	112,734	93,756	77,203	288,828	104,355	84,154	46,484	111,355
ASU3	155,713	123,498	100,757	454,788	199,226	146,550	67,026	147,094

IOPS Test Run –Response Time Frequency Distribution Graph



IOPS Test Run – I/O Request Information

I/O Requests Completed in the Measurement Interval	I/O Requests Completed with Response Time = or < 30 ms	I/O Requests Completed with Response Time > 30 ms
90,261,414	89,456.760	804,654

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 6.1.0

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).*

Clause 6.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.5.*

	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	0.2809	0.0700	0.2101	0.0180	0.0700	0.0350	0.2811
COV	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.000

Primary Metrics Test – Response Time Ramp Test Phase

Clause 6.4.3.4

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-1C IOPS™ primary metric. Each of the five Test Runs has a Measurement Interval of five (5) 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-1C LRT™ metric. That value represents the Average Response Time of a lightly loaded TSC.

Clause 10.4.8.3

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

1. *A Response Time Ramp Distribution graph.*
2. *The human readable Test Run Results File produced by the SPC-1C C Workload Generator for each Test Run within the Response Time Ramp Test Phase.*
3. *An Average Response Time Distribution graph and table for the 10% BSU Level Test Run (the SPC-1C LRT™ metric).*
4. *A listing of all input parameters supplied to the SPC-1C Workload Generator.*

SPC-1C Workload Generator Input Parameters

The SPC-1C Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1C Workload Generator Input Parameters" on Page 92.

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-1C 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 - 61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	20:34:36	20:42:37	0-7	0:08:01
Measurement Interval	20:42:37	20:47:37	8-12	0:05:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	303,405.05	180,809.23	37,379.65	85,216.17
1	304,673.90	181,556.28	37,486.45	85,631.17
2	304,847.50	181,674.33	37,495.22	85,677.95
3	303,990.08	181,194.37	37,416.43	85,379.28
4	305,138.17	181,890.13	37,534.22	85,713.82
5	304,346.58	181,371.42	37,462.93	85,512.23
6	304,149.73	181,270.50	37,405.80	85,473.43
7	304,880.30	181,729.77	37,498.08	85,652.45
8	300,566.60	179,142.87	36,944.08	84,479.65
9	300,209.30	178,899.42	36,947.53	84,362.35
10	300,469.35	179,046.27	36,955.10	84,467.98
11	301,924.98	179,923.05	37,098.10	84,903.83
12	301,197.13	179,504.13	37,052.43	84,640.57
Average	300,873.47	179,303.15	36,999.45	84,570.88

95% Load Level - 57,950 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	21:05:04	21:13:05	0-7	0:08:01
Measurement Interval	21:13:05	21:18:05	8-12	0:05:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	289,821.62	172,768.80	35,649.35	81,403.47
1	289,147.82	172,314.88	35,557.18	81,275.75
2	289,898.85	172,778.57	35,668.38	81,451.90
3	289,746.60	172,696.20	35,609.38	81,441.02
4	289,840.00	172,778.10	35,634.33	81,427.57
5	289,647.37	172,658.38	35,594.80	81,394.18
6	289,911.53	172,750.48	35,694.37	81,466.68
7	289,829.75	172,724.32	35,658.10	81,447.33
8	288,841.17	172,136.22	35,519.35	81,185.60
9	290,049.78	172,899.98	35,660.90	81,488.90
10	289,954.68	172,808.65	35,651.50	81,494.53
11	289,558.20	172,542.02	35,601.13	81,415.05
12	289,794.22	172,752.48	35,620.35	81,421.38
Average	289,639.61	172,627.87	35,610.65	81,401.09

90% Load Level - 54,900 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	21:34:40	21:42:41	0-7	0:08:01
Measurement Interval	21:42:41	21:47:41	8-12	0:05:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	274,609.57	163,679.05	33,756.28	77,174.23
1	274,505.95	163,605.47	33,745.63	77,154.85
2	274,513.40	163,614.08	33,753.57	77,145.75
3	273,968.23	163,296.08	33,682.33	76,989.82
4	274,356.20	163,462.58	33,765.90	77,127.72
5	274,737.75	163,772.95	33,723.55	77,241.25
6	274,471.58	163,613.28	33,772.03	77,086.27
7	274,409.00	163,515.70	33,768.07	77,125.23
8	274,195.87	163,439.42	33,750.67	77,005.78
9	274,656.73	163,714.13	33,744.27	77,198.33
10	274,401.92	163,637.13	33,739.03	77,025.75
11	274,524.72	163,567.57	33,806.07	77,151.08
12	274,401.33	163,505.37	33,775.42	77,120.55
Average	274,436.11	163,572.72	33,763.09	77,100.30

80% Load Level - 48,800 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:02:28	22:10:29	0-7	0:08:01
Measurement Interval	22:10:29	22:15:29	8-12	0:05:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	244,007.38	145,424.37	30,060.32	68,522.70
1	244,048.93	145,446.38	30,019.03	68,583.52
2	243,986.42	145,409.60	29,953.58	68,623.23
3	244,129.23	145,455.05	30,056.22	68,617.97
4	244,024.20	145,429.37	29,999.90	68,594.93
5	244,039.07	145,450.75	30,030.80	68,557.52
6	243,969.52	145,400.85	30,029.93	68,538.73
7	244,129.77	145,473.58	30,024.52	68,631.67
8	243,801.83	145,297.37	29,996.83	68,507.63
9	243,993.05	145,457.23	30,009.00	68,526.82
10	243,950.35	145,397.80	30,028.87	68,523.68
11	244,003.93	145,388.73	30,003.10	68,612.10
12	244,169.48	145,552.97	29,993.75	68,622.77
Average	243,983.73	145,418.82	30,006.31	68,558.60

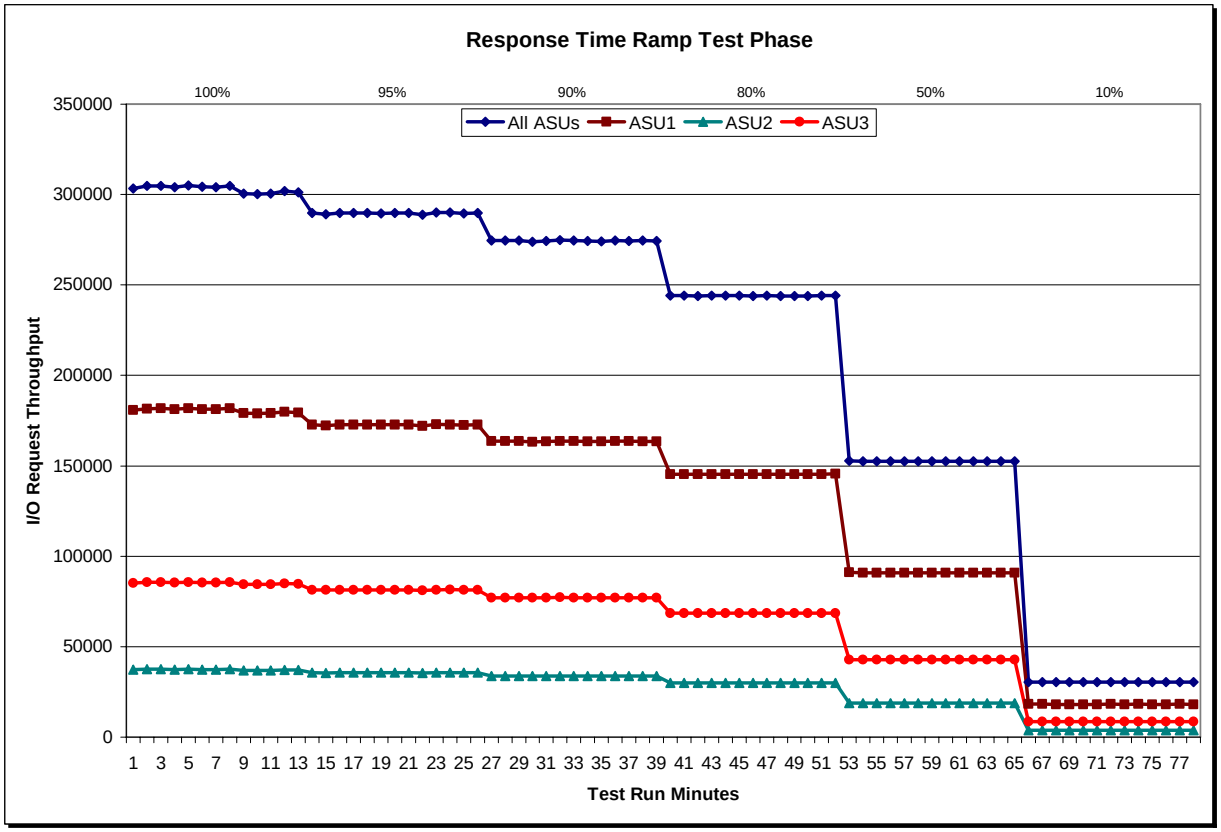
50% Load Level - 30,500 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:25:00	22:33:01	0-7	0:08:01
Measurement Interval	22:33:01	22:38:01	8-12	0:05:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	152,669.38	91,016.82	18,772.25	42,880.32
1	152,477.92	90,821.75	18,771.52	42,884.65
2	152,480.62	90,846.58	18,795.83	42,838.20
3	152,588.68	90,938.73	18,773.33	42,876.62
4	152,513.17	90,871.17	18,762.53	42,879.47
5	152,451.37	90,832.28	18,770.35	42,848.73
6	152,624.37	90,978.65	18,727.48	42,918.23
7	152,516.08	90,931.47	18,740.35	42,844.27
8	152,494.22	90,882.43	18,756.23	42,855.55
9	152,536.88	90,898.20	18,749.93	42,888.75
10	152,435.92	90,886.12	18,737.88	42,811.92
11	152,472.67	90,868.20	18,736.75	42,867.72
12	152,542.50	90,898.35	18,748.15	42,896.00
Average	152,496.44	90,886.66	18,745.79	42,863.99

10% Load Level - 6,100 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:40:37	22:48:38	0-7	0:08:01
Measurement Interval	22:48:38	22:53:38	8-12	0:05:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	30,565.82	18,221.87	3,752.03	8,591.92
1	30,527.10	18,224.17	3,740.43	8,562.50
2	30,476.08	18,159.70	3,743.88	8,572.50
3	30,536.58	18,186.17	3,756.82	8,593.60
4	30,510.55	18,165.55	3,755.35	8,589.65
5	30,518.78	18,175.50	3,762.05	8,581.23
6	30,521.97	18,229.15	3,747.70	8,545.12
7	30,505.83	18,195.50	3,745.15	8,565.18
8	30,516.92	18,210.55	3,755.63	8,550.73
9	30,490.13	18,167.55	3,752.53	8,570.05
10	30,489.87	18,168.00	3,757.40	8,564.47
11	30,529.07	18,212.37	3,753.17	8,563.53
12	30,519.00	18,174.60	3,758.57	8,585.83
Average	30,509.00	18,186.61	3,755.46	8,566.92

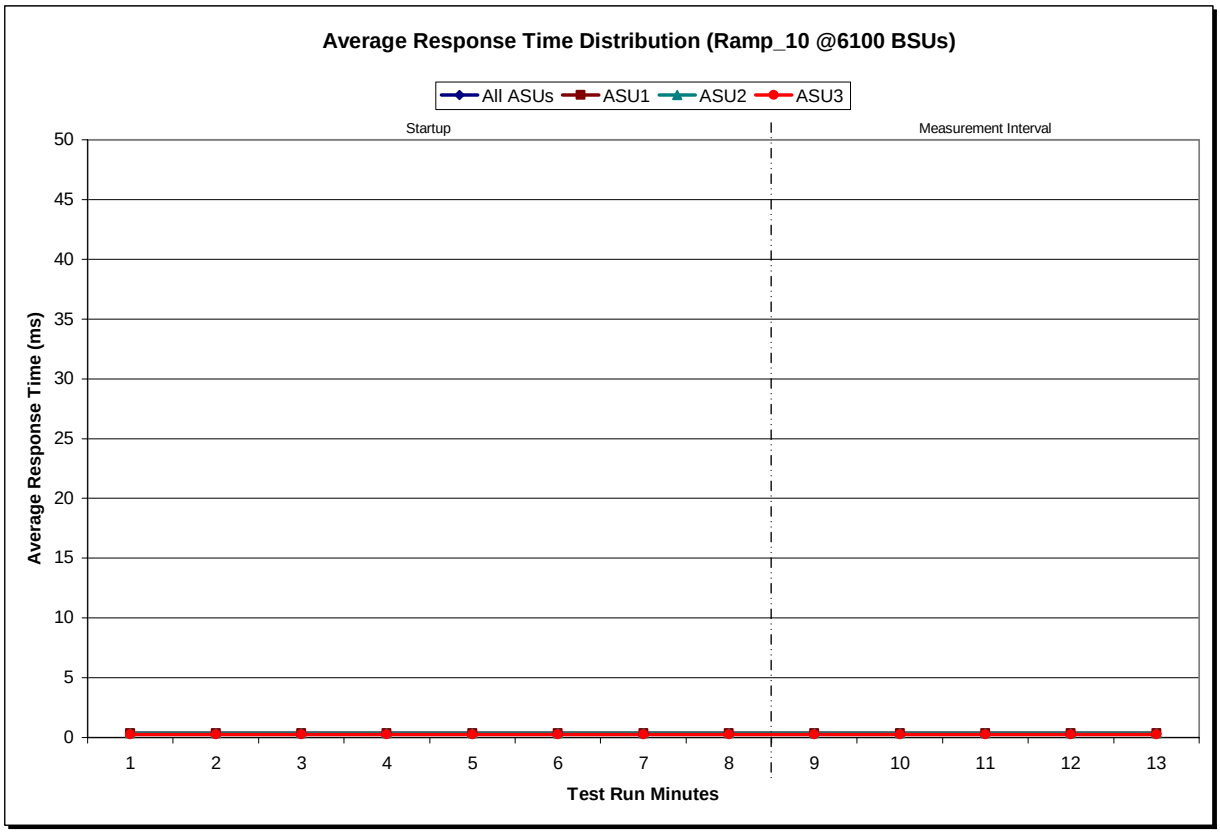
Response Time Ramp Distribution (IOPS) Graph



