SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

HUAWEI TECHNOLOGIES CO., LTD.
HUAWEI OCEANSTOR DORADO2100 G2

SPC-1 V1.14

Submitted for Review: May 22, 2013
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First Edition – May 2013

Trademarks

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AUDIT CERTIFICATION

Eric He
Huawei Technologies Co., Ltd.
Huawei Chengdu Base
No. 1899, Xiyuan Avenue
Chengdu, 611731 P.R. China

May 20, 2013

The SPC Benchmark 1™ Reported Data listed below for the Huawei OceanStor Dorado2100 G2 was produced in compliance with the SPC Benchmark 1™ v1.14 Remote Audit requirements.

SPC Benchmark 1™ v1.14 Reported Data	
Tested Storage Product (TSP) Name: Huawei OceanStor Dorado2100 G2	
Metric	**Reported Result**
SPC-1 IOPS™	400,587.11
SPC-1 Price-Performance	$0.57/SPC-1 IOPS™
Total ASU Capacity	3,801.046 GB
Data Protection Level	Protected 2 *(Mirroring)*
Total Price (including three-year maintenance)	$227,062.00
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with 1.14 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by information supplied by Huawei Technologies Co., Ltd.:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.

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Redwood City, CA 94062
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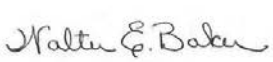
AUDIT CERTIFICATION *(CONT.)*

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

Audit Notes:

There were no audit notes or exceptions.

Respectfully,



Walter E. Baker
SPC Auditor

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

LETTER OF GOOD FAITH

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

Date: May 13, 2013

From: Huawei Technologies Co., Ltd.

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

Subject: SPC-1 Letter of Good Faith for the Huawei OceanStor Dorado2100 G2

Huawei Technologies Co., Ltd. is the SPC-1 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V1.14 of the SPC-1 benchmark specification.
In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark that affected the reported results even if the items are not explicitly required to be disclosed by the SPC-1 benchmark specification.

Signed: Date:

Fan Ruiqi

2013.5.13

Fan Ruiqi
President of Storage Product Line

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Eric He – eric.heji@huawei.com Huawei Chengdu Base No. 1899, Xiyuan Avenue Chengdu, 611731 P.R. China Phone: 86 28 65281999 FAX: 86 28 62282516
Test Sponsor Alternate Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Xu Zhong – xuzhong@huawei.com Huawei Chengdu Base No. 1899, Xiyuan Avenue Chengdu, 611731 P.R. China Phone: 86 28 65281927 FAX: 86 28 62282516
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.14
SPC-1 Workload Generator revision number	V2.3.0
Date Results were first used publicly	May 22, 2013
Date the FDR was submitted to the SPC	May 22, 2013
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	May 20, 2013

Tested Storage Product (TSP) Description

Huawei OceanStor Dorado2100 G2 (the Dorado2100 G2 for short) is a SAN-based solid state storage product designed for the enterprise-level high-performance storage market. The Dorado2100 G2 uses a full-SSD architecture and employs advanced cache management and I/O scheduling mechanisms. It offers an ideal choice for various storage scenarios that are performance-demanding such as database, VDI, and high-performance computing.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Huawei OceanStor Dorado2100 G2	
Metric	**Reported Result**
SPC-1 IOPS™	400,587.11
SPC-1 Price-Performance™	$0.57/SPC-1 IOPS™
Total ASU Capacity	3,801.046 GB
Data Protection Level	Protected 2 *(Mirroring)*
Total Price	$227,062.00
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

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

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

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

A **Data Protection Level** of **Protected 2** using ***Mirroring*** configures two or more identical copies of user data.