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

6,100 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:40:37	22:48:38	0-7	0:08:01
Measurement Interval	22:48:38	22:53:38	7-12	0:05:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.32	0.35	0.35	0.25
1	0.33	0.36	0.36	0.25
2	0.33	0.36	0.35	0.25
3	0.33	0.36	0.35	0.26
4	0.33	0.36	0.35	0.26
5	0.33	0.36	0.35	0.25
6	0.32	0.35	0.35	0.25
7	0.33	0.35	0.35	0.25
8	0.33	0.36	0.36	0.26
9	0.33	0.36	0.35	0.26
10	0.33	0.35	0.35	0.25
11	0.32	0.35	0.35	0.25
12	0.32	0.35	0.35	0.25
Average	***0.33***	***0.36***	***0.35***	***0.26***

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



SPC-1C 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 6.1.0

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).*

Clause 6.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.5.*

	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	0.2808	0.0700	0.2102	0.0181	0.0700	0.0350	0.2808
COV	0.003	0.001	0.004	0.001	0.009	0.003	0.003	0.002

Repeatability Test

Clause 6.4.4

The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1C IOPS™ primary metric and SPC-1C 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 five (5) 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-1C LRT™ metric. Each Average Response Time value must be less than the SPC-1C LRT™ metric plus 5%.

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-1C IOPS™ primary metric. Each I/O Request Throughput value must be greater than the SPC-1C 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 10.4.8.4

The FDR shall contain the following for the Repeatability Test:

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

SPC-1C Workload Generator Input Parameters

The SPC-1C Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in “Appendix E: SPC-1C Workload Generator Input Parameters” on Page 92.

Repeatability Test Results File

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

	SPC-1C IOPS™
Primary Metrics	***300,873.47***
Repeatability Test Phase 1	302,939.67
Repeatability Test Phase 2	302,134.06

The SPC-1C 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-1C IOPS™ must greater than 95% of the reported SPC-1C IOPS™ Primary Metric.

	SPC-1C LRT™
Primary Metrics	***0.33 ms***
Repeatability Test Phase 1	0.33 ms
Repeatability Test Phase 2	0.33 ms

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

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

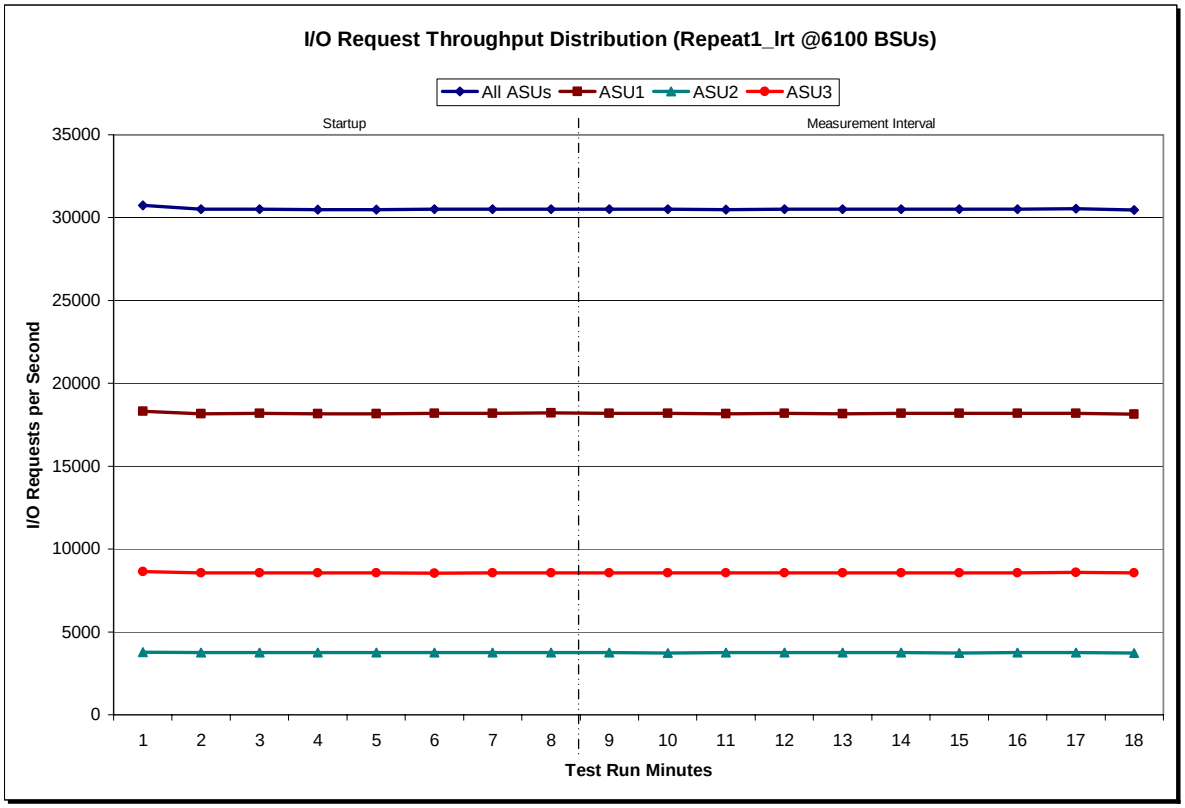
Repeatability Test Phase 1, Test Run 1 (LRT)
Repeatability Test Phase 1, Test Run 2 (IOPS)
Repeatability Test Phase 2, Test Run 1 (LRT)
Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

6,100 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:59:44	23:07:44	0-7	0:08:00
Measurement Interval	23:07:44	23:17:44	8-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	30,730.12	18,324.82	3,768.58	8,636.72
1	30,505.62	18,164.33	3,763.18	8,578.10
2	30,504.22	18,180.90	3,751.40	8,571.92
3	30,498.85	18,177.35	3,750.43	8,571.07
4	30,495.57	18,180.32	3,750.55	8,564.70
5	30,504.67	18,192.62	3,758.98	8,553.07
6	30,514.22	18,198.17	3,760.70	8,555.35
7	30,522.52	18,205.70	3,748.65	8,568.17
8	30,516.90	18,195.62	3,752.72	8,568.57
9	30,506.23	18,191.33	3,739.00	8,575.90
10	30,480.60	18,168.93	3,743.78	8,567.88
11	30,524.57	18,190.70	3,756.42	8,577.45
12	30,507.00	18,176.50	3,759.55	8,570.95
13	30,527.18	18,186.37	3,764.02	8,576.80
14	30,504.33	18,189.67	3,740.78	8,573.88
15	30,506.43	18,183.80	3,753.22	8,569.42
16	30,540.88	18,189.60	3,762.30	8,588.98
17	30,460.83	18,153.13	3,739.85	8,567.85
Average	***30,507.50***	***18,182.57***	***3,751.16***	***8,573.77***

Repeatability 1 LRT – I/O Request Throughput Distribution Graph

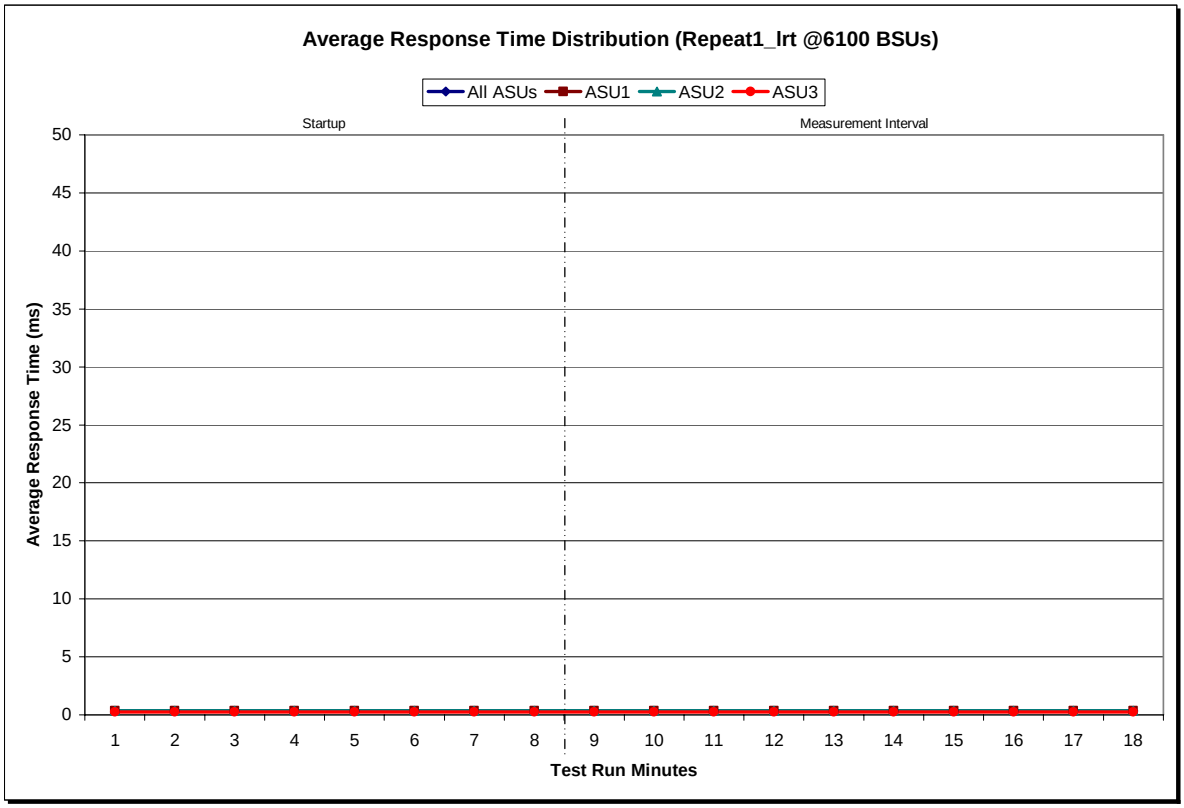


Repeatability 1 LRT –Average Response Time (ms) Distribution Data

6,100 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:59:44	23:07:44	0-7	0:08:00
Measurement Interval	23:07:44	23:17:44	8-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	0.34	0.37	0.36	0.27
1	0.33	0.36	0.35	0.26
2	0.33	0.36	0.35	0.26
3	0.33	0.36	0.35	0.26
4	0.33	0.36	0.35	0.26
5	0.32	0.35	0.35	0.25
6	0.33	0.35	0.35	0.26
7	0.33	0.35	0.35	0.25
8	0.33	0.36	0.35	0.26
9	0.33	0.36	0.35	0.26
10	0.33	0.36	0.35	0.26
11	0.33	0.36	0.35	0.26
12	0.33	0.36	0.35	0.26
13	0.33	0.35	0.35	0.26
14	0.33	0.36	0.36	0.26
15	0.33	0.36	0.35	0.26
16	0.33	0.35	0.35	0.26
17	0.33	0.36	0.35	0.26
Average	***0.33***	***0.36***	***0.35***	***0.26***

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

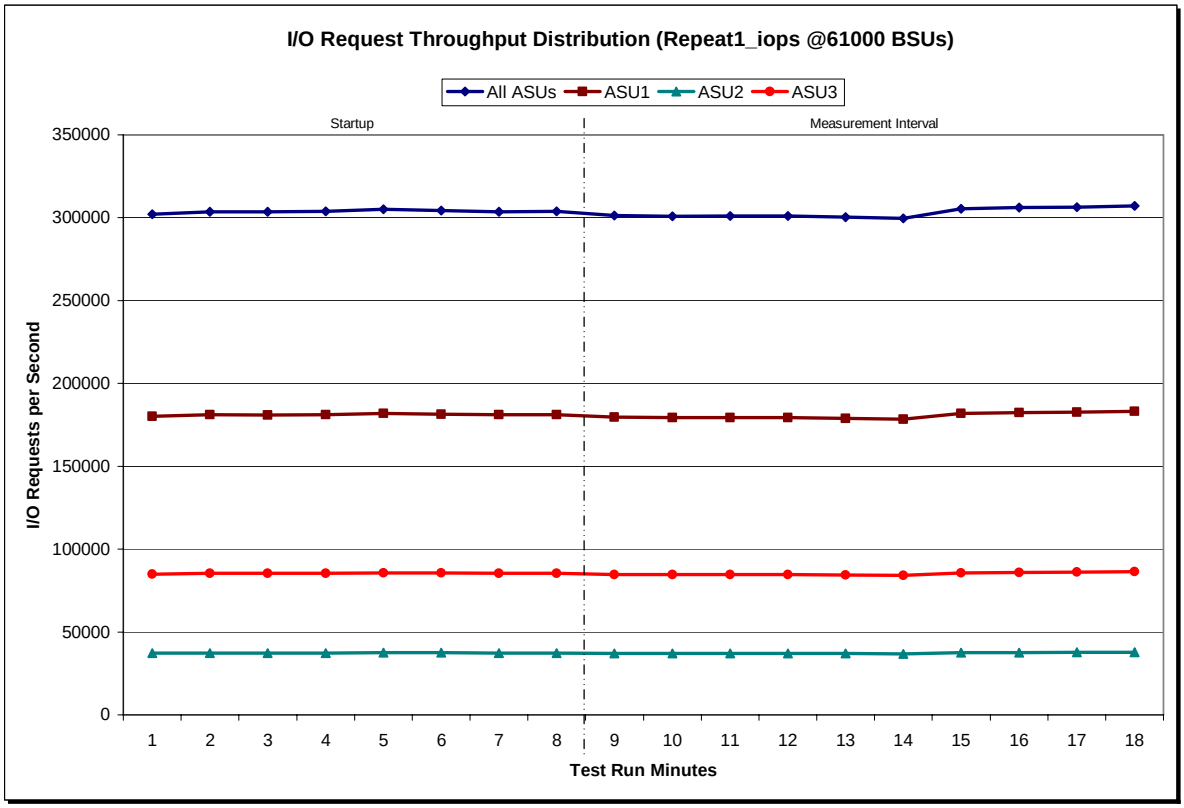


Repeatability 1 IOPS – I/O Request Throughput Distribution Data

61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:36:16	23:44:17	0-7	0:08:01
Measurement Interval	23:44:17	23:54:17	8-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	302,246.95	180,134.20	37,222.43	84,890.32
1	303,732.57	181,069.07	37,357.28	85,306.22
2	303,571.77	180,936.50	37,338.28	85,296.98
3	303,876.30	181,055.35	37,395.38	85,425.57
4	305,185.07	181,898.50	37,555.38	85,731.18
5	304,431.23	181,439.13	37,443.93	85,548.17
6	303,726.87	181,075.18	37,342.90	85,308.78
7	303,902.53	181,109.83	37,354.03	85,438.67
8	301,490.53	179,654.87	37,076.02	84,759.65
9	300,965.38	179,326.25	37,021.87	84,617.27
10	301,006.53	179,437.57	37,015.40	84,553.57
11	301,075.07	179,436.90	36,996.52	84,641.65
12	300,234.15	178,911.73	36,957.72	84,364.70
13	299,506.65	178,488.68	36,819.23	84,198.73
14	305,302.93	181,923.20	37,583.45	85,796.28
15	306,164.78	182,505.88	37,644.73	86,014.17
16	306,472.12	182,644.93	37,676.55	86,150.63
17	307,178.50	183,099.27	37,750.98	86,328.25
Average	***302,939.67***	***180,542.93***	***37,254.25***	***85,142.49***

Repeatability 1 IOPS – I/O Request Throughput Distribution Graph

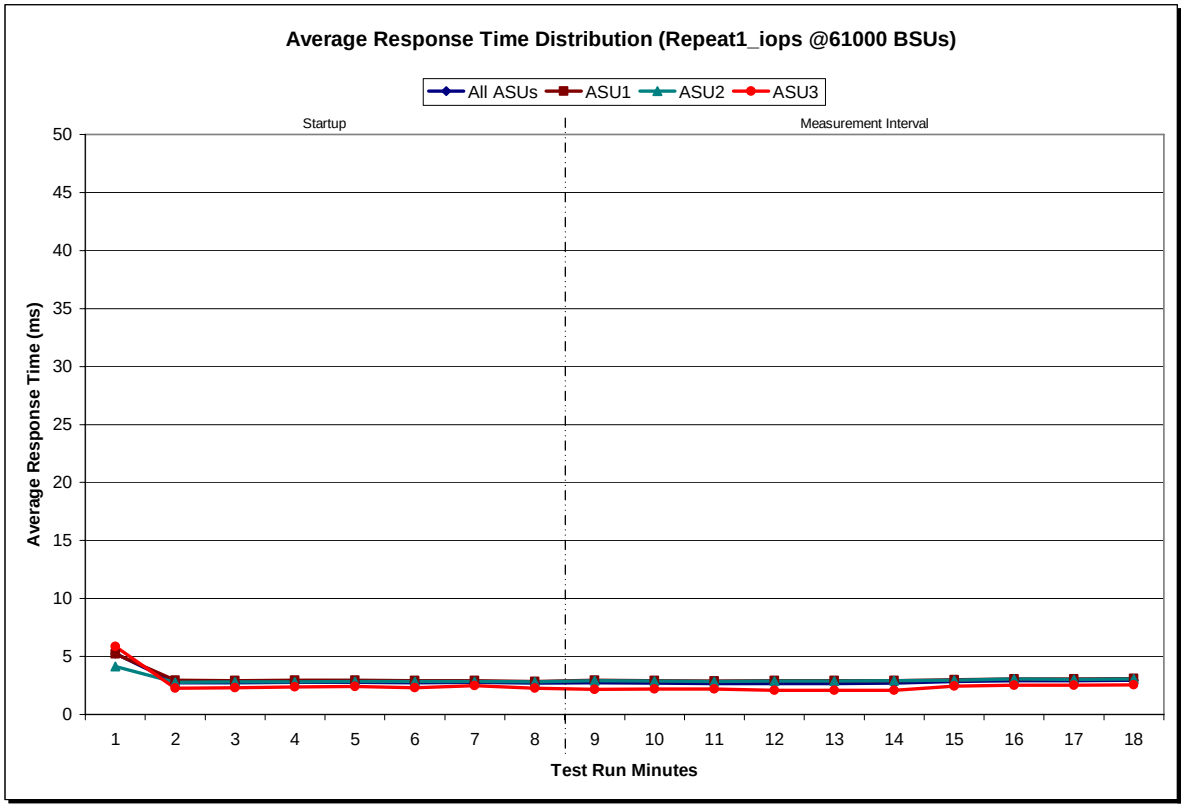


Repeatability 1 IOPS –Average Response Time (ms) Distribution Data

61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:36:16	23:44:17	0-7	0:08:01
Measurement Interval	23:44:17	23:54:17	8-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	5.27	5.23	4.13	5.86
1	2.73	2.94	2.77	2.28
2	2.73	2.92	2.80	2.29
3	2.76	2.94	2.82	2.38
4	2.78	2.94	2.84	2.41
5	2.74	2.93	2.85	2.30
6	2.78	2.91	2.84	2.48
7	2.69	2.86	2.80	2.28
8	2.72	2.95	2.90	2.17
9	2.71	2.93	2.89	2.18
10	2.68	2.87	2.84	2.19
11	2.68	2.92	2.88	2.08
12	2.67	2.90	2.87	2.10
13	2.69	2.92	2.91	2.10
14	2.83	2.98	2.96	2.46
15	2.91	3.07	3.06	2.50
16	2.90	3.05	3.04	2.51
17	2.95	3.11	3.08	2.55
Average	***2.77***	***2.97***	***2.94***	***2.29***

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

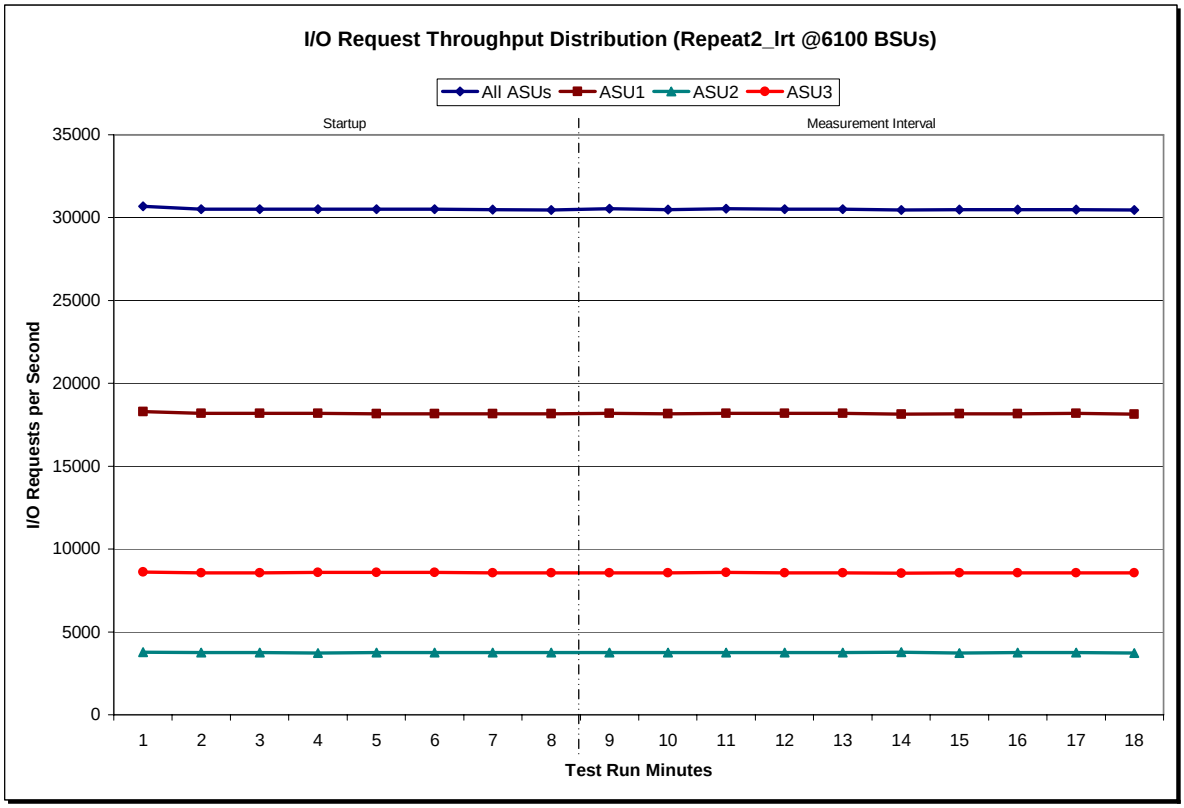


Repeatability 2 LRT – I/O Request Throughput Distribution Data

6,100 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:00:44	0:08:44	0-7	0:08:00
Measurement Interval	0:08:44	0:18:44	8-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	30,694.23	18,293.35	3,779.53	8,621.35
1	30,516.55	18,200.12	3,748.83	8,567.60
2	30,522.25	18,191.45	3,757.10	8,573.70
3	30,522.50	18,187.75	3,740.35	8,594.40
4	30,509.12	18,167.90	3,758.48	8,582.73
5	30,507.68	18,168.00	3,748.18	8,591.50
6	30,498.15	18,167.25	3,761.72	8,569.18
7	30,466.38	18,160.38	3,751.00	8,555.00
8	30,536.85	18,199.57	3,758.90	8,578.38
9	30,481.48	18,172.82	3,753.05	8,555.62
10	30,536.40	18,195.50	3,754.72	8,586.18
11	30,520.25	18,193.22	3,759.22	8,567.82
12	30,503.25	18,181.28	3,759.75	8,562.22
13	30,463.00	18,145.30	3,769.92	8,547.78
14	30,482.00	18,179.85	3,738.57	8,563.58
15	30,489.10	18,169.10	3,759.40	8,560.60
16	30,498.67	18,180.82	3,745.98	8,571.87
17	30,451.95	18,148.42	3,740.87	8,562.67
Average	***30,496.30***	***18,176.59***	***3,754.04***	***8,565.67***