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

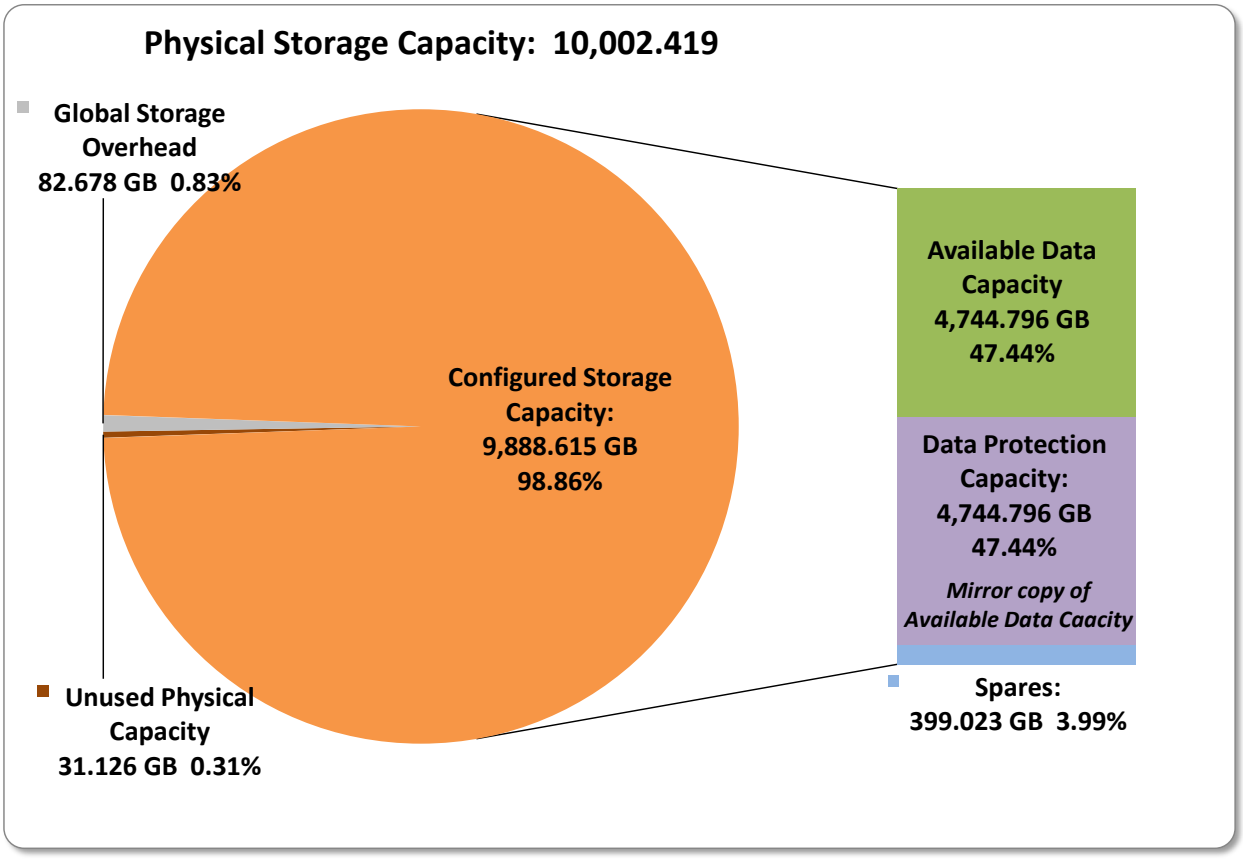
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 16.

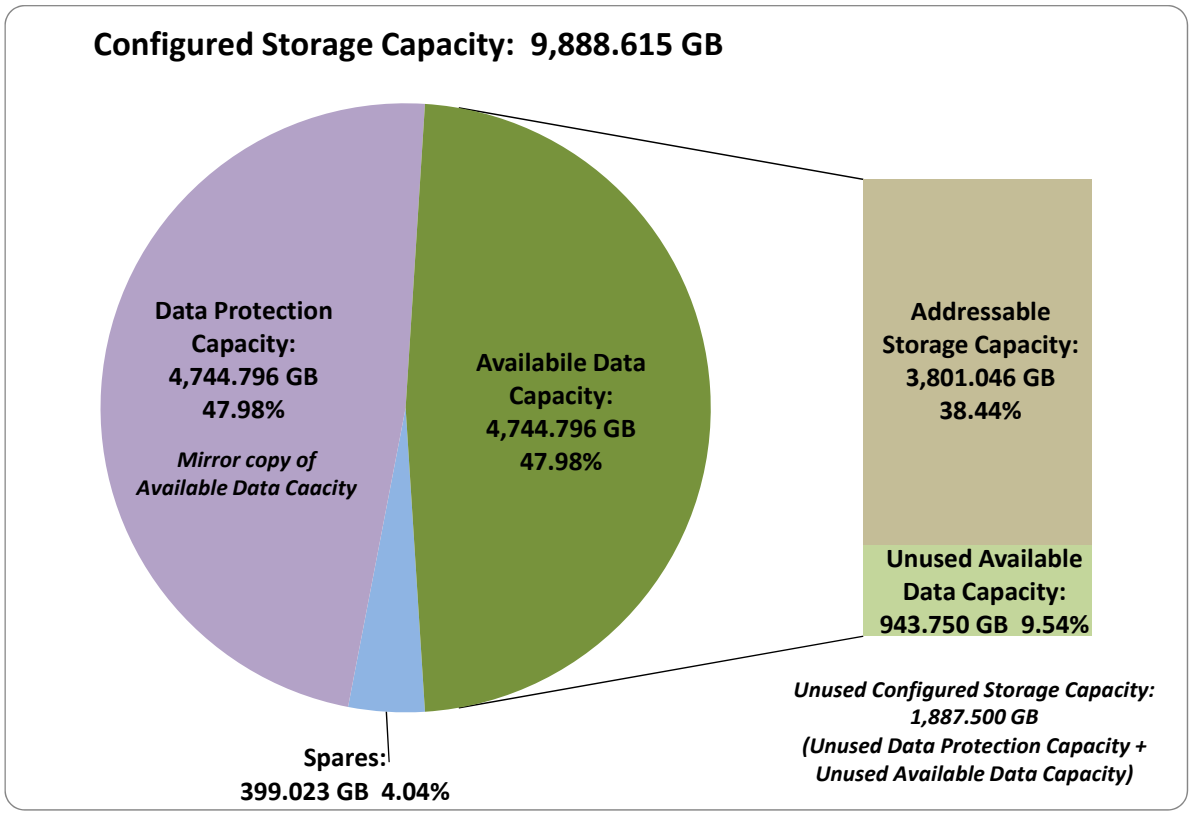
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