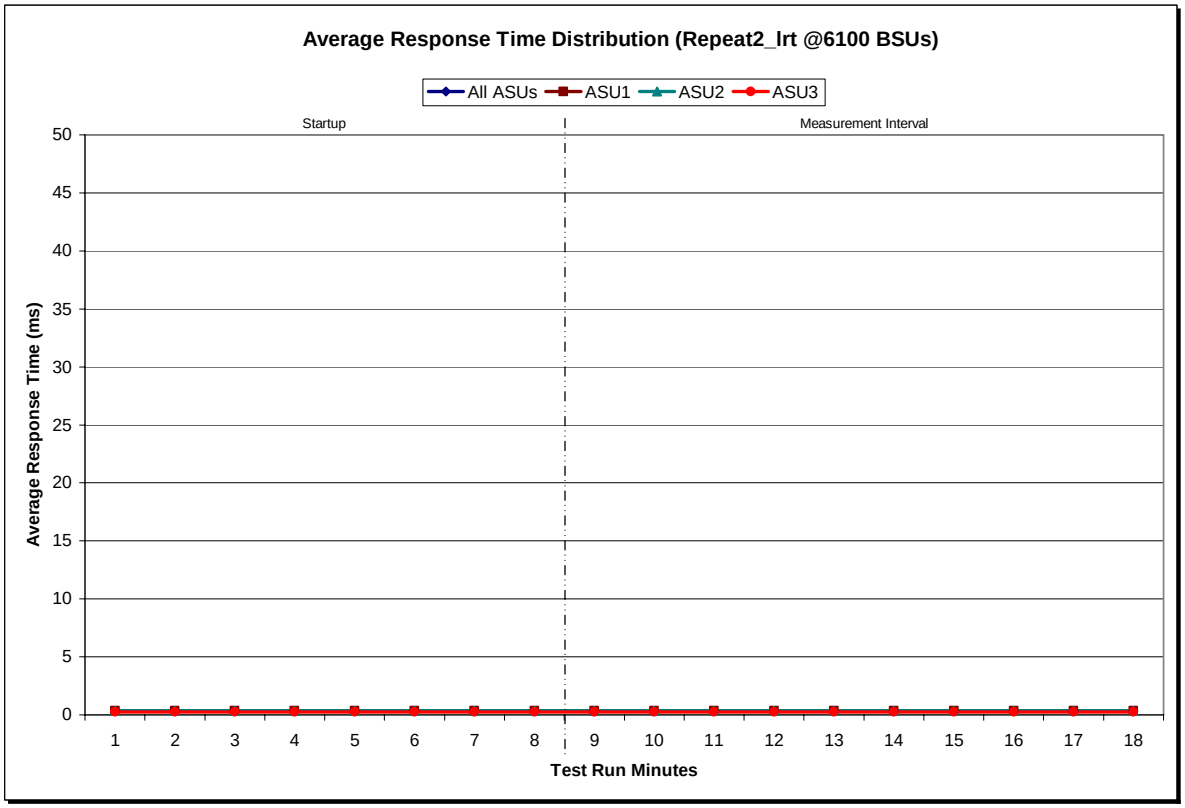
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

6,100 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:00:44	0:08:44	0-7	0:08:00
Measurement Interval	0:08:44	0:18:44	8-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.33	0.36	0.35	0.26
1	0.33	0.36	0.35	0.26
2	0.33	0.35	0.35	0.25
3	0.34	0.37	0.36	0.26
4	0.33	0.36	0.35	0.25
5	0.33	0.36	0.35	0.25
6	0.33	0.36	0.35	0.25
7	0.32	0.35	0.35	0.25
8	0.33	0.36	0.36	0.26
9	0.33	0.36	0.36	0.25
10	0.33	0.36	0.36	0.25
11	0.33	0.36	0.35	0.25
12	0.33	0.36	0.35	0.26
13	0.33	0.36	0.35	0.26
14	0.33	0.36	0.35	0.25
15	0.33	0.36	0.36	0.26
16	0.33	0.36	0.35	0.26
17	0.33	0.36	0.35	0.26
Average	***0.33***	***0.36***	***0.35***	***0.26***

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

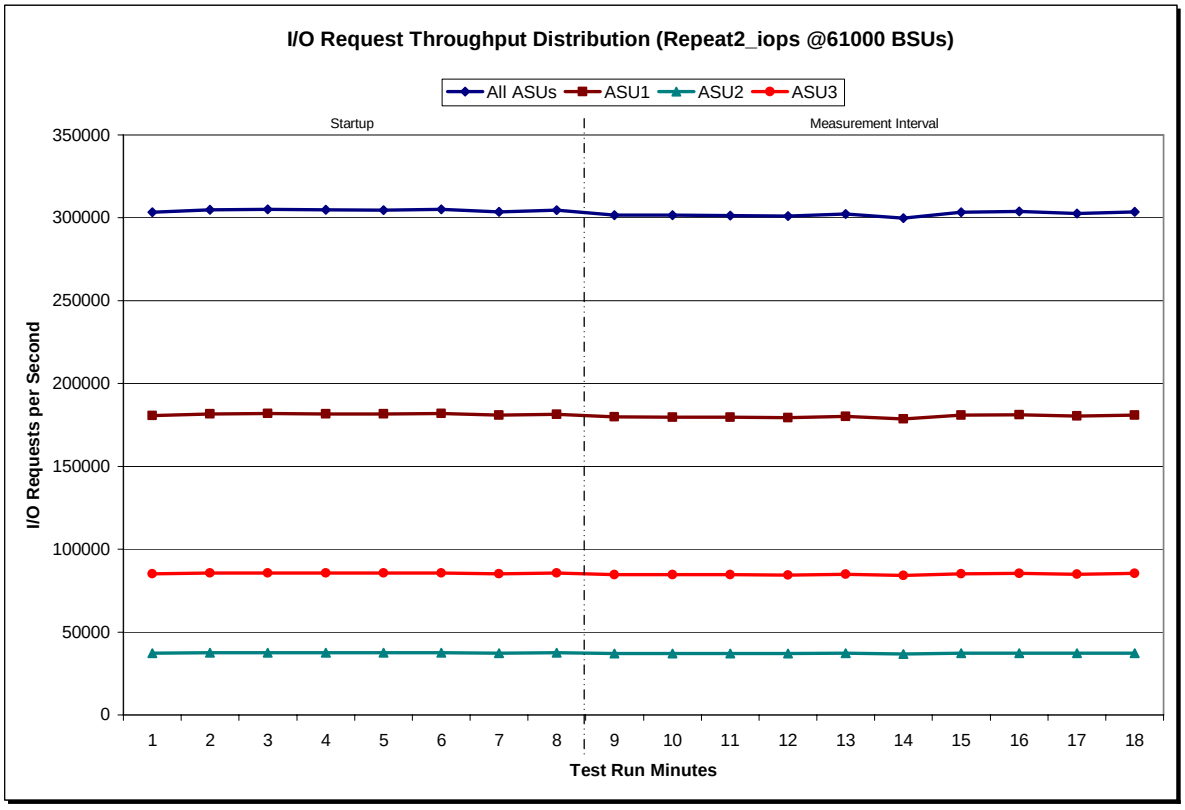


Repeatability 2 IOPS – I/O Request Throughput Distribution Data

61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:37:16	0:45:17	0-7	0:08:01
Measurement Interval	0:45:17	0:55:17	8-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	303,388.52	180,788.00	37,306.32	85,294.20
1	305,009.08	181,779.62	37,498.23	85,731.23
2	305,072.43	181,849.58	37,480.52	85,742.33
3	304,937.97	181,733.18	37,521.18	85,683.60
4	304,750.17	181,603.07	37,501.58	85,645.52
5	305,194.22	181,887.32	37,542.77	85,764.13
6	303,525.28	180,969.45	37,281.90	85,273.93
7	304,554.82	181,461.27	37,475.78	85,617.77
8	301,712.63	179,870.37	37,082.92	84,759.35
9	301,548.40	179,694.38	37,090.93	84,763.08
10	301,469.72	179,673.10	37,065.70	84,730.92
11	301,034.97	179,479.83	37,043.95	84,511.18
12	302,436.63	180,256.27	37,214.00	84,966.37
13	299,777.00	178,632.72	36,880.28	84,264.00
14	303,448.70	180,888.05	37,305.63	85,255.02
15	303,805.13	181,062.55	37,380.90	85,361.68
16	302,521.58	180,319.38	37,173.17	85,029.03
17	303,585.80	180,912.10	37,356.03	85,317.67
Average	***302,134.06***	***180,078.88***	***37,159.35***	***84,895.83***

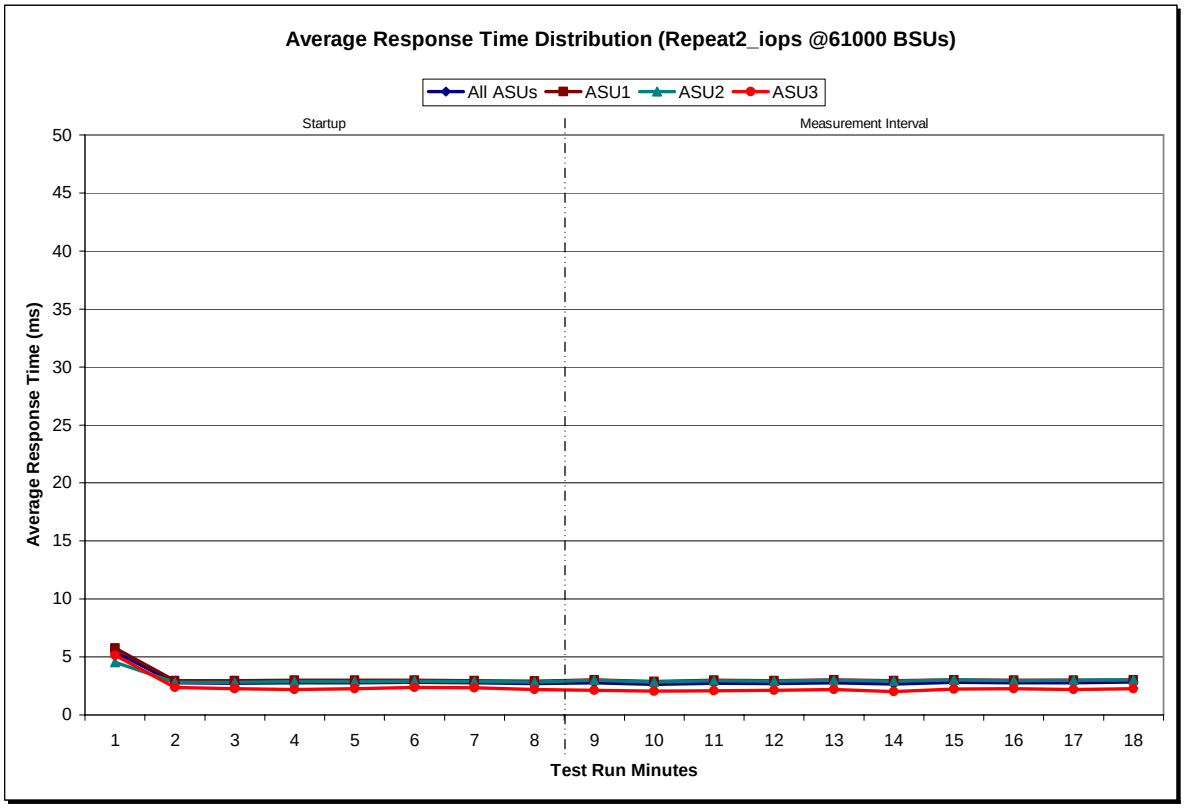
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

61,000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:37:16	0:45:17	0-7	0:08:01
Measurement Interval	0:45:17	0:55:17	8-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	5.43	5.76	4.54	5.13
1	2.77	2.95	2.80	2.37
2	2.74	2.94	2.81	2.28
3	2.76	3.00	2.89	2.20
4	2.77	2.98	2.88	2.27
5	2.81	2.99	2.91	2.38
6	2.77	2.96	2.88	2.34
7	2.69	2.90	2.85	2.19
8	2.76	3.02	2.97	2.12
9	2.63	2.87	2.83	2.05
10	2.72	2.98	2.95	2.09
11	2.72	2.95	2.93	2.12
12	2.78	3.01	2.98	2.19
13	2.68	2.94	2.92	2.00
14	2.81	3.04	3.02	2.22
15	2.77	2.97	2.97	2.25
16	2.77	3.01	3.00	2.19
17	2.83	3.04	3.03	2.28
Average	***2.75***	***2.98***	***2.96***	***2.15***

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 6.1.0

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).*

Clause 6.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.5.*

	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	0.2808	0.0700	0.2101	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.001	0.003	0.001	0.005	0.003	0.005	0.001

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2811
COV	0.001	0.000	0.001	0.000	0.001	0.001	0.002	0.000

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	0.0349	0.02812	0.0699	0.2100	0.0180	0.0701	0.0350	0.2809
COV	0.005	0.001	0.001	0.001	0.006	0.004	0.003	0.001

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.001	0.000	0.002	0.001	0.001	0.000

Data Persistence Test

Clause 7

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

Clause 10.4.8.5

The FDR shall contain the following for the Data Persistence Test:

1. *A listing of the SPC-1C Workload Generator commands and parameters used to execute each of the Test Runs in the Persistence Test.*
2. *The human readable SPC-1C Test Results File for each of the Test Runs in the Data Persistence Test.*
3. *A table from the successful Persistence Test, which contains the results from the test.*

SPC-1C Workload Generator Input Parameters

The SPC-1C Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1C Workload Generator Input Parameters" on Page 92.

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	375,269,360
Total Number of Logical Blocks Verified	145,056,240
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 10.4.9

The committed delivery date 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 must be the date at which all components are committed to be available. All availability dates, whether for individual components or for the Priced Storage Configuration as a whole, must be disclosed to a precision of one day.

The Availability Date shall be stated in the FDR by either a combination of specific alphanumeric month, numeric day, and numeric year or as "Currently Available" in the case where all components that comprise the Priced Storage Configuration are currently available for customer order and shipment.

The Sun Storage F5100 Flash Array as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

ANOMALIES OR IRREGULARITIES

Clause 10.4.10

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

There were no anomalies or irregularities encountered during the SPC-1C Remote Audit of the Sun Storage F5100 Flash Array.

APPENDIX A: SPC-1C 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-1C Data Repository Definitions

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

Application Storage Unit (ASU): The logical interface between the storage and SPC-1C 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-1C 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-1C 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-1C Data Protection Levels

Protected: Data protection in the event of a single point of failure of any of the configured storage devices.

Unprotected: The Test Sponsor asserts no claim of data protection in the event of a single point of failure.

SPC-1C 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-1C 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-1C 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-1C test result or support an SPC-1C 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.

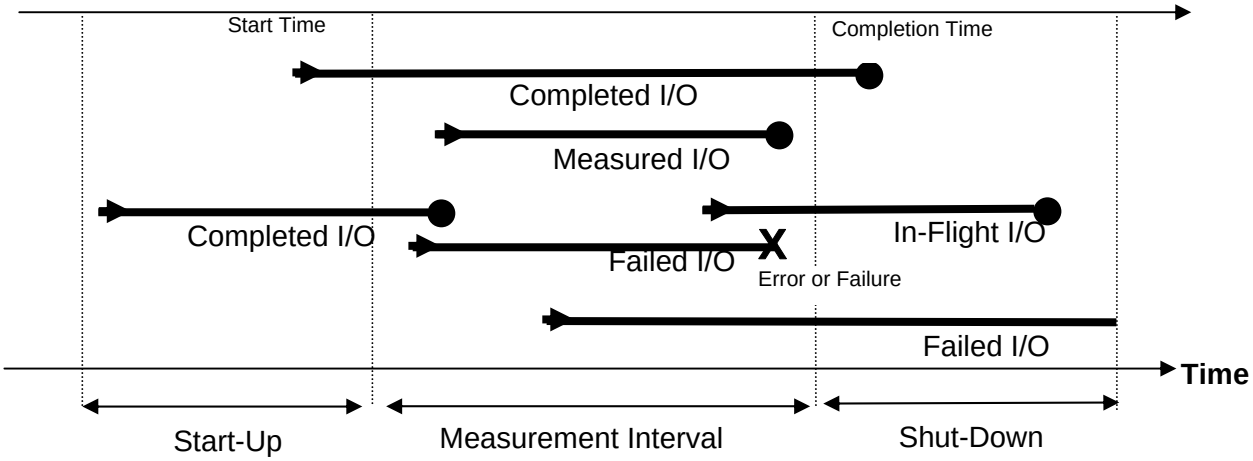
Steady State: The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant.

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

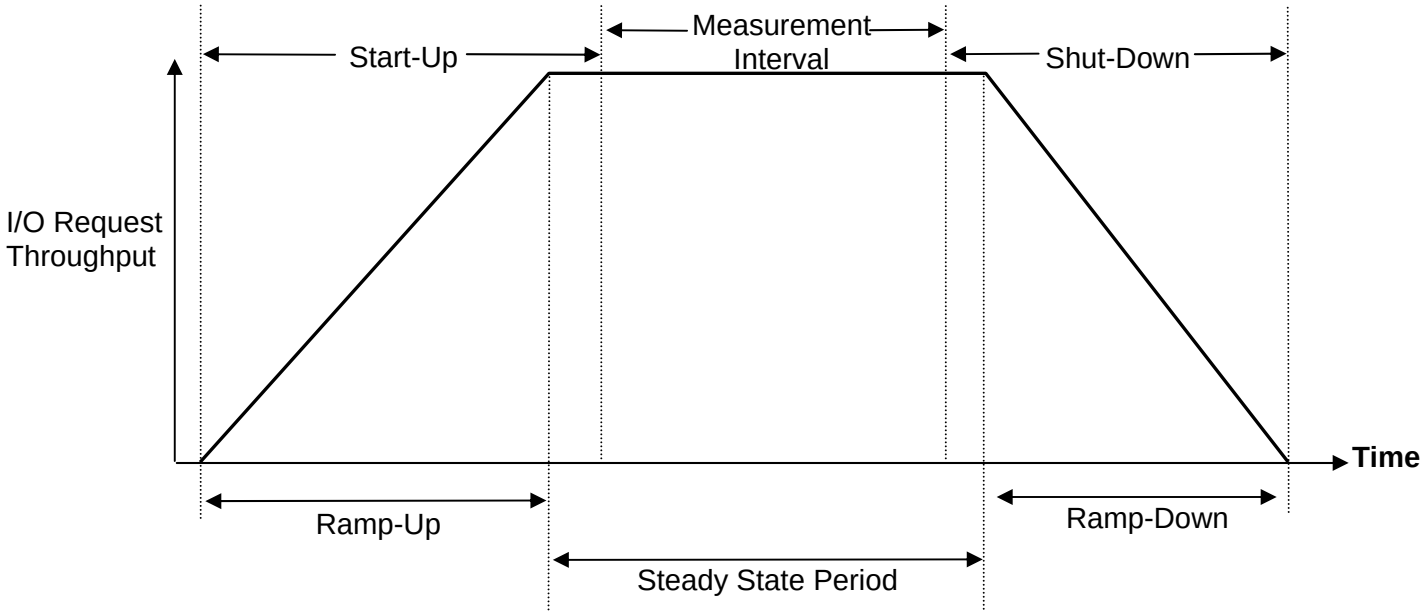
Test Run: The execution of SPC-1C for the purpose of producing or supporting an SPC-1C test result. SPC-1C Test Runs may have a finite and measured Ramp-Up period, Start-Up period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1C Test Run Components" below. All SPC-1C Test Runs shall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

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

I/O Completion Types



SPC-1C Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

Solaris

The following entries were added to the Solaris **/etc/system** file information for execution of the SPC-1 Workload Generator on the Sun SPARC Enterprise M5000 Server.

```
set vxio:vol_default_iodelay = 10
set vxio:vol_maxkiocount = 32768
set vxio:vol_maxioctl = 131072
set vxio:vol_maxio = 8192
set vxio:vol_maxspecialio = 10240
set maxpgio = 65536
set fastscan = 65536
set ufs:ufs_HW = 20971520
set ufs:ufs_LW = 15728640
set autoup = 1024
set tune_t_fsflushr = 1
set sq_max_size = 100
set sdd:sdd_max_throttle=32
set maxphys = 8388608
set sd:sd_max_throttle=32
#set qlc:qlc_enable_pm= 0x0
#set qlc:qlc_execution_throttle=256
set enable_halt_idle_cpus = 0
# for paulr, allows more accurate profiling
set profile:profile_aframes = 4
```

ssd.conf

The following entry was added to the **/kernel/drv/ssd.conf** file:

```
sd-config-list = "ATA     MARVELL SD88SA02","throttle-max:32, throttle-min:1, cache-
nonvolatile:true";

enable-partition-kstats=0;
```

The "ssd.conf" file, used by SPARC systems, and the "sd.conf" file, used by x86 systems, allow for global and individual storage device setting to be configured. For this benchmark, the maximum queue depth was set for the storage devices. In addition, the **enable-partition-kstats** parameter was changed from its default value of zero (0) to prevent the Host System from recording partition statistics. This change slightly reduces CPU overhead for I/O.

sd.conf

The following entries were added to the **/kernel/drv/sd.conf** file:

```
sd-config-list = "ATA     MARVELL SD88SA02","throttle-max:32, throttle-min:1, cache-
nonvolatile:true";

enable-partition-kstats=0;
```

mpt.conf

The following entry was added to the **/kernel/drv/mt.conf** file:

```
# spc1c does not need io completion fanout for 300k IOPS on 16 HBAs
# however, turning it on causes  the IO request code path to
# also avoid mutex contention

mpt_doneq_thread_n_prop=1;
```

This file is the multipath configuration file for multipath feature in Solaris. The above entry was set to avoid mutex contention.

Server CPU Fencing

A server CPU fencing script was run, **fench.sh**, which fences off CPUs to handle interrupts.

fench.sh

```
#!/bin/sh

echo fence.sh updated for M5000 SPC-1c
echo sd.conf tweaking\?
grep enable-partition-kstats /kernel/drv/sd.conf

# turn on all CPUs
psradm -an
# turn off interrupts on 1st half
psradm -i 0-31

# delete all prssets
psrset -i | nawk '{print substr($4,1,length($4)-1)}' | xargs psrset -d 2>/dev/null

# we have 16 major interrupt sources and 64 CPUs
# disable interrupts on 75% of the CPUs.
# - not for now
#nawk 'BEGIN {for (i=0; i<64; i++) if (i%4!=0) print i; exit}' | xargs psradm -i


#  mpt interrupt CPUs go into single CPU processor sets
#  just the 16 mpt instances used by the benchmark
echo ::interrupts | mdb -k | nawk '
BEGIN {
  h["mpt#1"]++;   h["mpt#2"]++;   h["mpt#3"]++;   h["mpt#4"]++;
  h["mpt#5"]++;   h["mpt#6"]++;   h["mpt#7"]++;   h["mpt#8"]++;
  h["mpt#10"]++;  h["mpt#11"]++;  h["mpt#12"]++;  h["mpt#13"]++;
  h["mpt#14"]++;  h["mpt#15"]++;  h["mpt#16"]++;  h["mpt#17"]++;
}

$1 in h {print $NF}' | xargs -n 1 psrset -c
```

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

Configure SAS Expander Domains

The F5100 is configured with four SAS expander domains. Each domain has four zones for a total of sixteen zones and each zone is assigned five of the eighty SATA enterprise-class SLC Flash modules. The files **exp1.txt**, **exp2.txt**, **exp3.txt** and **exp4.txt** are used to configure four zones per each expander domain of the F5100 via the **sscs** command as shown below. The **sscs** command is accessed via the "SUNWstkcam" package found in the CD that ships with the F5100.