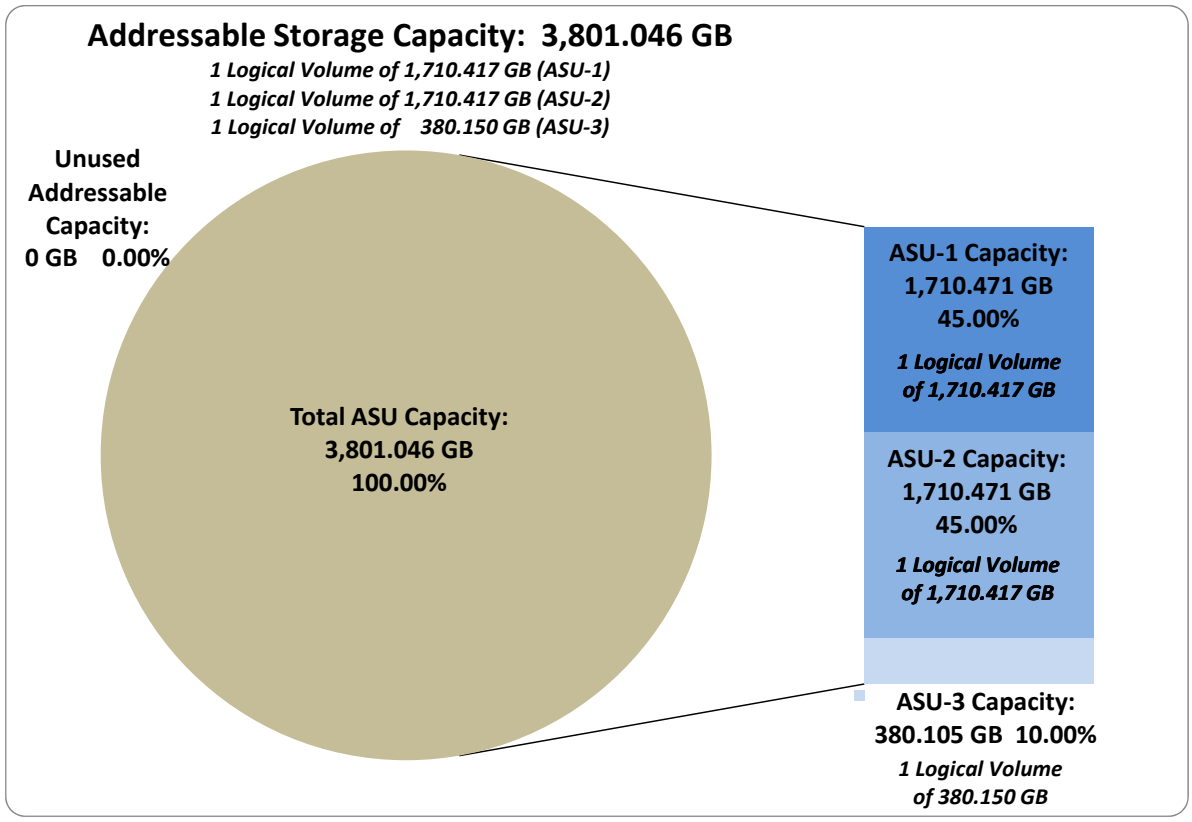
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