SPC1c-Bur-F5100 is the name assigned to the F5100 used in the benchmark.

```
# sscs import –t exp1.txt SPC1c-Bur-F5100
# sscs import –t exp2.txt SPC1c-Bur-F5100
# sscs import –t exp3.txt SPC1c-Bur-F5100
# sscs import –t exp4.txt SPC1c-Bur-F5100
```

exp1.txt

```
{
 "SASConnectors":[{
  "componentClass":"port",
  "componentName":"Chassis.Expander.00.Port 2",
  "description":"Port 2",
  "deviceName":"SPC1c-Bur-F5100",
  "deviceType":"f5100",
  "endpoints":["50800200004d223f:32,33,34,35"],
  "key":"SUN.f5100.50800200004d2200:connector:expander00.PORT2",
  "name":"SPC1c-Bur-F5100.Chassis.Expander.00.Port_2"},{
  "componentClass":"port",
  "componentName":"Chassis.Expander.00.Port 3",
  "description":"Port 3",
  "deviceName":"SPC1c-Bur-F5100",
  "deviceType":"f5100",
  "endpoints":["50800200004d223f:20,21,22,23"],
  "key":"SUN.f5100.50800200004d2200:connector:expander00.PORT3",
  "name":"SPC1c-Bur-F5100.Chassis.Expander.00.Port_3"},{
  "componentClass":"port",
  "componentName":"Chassis.Expander.00.Port 0",
  "description":"Port 0",
  "deviceName":"SPC1c-Bur-F5100",
  "deviceType":"f5100",
  "endpoints":["50800200004d223f:28,29,30,31"],
  "key":"SUN.f5100.50800200004d2200:connector:expander00.PORT0",
  "name":"SPC1c-Bur-F5100.Chassis.Expander.00.Port_0"},{
  "componentClass":"port",
  "componentName":"Chassis.Expander.00.Port 1",
  "description":"Port 1",
  "deviceName":"SPC1c-Bur-F5100",
  "deviceType":"f5100",
  "endpoints":["50800200004d223f:24,25,26,27"],
  "key":"SUN.f5100.50800200004d2200:connector:expander00.PORT1",
  "name":"SPC1c-Bur-F5100.Chassis.Expander.00.Port_1"}],
 "SASEndpoints":[{
```

```
    "EPKey":"500605b0002cd844:4,5,6,7",
    "EPType":"2",
    "SESReference":"host:bur834-66:hba:mpt:16:4,5,6,7",
    "attachedEndpointKey":"50800200004d223f:32,33,34,35",
    "componentClass":"hba",
    "componentName":"mpt:16:4,5,6,7",
    "deviceModel":"host",
    "deviceName":"bur834-66"},{
    "EPKey":"50800200004d220d:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.13",
    "attachedEndpointKey":"50800200004d223f:13",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.13",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2201:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.01",
    "attachedEndpointKey":"50800200004d223f:1",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.01",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2213:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.19",
    "attachedEndpointKey":"50800200004d223f:19",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.19",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2205:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.05",
    "attachedEndpointKey":"50800200004d223f:5",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.05",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"500605b000b09a50:0,1,2,3",
    "EPType":"2",
    "SESReference":"host:bur834-66:hba:mpt:11:0,1,2,3",
    "attachedEndpointKey":"50800200004d223f:28,29,30,31",
    "componentClass":"hba",
    "componentName":"mpt:11:0,1,2,3",
    "deviceModel":"host",
    "deviceName":"bur834-66"},{
    "EPKey":"50800200004d2200:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.00",
    "attachedEndpointKey":"50800200004d223f:0",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.00",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d220b:0",
    "EPType":"3",
```

```
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.11",
    "attachedEndpointKey":"50800200004d223f:11",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.11",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"500605b000a111e4:4,5,6,7",
    "EPType":"2",
    "SESReference":"host:bur834-66:hba:mpt:17:4,5,6,7",
    "attachedEndpointKey":"50800200004d223f:20,21,22,23",
    "componentClass":"hba",
    "componentName":"mpt:17:4,5,6,7",
    "deviceModel":"host",
    "deviceName":"bur834-66"},{
    "EPKey":"50800200004d220a:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.10",
    "attachedEndpointKey":"50800200004d223f:10",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.10",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2203:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.03",
    "attachedEndpointKey":"50800200004d223f:3",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.03",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2209:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.09",
    "attachedEndpointKey":"50800200004d223f:9",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.09",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2204:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.04",
    "attachedEndpointKey":"50800200004d223f:4",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.04",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2212:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.18",
    "attachedEndpointKey":"50800200004d223f:18",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.18",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d220f:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.15",
```

```
    "attachedEndpointKey":"50800200004d223f:15",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.15",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2206:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.06",
    "attachedEndpointKey":"50800200004d223f:6",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.06",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d220c:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.12",
    "attachedEndpointKey":"50800200004d223f:12",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.12",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d220e:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.14",
    "attachedEndpointKey":"50800200004d223f:14",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.14",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2211:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.17",
    "attachedEndpointKey":"50800200004d223f:17",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.17",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2208:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.08",
    "attachedEndpointKey":"50800200004d223f:8",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.08",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2207:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.07",
    "attachedEndpointKey":"50800200004d223f:7",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.07",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d2210:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.16",
```

```
    "attachedEndpointKey":"50800200004d223f:16",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.16",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"500605b000a0f800:0,1,2,3",
    "EPType":"2",
    "SESReference":"host:bur834-66:hba:mpt:10:0,1,2,3",
    "attachedEndpointKey":"50800200004d223f:24,25,26,27",
    "componentClass":"hba",
    "componentName":"mpt:10:0,1,2,3",
    "deviceModel":"host",
    "deviceName":"bur834-66"},{
    "EPKey":"50800200004d2202:0",
    "EPType":"3",
    "SESReference":"f5100:SPC1c-Bur-F5100:disk:EXP0.FMod.02",
    "attachedEndpointKey":"50800200004d223f:2",
    "capacity":"24575868416",
    "componentClass":"disk",
    "componentName":"EXP0.FMod.02",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d223f:32,33,34,35",
    "EPType":"4",
    "SESReference":"f5100:SPC1c-Bur-F5100:port:Chassis.Expander.00.Port 2",
    "attachedEndpointKey":"500605b0002cd844:4,5,6,7",
    "componentClass":"port",
    "componentName":"Chassis.Expander.00.Port 2",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d223f:20,21,22,23",
    "EPType":"4",
    "SESReference":"f5100:SPC1c-Bur-F5100:port:Chassis.Expander.00.Port 3",
    "attachedEndpointKey":"500605b000a111e4:4,5,6,7",
    "componentClass":"port",
    "componentName":"Chassis.Expander.00.Port 3",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d223f:28,29,30,31",
    "EPType":"4",
    "SESReference":"f5100:SPC1c-Bur-F5100:port:Chassis.Expander.00.Port 0",
    "attachedEndpointKey":"500605b000b09a50:0,1,2,3",
    "componentClass":"port",
    "componentName":"Chassis.Expander.00.Port 0",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"},{
    "EPKey":"50800200004d223f:24,25,26,27",
    "EPType":"4",
    "SESReference":"f5100:SPC1c-Bur-F5100:port:Chassis.Expander.00.Port 1",
    "attachedEndpointKey":"500605b000a0f800:0,1,2,3",
    "componentClass":"port",
    "componentName":"Chassis.Expander.00.Port 1",
    "deviceModel":"f5100",
    "deviceName":"SPC1c-Bur-F5100"}],
  "SASExpanders":[{
    "JBODref":"SUN.f5100.50800200004d2200",
    "expKey":"50800200004d223f"}],
  "SASGroups":[{
    "groupId":"22",
    "key":"50800200004d223f.0x16",
```

```
  "memberEndPoint":["50800200004d223f:19","50800200004d223f:20,21,22,23","50800200004d
  223f:18","50800200004d223f:15","50800200004d223f:17","50800200004d223f:16"],
    "permittedGroup":["22"],

  "viewableEndPoint":["50800200004d223f:19","50800200004d223f:20,21,22,23","5080020000
  4d223f:18","50800200004d223f:15","50800200004d223f:17","50800200004d223f:16","508002
  00004d2213:0","500605b000a111e4:4,5,6,7","50800200004d2212:0","50800200004d220f:0","
  50800200004d2211:0","50800200004d2210:0"],
    "zpsdsKey":"50800200004d223f"},{
    "groupId":"18",
    "key":"50800200004d223f.0x12",

  "memberEndPoint":["50800200004d223f:13","50800200004d223f:32,33,34,35","50800200004d
  223f:14","50800200004d223f:11","50800200004d223f:10","50800200004d223f:12"],
    "permittedGroup":["18"],

  "viewableEndPoint":["50800200004d223f:13","50800200004d223f:32,33,34,35","5080020000
  4d223f:14","50800200004d223f:11","50800200004d223f:10","50800200004d223f:12","508002
  00004d220d:0","500605b0002cd844:4,5,6,7","50800200004d220e:0","50800200004d220b:0","
  50800200004d220a:0","50800200004d220c:0"],
    "zpsdsKey":"50800200004d223f"},{
    "groupId":"0",
    "key":"50800200004d223f.0x0",
    "memberEndPoint":[],
    "permittedGroup":[],
    "viewableEndPoint":[],
    "zpsdsKey":"50800200004d223f"},{
    "groupId":"10",
    "key":"50800200004d223f.0xa",

  "memberEndPoint":["50800200004d223f:28,29,30,31","50800200004d223f:2","50800200004d2
  23f:1","50800200004d223f:0","50800200004d223f:3","50800200004d223f:4"],
    "permittedGroup":["10"],

  "viewableEndPoint":["50800200004d223f:28,29,30,31","50800200004d223f:2","50800200004
  d223f:1","50800200004d223f:0","50800200004d223f:3","50800200004d223f:4","500605b000b
  09a50:0,1,2,3","50800200004d2202:0","50800200004d2201:0","50800200004d2200:0","50800
  200004d2203:0","50800200004d2204:0"],
    "zpsdsKey":"50800200004d223f"},{
    "groupId":"1",
    "key":"50800200004d223f.0x1",
    "memberEndPoint":[],
    "permittedGroup":[],
    "viewableEndPoint":[],
    "zpsdsKey":"50800200004d223f"},{
    "groupId":"14",
    "key":"50800200004d223f.0xe",

  "memberEndPoint":["50800200004d223f:5","50800200004d223f:24,25,26,27","50800200004d2
  23f:9","50800200004d223f:6","50800200004d223f:8","50800200004d223f:7"],
    "permittedGroup":["14"],

  "viewableEndPoint":["50800200004d223f:5","50800200004d223f:24,25,26,27","50800200004
  d223f:9","50800200004d223f:6","50800200004d223f:8","50800200004d223f:7","50800200004
  d2205:0","500605b000a0f800:0,1,2,3","50800200004d2209:0","50800200004d2206:0","50800
  200004d2208:0","50800200004d2207:0"],
    "zpsdsKey":"50800200004d223f"}],
   "TDate":"2010-04-05 12:57:21",
   "TKey":"50800200004d223f.txt14652338",
   "TName":"50800200004d223f.txt",
   "TNameResource":"50800200004d223f.txt",
   "TVersion":"2.0",
```

```
  "anchorPoints":[{
   "APDescription":"f5100",
   "APName":"SPC1c-Bur-F5100",
   "JBODRef":"SUN.f5100.50800200004d2200",
   "zoneRefElement":"50800200004d223f"}],
  "autosave":false,
  "factory":false}
```


exp2.txt


```
 {
  "SASConnectors":[{
   "componentClass":"port",
   "componentName":"Chassis.Expander.01.Port 3",
   "description":"Port 3",
   "deviceName":"SPC1c-Bur-F5100",
   "deviceType":"f5100",
   "endpoints":["50800200004d227f:20,21,22,23"],
   "key":"SUN.f5100.50800200004d2200:connector:expander01.PORT3",
   "name":"SPC1c-Bur-F5100.Chassis.Expander.01.Port_3"},{
   "componentClass":"port",
   "componentName":"Chassis.Expander.01.Port 2",
   "description":"Port 2",
   "deviceName":"SPC1c-Bur-F5100",
   "deviceType":"f5100",
   "endpoints":["50800200004d227f:32,33,34,35"],
   "key":"SUN.f5100.50800200004d2200:connector:expander01.PORT2",
   "name":"SPC1c-Bur-F5100.Chassis.Expander.01.Port_2"},{
   "componentClass":"port",
   "componentName":"Chassis.Expander.01.Port 1",
   "description":"Port 1",
   "deviceName":"SPC1c-Bur-F5100",
   "deviceType":"f5100",
   "endpoints":["50800200004d227f:24,25,26,27"],
   "key":"SUN.f5100.50800200004d2200:connector:expander01.PORT1",
   "name":"SPC1c-Bur-F5100.Chassis.Expander.01.Port_1"},{
   "componentClass":"port",
   "componentName":"Chassis.Expander.01.Port 0",
   "description":"Port 0",
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  "viewableEndPoint":["50800200004d227f:5","50800200004d227f:9","50800200004d227f:24,2
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  d2240:0","50800200004d2242:0","50800200004d2243:0","500605b000a0d400:0,1,2,3","50800
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exp2.txt


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exp3.txt


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  4d22ff:15","50800200004d22ff:17","50800200004d22ff:16","50800200004d22ff:18","508002
  00004d22d3:0","500605b000a112f4:4,5,6,7","50800200004d22cf:0","50800200004d22d1:0","
  50800200004d22d0:0","50800200004d22d2:0"],
    "zpsdsKey":"50800200004d22ff"},{
    "groupId":"23",
    "key":"50800200004d22ff.0x17",
    "memberEndPoint":[],
    "permittedGroup":[],
    "viewableEndPoint":[],
    "zpsdsKey":"50800200004d22ff"},{
    "groupId":"10",
    "key":"50800200004d22ff.0xa",

  "memberEndPoint":["50800200004d22ff:8","50800200004d22ff:6","50800200004d22ff:9","50
  800200004d22ff:7","50800200004d22ff:5","50800200004d22ff:24,25,26,27"],
    "permittedGroup":["10"],

  "viewableEndPoint":["50800200004d22ff:8","50800200004d22ff:6","50800200004d22ff:9","
  50800200004d22ff:7","50800200004d22ff:5","50800200004d22ff:24,25,26,27","50800200004
  d22c8:0","50800200004d22c6:0","50800200004d22c9:0","50800200004d22c7:0","50800200004
  d22c5:0","500605b00080bef4:4,5,6,7"],
```

```
   "zpsdsKey":"50800200004d22ff"},{
   "groupId":"1",
   "key":"50800200004d22ff.0x1",
   "memberEndPoint":[],
   "permittedGroup":[],
   "viewableEndPoint":[],
   "zpsdsKey":"50800200004d22ff"},{
   "groupId":"15",
   "key":"50800200004d22ff.0xf",
   "memberEndPoint":[],
   "permittedGroup":[],
   "viewableEndPoint":[],
   "zpsdsKey":"50800200004d22ff"},{
   "groupId":"11",
   "key":"50800200004d22ff.0xb",
   "memberEndPoint":[],
   "permittedGroup":[],
   "viewableEndPoint":[],
   "zpsdsKey":"50800200004d22ff"}],
  "TDate":"2010-04-05 12:59:03",
  "TKey":"50800200004d22ff.txt31305600",
  "TName":"50800200004d22ff.txt",
  "TNameResource":"50800200004d22ff.txt",
  "anchorPoints":[],
  "autosave":false,
  "factory":false}
```

Create SPC-1 Logical Volumes

The configuration script **config-lf-seg.sh** is run on the M5000 Host System. This script creates the 5 SPC-1 Logical Volumes, which comprise the three ASUs, used in the benchmark.

config-lf-seg.sh

```
#!/bin/ksh
# By Javier Chavez
#
#set -x
export NOINUSE_CHECK=1
#
clear
rm pr* di* md.tab
echo " "
echo " "
echo " Removing old Disk links and Meta devices"
echo " "
echo " "
sleep 2
for x in `metastat -p | grep ^d* | awk '{print$1}'`
do
metaclear -f $x
done
#
echo " kill me now or wait 15 minutes ! "
sleep 3
#
## Probe server and remove all old device links
devfsadm -C
## Probe server and add new device links
devfsadm
```

```
echo " "
echo " "
##
##
#### Configuring new disks on controller 2
echo " Configuring new disks"
echo " "
echo " Configuring `ls /dev/rdsk/c1t*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c2*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c3*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c4*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c5*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c6*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c7*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c8*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c10*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c11*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c12*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c13*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c14*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c15*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c16*d0s2 | wc -l ` disks"
echo " Configuring `ls /dev/rdsk/c17*d0s2 | wc -l ` disks"
##sleep 2
touch disks
echo " "
ls /dev/rdsk/c2t*d0s2 >> disks
ls /dev/rdsk/c3t*d0s2 >> disks
ls /dev/rdsk/c4t*d0s2 >> disks
ls /dev/rdsk/c5t*d0s2 >> disks
ls /dev/rdsk/c6t*d0s2 >> disks
ls /dev/rdsk/c7t*d0s2 >> disks
ls /dev/rdsk/c8t*d0s2 >> disks
ls /dev/rdsk/c1t*d0s2 >> disks
ls /dev/rdsk/c10t*d0s2 >> disks
ls /dev/rdsk/c11t*d0s2 >> disks
ls /dev/rdsk/c12t*d0s2 >> disks
ls /dev/rdsk/c13t*d0s2 >> disks
ls /dev/rdsk/c14t*d0s2 >> disks
ls /dev/rdsk/c15t*d0s2 >> disks
ls /dev/rdsk/c16t*d0s2 >> disks
ls /dev/rdsk/c17t*d0s2 >> disks
echo " "
echo `wc -l disks` are being configured
echo " Starting to Label all new disks"
sleep 2
cat disks | sed 's/s2\@/s2/g' > disk1
rm disks
# Now we sort by controller
######
######
touch asu3-disk2
touch disk2
# Sort disks to round robin the expander
cat disk1 | grep c3 | grep t5 >> asu3-disk2
cat disk1 | grep c12 | grep t5 >> asu3-disk2
cat disk1 | grep c2 | grep t5 >> asu3-disk2
cat disk1 | grep c11 | grep t5 >> asu3-disk2
#
cat disk1 | grep c6 | grep t5 >> asu3-disk2
cat disk1 | grep c15 | grep t5 >> disk2
cat disk1 | grep c10 | grep t5 >> disk2
cat disk1 | grep c1t | grep t5 >> disk2
```

```
#
cat disk1 | grep c4 | grep t5 >> disk2
cat disk1 | grep c13 | grep t5 >> disk2
cat disk1 | grep c16 | grep t5 >> disk2
cat disk1 | grep c8 | grep t5 >> disk2
#
cat disk1 | grep c5 | grep t5 >> disk2
cat disk1 | grep c14 | grep t5 >> disk2
cat disk1 | grep c17 | grep t5 >> disk2
cat disk1 | grep c7 | grep t5 >> disk2
######
wc -l disk2
wc -l asu3-disk2
sleep 5
######
cat disk1 | grep c3 | grep t1 >> asu3-disk2
cat disk1 | grep c12 | grep t1 >> asu3-disk2
cat disk1 | grep c2 | grep t1 >> asu3-disk2
cat disk1 | grep c11 | grep t1 >> asu3-disk2
#
cat disk1 | grep c6 | grep t1 >> asu3-disk2
cat disk1 | grep c15 | grep t1 >> disk2
cat disk1 | grep c10 | grep t1 >> disk2
cat disk1 | grep c1t | grep t1 >> disk2
#
cat disk1 | grep c4 | grep t1 >> disk2
cat disk1 | grep c13 | grep t1 >> disk2
cat disk1 | grep c16 | grep t1 >> disk2
cat disk1 | grep c8 | grep t1 >> disk2
#
cat disk1 | grep c5 | grep t1 >> disk2
cat disk1 | grep c14 | grep t1 >> disk2
cat disk1 | grep c17 | grep t1 >> disk2
cat disk1 | grep c7 | grep t1 >> disk2
######
wc -l disk2
wc -l asu3-disk2
sleep 5
######
cat disk1 | grep c3 | grep t2 >> asu3-disk2
cat disk1 | grep c12 | grep t2 >> asu3-disk2
cat disk1 | grep c2 | grep t2 >> asu3-disk2
cat disk1 | grep c11 | grep t2 >> asu3-disk2
#
cat disk1 | grep c6 | grep t2 >> asu3-disk2
cat disk1 | grep c15 | grep t2 >> disk2
cat disk1 | grep c10 | grep t2 >> disk2
cat disk1 | grep c1t | grep t2 >> disk2
#
cat disk1 | grep c4 | grep t2 >> disk2
cat disk1 | grep c13 | grep t2 >> disk2
cat disk1 | grep c16 | grep t2 >> disk2
cat disk1 | grep c8 | grep t2 >> disk2
#
cat disk1 | grep c5 | grep t2 >> disk2
cat disk1 | grep c14 | grep t2 >> disk2
cat disk1 | grep c17 | grep t2 >> disk2
cat disk1 | grep c7 | grep t2 >> disk2
#####
wc -l disk2
wc -l asu3-disk2
sleep 5
#####
```

```
cat disk1 | grep c3 | grep t3 >> asu3-disk2
cat disk1 | grep c12 | grep t3 >> asu3-disk2
cat disk1 | grep c2 | grep t3 >> asu3-disk2
cat disk1 | grep c11 | grep t3 >> asu3-disk2
#
cat disk1 | grep c6 | grep t3 >> asu3-disk2
cat disk1 | grep c15 | grep t3 >> disk2
cat disk1 | grep c10 | grep t3 >> disk2
cat disk1 | grep c1t | grep t3 >> disk2
#
cat disk1 | grep c4 | grep t3 >> disk2
cat disk1 | grep c13 | grep t3 >> disk2
cat disk1 | grep c16 | grep t3 >> disk2
cat disk1 | grep c8 | grep t3 >> disk2
#
cat disk1 | grep c5 | grep t3 >> disk2
cat disk1 | grep c14 | grep t3 >> disk2
cat disk1 | grep c17 | grep t3 >> disk2
cat disk1 | grep c7 | grep t3 >> disk2
######
wc -l disk2
wc -l asu3-disk2
sleep 5
######
cat disk1 | grep c3 | grep t4 >> asu3-disk2
cat disk1 | grep c12 | grep t4 >> asu3-disk2
cat disk1 | grep c2 | grep t4 >> asu3-disk2
cat disk1 | grep c11 | grep t4 >> asu3-disk2
#
cat disk1 | grep c6 | grep t4 >> asu3-disk2
cat disk1 | grep c15 | grep t4 >> disk2
cat disk1 | grep c10 | grep t4 >> disk2
cat disk1 | grep c1t | grep t4 >> disk2
#
cat disk1 | grep c4 | grep t4 >> disk2
cat disk1 | grep c13 | grep t4 >> disk2
cat disk1 | grep c16 | grep t4 >> disk2
cat disk1 | grep c8 | grep t4 >> disk2
#
cat disk1 | grep c5 | grep t4 >> disk2
cat disk1 | grep c14 | grep t4 >> disk2
cat disk1 | grep c17 | grep t4 >> disk2
cat disk1 | grep c7 | grep t4 >> disk2
######
######
rm disk1
#mv disk1 del-disk1
wc -l disk2
wc -l asu3-disk2
sleep 5
wc -l asu3-disk2
sleep 5
##
C_disks=asu3-disk2
#
for f in `cat $C_disks`
do
format $f << EOFF
y
ty
0
y
p
```

```
p
0
usr
wu
8
23427c
l
y
quit
quit
EOFF
done
##
C_disks=disk2
#
for f in `cat $C_disks`
do
format $f << EOFF
y
ty
0
y
p
p
3
usr
wu
8
3.81g
4
usr
wu
3910
3.81g
5
usr
wu
7812
3.81g
6
usr
wu
11714
11.445g
l
y
quit
quit
EOFF
done
clear
echo " "
echo " "
echo " All `ls /dev/rdsk/c2t*d0s2 | wc -l ` disks have been configured"
echo " "

# Create a new disk list
cat asu3-disk2 | sed 's/s2/s0/g' > disk0
cat disk2 | sed 's/s2/s3/g' > disk3
cat disk2 | sed 's/s2/s4/g' > disk4
cat disk2 | sed 's/s2/s5/g' > disk5
cat disk2 | sed 's/s2/s6/g' > disk6
#
```

```
sleep 2
echo " "
echo " "
echo " Configuring asu device files"
sleep 2
# asu config files
# d31
echo " " > asu31
echo " " >> asu31
echo "d31 1 25 \\" >> asu31
cat disk0 >> asu31
echo "-i 512k" >>asu31
echo " " >> asu31
# d32
#echo " " > asu32
#echo "d32 1 80 \\" >> asu32
#cat disk1 >> asu32
#echo "-i 1m" >>asu32
#echo " " >> asu32
# d11
echo " " > asu11
echo " " >> asu11
echo "d11 1 55 \\" >> asu11
cat disk3 >> asu11
echo "-i 512k" >>asu11
echo " " >> asu11
# d12
echo " " > asu12
echo " " >> asu12
echo "d12 1 55 \\" >> asu12
cat disk4 >> asu12
echo "-i 512k" >>asu12
echo " " >> asu12
# d13
echo " " > asu13
echo " " >> asu13
echo "d13 1 55 \\" >> asu13
cat disk5 >> asu13
echo "-i 512k" >>asu13
echo " " >> asu13
# d2
echo " " > asu2
echo " " >> asu2
echo "d2 1 55 \\" >> asu2
cat disk6 >> asu2
echo "-i 512k" >>asu2
echo " " >> asu2
#
# Create md.tab file
mv asu3-disk2 disk2-asu3
cat asu* > m
#
#
rm asu*
# Clean up md.tab file
cat m | sed 's/d0s0/d0s0 \\/g' > md
#cat md | sed 's/d0s1/d0s1 \\/g' > md.
cat md | sed 's/d0s3/d0s3 \\/g' > md.t
cat md.t | sed 's/d0s4/d0s4 \\/g' > md.ta
cat md.ta | sed 's/d0s5/d0s5 \\/g' > md.taa
cat md.taa | sed 's/d0s6/d0s6 \\/g' > md.tab
##
# Copy new md.tab file to /etc/lvm
```

```
mv /etc/lvm/md.tab /etc/lvm/save-md.tab-orig
cp md.tab /etc/lvm/md.tab
rm md*
rm m
cp /etc/lvm/md.tab .

echo " New md.tab file has been created"
sleep 2
echo " Starting to create new metadevices."
# create metadevice
echo " "
metainit d31
echo " "
#metainit d32
echo " "
metainit d11
echo " "
metainit d12
echo " "
metainit d13
echo " "
metainit d2
#sleep 5
## Display results
clear
metastat
#
# Create  prtvtoc.txt file
touch prtvtoc.txt
cat disk2-asu3 >> disk2
rm disk2-asu3
#mv disk2-asu3 del-disk2-asu3
for x in `cat disk2`
do
prtvtoc $x >> prtvtoc.txt
done
#prtvtoc /dev/md/rdsk/d31 >> prtvtoc.txt
#prtvtoc /dev/md/rdsk/d32 >> prtvtoc.txt
prtvtoc /dev/md/rdsk/d11 >> prtvtoc.txt
prtvtoc /dev/md/rdsk/d12 >> prtvtoc.txt
prtvtoc /dev/md/rdsk/d13 >> prtvtoc.txt
prtvtoc /dev/md/rdsk/d2 >> prtvtoc.txt
#
clear
##
# Create List of disks for parameter files.
mv disk2 disklist.txt
rm disk?
```

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

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

```
sd=asu1_1,lun=/dev/md/rdsk/d11,size=206158.5m
sd=asu1_2,lun=/dev/md/rdsk/d12,size=206158.5m
sd=asu1_3,lun=/dev/md/rdsk/d13,size=206158.5m
sd=asu2_1,lun=/dev/md/rdsk/d2,size=618475.5m
sd=asu3_1,lun=/dev/md/rdsk/d31,size=137439m
#sd=asu1_1,lun=/dev/md/rdsk/d11,size=147440271360
#sd=asu1_2,lun=/dev/md/rdsk/d12,size=147440271360
#sd=asu1_3,lun=/dev/md/rdsk/d13,size=147440271360
#sd=asu2_1,lun=/dev/md/rdsk/d2,size=442320814080
#sd=asu3_1,lun=/dev/md/rdsk/d31,size=98293514240
```

APPENDIX E: SPC-1C 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.

```
#!/usr/bin/ksh
#
#  80 Fmods SPC-1c
#
#
script=runSpc1c-LF.sh
#
# Audit run-1 4-6-2010
#
output=Audit-R1
basedir=/spc/output/spc-1c/LF/m5000/Audit-80Fmods
outdir=$basedir/$output
mkdir -p $outdir
# Comment this next line if running persist 2
cp $script $outdir
# Uncomment this next line if running persist 2
#cp $script $outdir/$script-P2
#
# Send out email informing spc1c started
mailx -s $script-Started -r Javier.Chavez@oracle.com Javier.Chavez@oracle.com <
$script
#
## Create config files and the prtvtoc
#clear
#echo " we are going to create the metadevices then run the benchmark "
#cd config-LF-seg ;./config-lf-seg.sh ; cd
#sleep 3
## Now copy config script and all config files to the output directory
cp -r config-LF-seg $outdir/
##
#
# Gather system tunables and disk information from the F5100
# Comment this next line if running persist 2
hostdir=$outdir/HostP1
# Uncomment this next line if running persist 2
#hostdir=$outdir/HostP2
mkdir -p $hostdir
cp fence.sh $hostdir
cp /etc/system $hostdir
cp /kernel/drv/sd.conf $hostdir
cp /kernel/drv/ssd.conf $hostdir
cp /kernel/drv/mpt.conf $hostdir
/usr/dist/exe/whatami > $hostdir/sys-profile.txt
cp /usr/dist/exe/whatami $hostdir/
cd /net/sbm-240a.central/export/sae/lffw/5440a ; ./getDiskList.sh
cp Complete-F5100-Fmod-List.txt F5100-Fmod-List.txt $hostdir
cp getDiskList.sh $hostdir; cd
# get a metastat from the hosts
touch $hostdir/metastat-output.txt
metastat >> $hostdir/metastat-output.txt
sleep 2
```

```
# Setup a Link to check realtime status on Currnet run..
#
touch $outdir/link ; echo " " >> $outdir/link
echo "  Use the link below to Monitor the current run" >> $outdir/link
echo " " >> $outdir/link
echo http://sbm-240a.central.sun.com/export/spc/spc-1c/metrics >> $outdir/link
echo " " >> $outdir/link
echo "  Use the link below to Monitor the archive " >> $outdir/link
echo " " >> $outdir/link
echo http://sbm-240a.central.sun.com/export/$outdir >> $outdir/link
echo " " >> $outdir/link
echo "  The script Below is currently running .. " >> $outdir/link
echo " " >> $outdir/link
head -50  $script >> $outdir/link
mailx -r Javier.Chavez@oracle.com -s $script--Started Javier.Chavez@oracle.com <
$outdir/link
rm $outdir/link
#
# Run fence script
sleep 5
priocntl -c FX -p 17 -m 17  -s $$
echo " Running fence script now"
sleep 1
./fence.sh
#
bsu=61000
STEP=10
startup=480
while [[ $bsu -le 61000 ]]
do
Outdir=$outdir/${bsu}
mkdir -p $Outdir
cp spc1c.cfg $Outdir
cp /etc/lvm/md.tab $Outdir
echo "Metrics will start in 10 seconds"
sleep 2
###
java -Xmx1024m -Xss128k -Xms128m metrics -b $bsu -s $startup
sleep 3
mv metrics $Outdir
sleep 3
#######
java -Xmx1024m -Xss128k -Xms128m repeat1 -b $bsu -s $startup
sleep 30
java -Xmx1024m -Xss128k -Xms128m repeat2 -b $bsu -s $startup
sleep 30
java -Xmx1024m -Xss128k -Xms128m persist1 -b $bsu
sleep 30
#java -Xmx1024m -Xss128k -Xms128m persist2
#sleep 30
#mv repeatability1 $Outdir
#mv repeatability2 $Outdir
#mv persistence1 $Outdir
#mv persistence2 $Outdir
#mv asu* $Outdir
#mv SPCOut $Outdir
#
bsu=`expr $bsu + $STEP`
echo "All done .... sleeping for 5 minutes"
sleep 3
done
#
cd $basedir ;/bin/chmod -R 777 $output ;/usr/bin/zip -r $output.zip $output
```

```
#cd $basedir ;/bin/chmod -R 777 $output ;mv $output.zip $output.zip-P1 ;/usr/bin/zip
-r $output.zip $output
touch $basedir/link ; echo " " >> $basedir/link
echo "  Use the link below to download the zipped file" >> $basedir/link
echo " " >> $basedir/link
echo http://sbm-240a.central.sun.com/export/$basedir/$output.zip >> $basedir/link
echo " " >> $basedir/link
echo "  Use the link below to take a look at the output files" >> $basedir/link
echo " " >> $basedir/link
echo http://sbm-240a.central.sun.com/export/$basedir >> $basedir/link
mailx -s $script-is-finished Javier.Chavez@oracle.com < $basedir/link
rm $basedir/link ; cd
sleep 60
cp nohup.out $Outdir/nohup.out.txt
#cp nohup.out $Outdir/nohup.out-P2.txt
reboot
```

Persistence Test Run 2

The following script was used to execute Persistence Test Run 2 after the above execution sequence and the required power-off cycle, which followed successful completion of Persistence Test Run 1.

```
#!/usr/bin/ksh
#
#  80 Fmods SPC-1c
#
#
script=runSpc1c-LF.sh
#
# run-1 3-30-2010
# run-2 3-31-2010
# run-3 4-1-2010
# run-4 4-1-2010
# run-5 4-1-2010
# run-6 4-2-2010
# run-7 4-2-2010
# Audit run-1 4-6-2010
#
output=Audit-R1
basedir=/spc/output/spc-1c/LF/m5000/Audit-80Fmods
outdir=$basedir/$output
mkdir -p $outdir
# Comment this next line if running persist 2
#cp $script $outdir
# Uncomment this next line if running persist 2
cp $script $outdir/$script-P2
#
# Send out email informing spc1c started
mailx -s $script-Started -r Javier.Chavez@oracle.com Javier.Chavez@oracle.com <
$script
#
## Create config files and the prtvtoc
#clear
#echo " we are going to create the metadevices then run the benchmark "
#cd config-LF-seg ;./config-lf-seg.sh ; cd
#sleep 3
## Now copy config script and all config files to the output directory
#cp -r config-LF-seg $outdir/
##
#
```

```
# Gather system tunables and disk information from the F5100
# Comment this next line if running persist 2
#hostdir=$outdir/HostP1
# Uncomment this next line if running persist 2
hostdir=$outdir/HostP2
mkdir -p $hostdir
cp fence.sh $hostdir
cp /etc/system $hostdir
cp /kernel/drv/sd.conf $hostdir
cp /kernel/drv/ssd.conf $hostdir
cp /kernel/drv/mpt.conf $hostdir
/usr/dist/exe/whatami > $hostdir/sys-profile.txt
cp /usr/dist/exe/whatami $hostdir/
cd /net/sbm-240a.central/export/sae/lffw/5440a ; ./getDiskList.sh
cp Complete-F5100-Fmod-List.txt F5100-Fmod-List.txt $hostdir
cp getDiskList.sh $hostdir; cd
# get a metastat from the hosts
touch $hostdir/metastat-output.txt
#metastat >> $hostdir/metastat-output.txt
#sleep 2
# Setup a Link to check realtime status on Currnet run..
#
touch $outdir/link ; echo " " >> $outdir/link
echo "  Use the link below to Monitor the current run" >> $outdir/link
echo " " >> $outdir/link
echo http://sbm-240a.central.sun.com/export/spc/spc-1c/metrics >> $outdir/link
echo " " >> $outdir/link
echo "  Use the link below to Monitor the archive " >> $outdir/link
echo " " >> $outdir/link
echo http://sbm-240a.central.sun.com/export/$outdir >> $outdir/link
echo " " >> $outdir/link
echo "  The script Below is currently running .. " >> $outdir/link
echo " " >> $outdir/link
head -50  $script >> $outdir/link
mailx -r Javier.Chavez@oracle.com -s $script--Started Javier.Chavez@oracle.com <
$outdir/link
rm $outdir/link
#
# Run fence script
sleep 5
priocntl -c FX -p 17 -m 17  -s $$
echo " Running fence script now"
sleep 1
./fence.sh
#
bsu=61000
STEP=10
startup=480
while [[ $bsu -le 61000 ]]
do
Outdir=$outdir/${bsu}
mkdir -p $Outdir
cp spc1c.cfg $Outdir
cp /etc/lvm/md.tab $Outdir
echo "Metrics will start in 10 seconds"
sleep 2
###
#java -Xmx1024m -Xss128k -Xms128m metrics -b $bsu -s $startup
#sleep 3
#mv metrics $Outdir
#sleep 3
#######
#java -Xmx1024m -Xss128k -Xms128m repeat1 -b $bsu -s $startup
```

```
#sleep 30
#java -Xmx1024m -Xss128k -Xms128m repeat2 -b $bsu -s $startup
#sleep 30
#java -Xmx1024m -Xss128k -Xms128m persist1 -b $bsu
#sleep 30
java -Xmx1024m -Xss128k -Xms128m persist2
sleep 30
mv repeatability1 $Outdir
mv repeatability2 $Outdir
mv persistence1 $Outdir
mv persistence2 $Outdir
mv asu* $Outdir
mv SPCOut $Outdir
#
bsu=`expr $bsu + $STEP`
echo "All done .... sleeping for 5 minutes"
sleep 3
done
#
#cd $basedir ;/bin/chmod -R 777 $output ;/usr/bin/zip -r $output.zip $output
cd $basedir ;/bin/chmod -R 777 $output ;mv $output.zip $output.zip-P1 ;/usr/bin/zip
-r $output.zip $output
touch $basedir/link ; echo " " >> $basedir/link
echo "  Use the link below to download the zipped file" >> $basedir/link
echo " " >> $basedir/link
echo http://sbm-240a.central.sun.com/export/$basedir/$output.zip >> $basedir/link
echo " " >> $basedir/link
echo "  Use the link below to take a look at the output files" >> $basedir/link
echo " " >> $basedir/link
echo http://sbm-240a.central.sun.com/export/$basedir >> $basedir/link
mailx -s $script-is-finished Javier.Chavez@oracle.com < $basedir/link
rm $basedir/link ; cd
banner done
sleep 60
#cp nohup.out $Outdir/nohup.out.txt
cp nohup.out $Outdir/nohup.out-P2.txt
#reboot
```