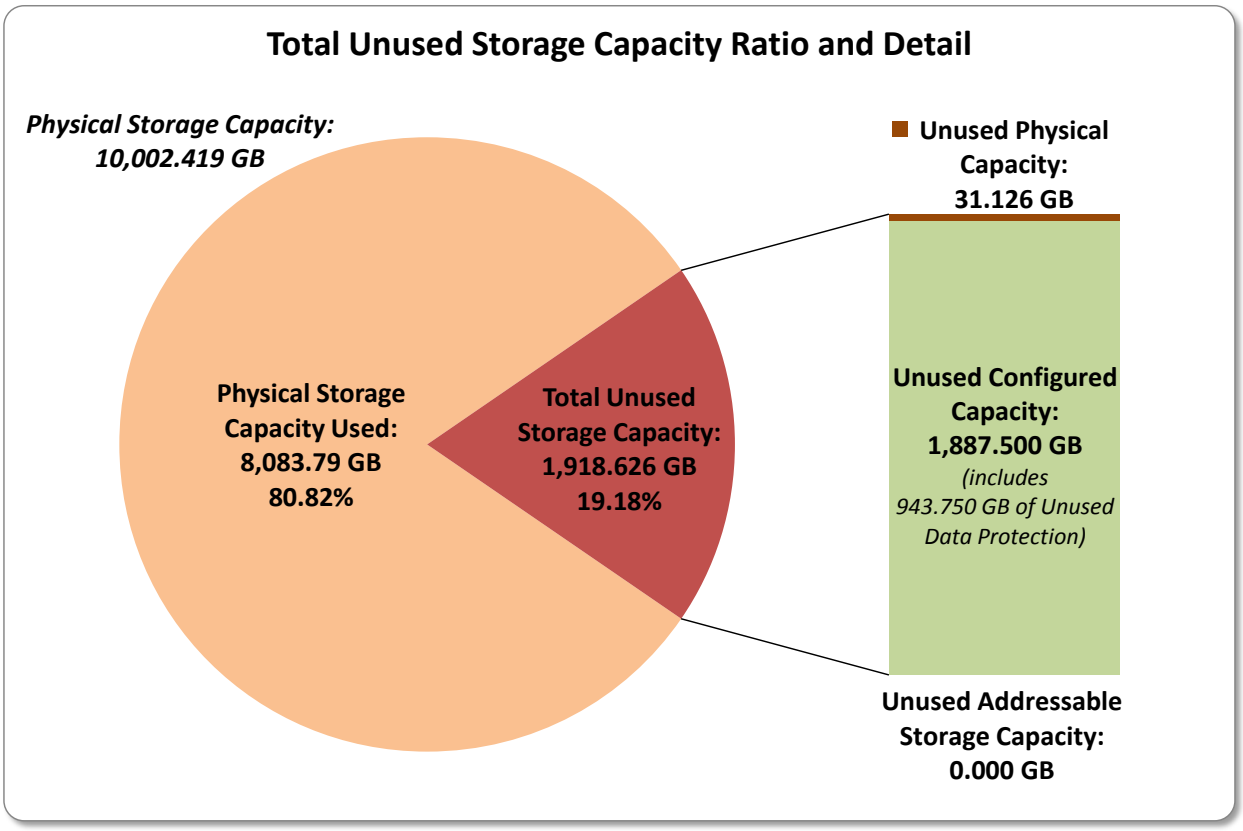
Storage Capacities, Relationships, and Utilization

The following four charts and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.




Configured Storage Capacity: 9,888.615 GB
Data Protection Capacity: 4,744.796 GB 47.98%
Mirror copy of Available Data Caacity
Availabile Data Capacity: 4,744.796 GB 47.98%
Spares: 399.023 GB 4.04%
Addressable Storage Capacity: 3,801.046 GB 38.44%
Unused Available Data Capacity: 943.750 GB 9.54%
Unused Configured Storage Capacity: 1,887.500 GB
(Unused Data Protection Capacity + Unused Available Data Capacity)


Addressable Storage Capacity: 3,801.046 GB
1 Logical Volume of 1,710.417 GB (ASU-1)
1 Logical Volume of 1,710.417 GB (ASU-2)
1 Logical Volume of 380.150 GB (ASU-3)
Unused Addressable Capacity: 0 GB 0.00%
Total ASU Capacity: 3,801.046 GB 100.00%
ASU-1 Capacity: 1,710.471 GB 45.00%
1 Logical Volume of 1,710.417 GB
ASU-2 Capacity: 1,710.471 GB 45.00%
1 Logical Volume of 1,710.417 GB
ASU-3 Capacity: 380.105 GB 10.00%
1 Logical Volume of 380.150 GB



SPC-1 Storage Capacity Utilization	
Application Utilization	38.00%
Protected Application Utilization	76.00%
Unused Storage Ratio	19.18%

Application Utilization: Total ASU Capacity *(3,801.046 GB)* divided by Physical Storage Capacity *(10,002.419 GB)*

Protected Application Utilization: Total ASU Capacity *(3,801.046 GB)* plus total Data Protection Capacity *(4,755.796 GB)* minus unused Data Protection Capacity *(943.750 GB)* divided by Physical Storage Capacity *(10,002.419 GB)*

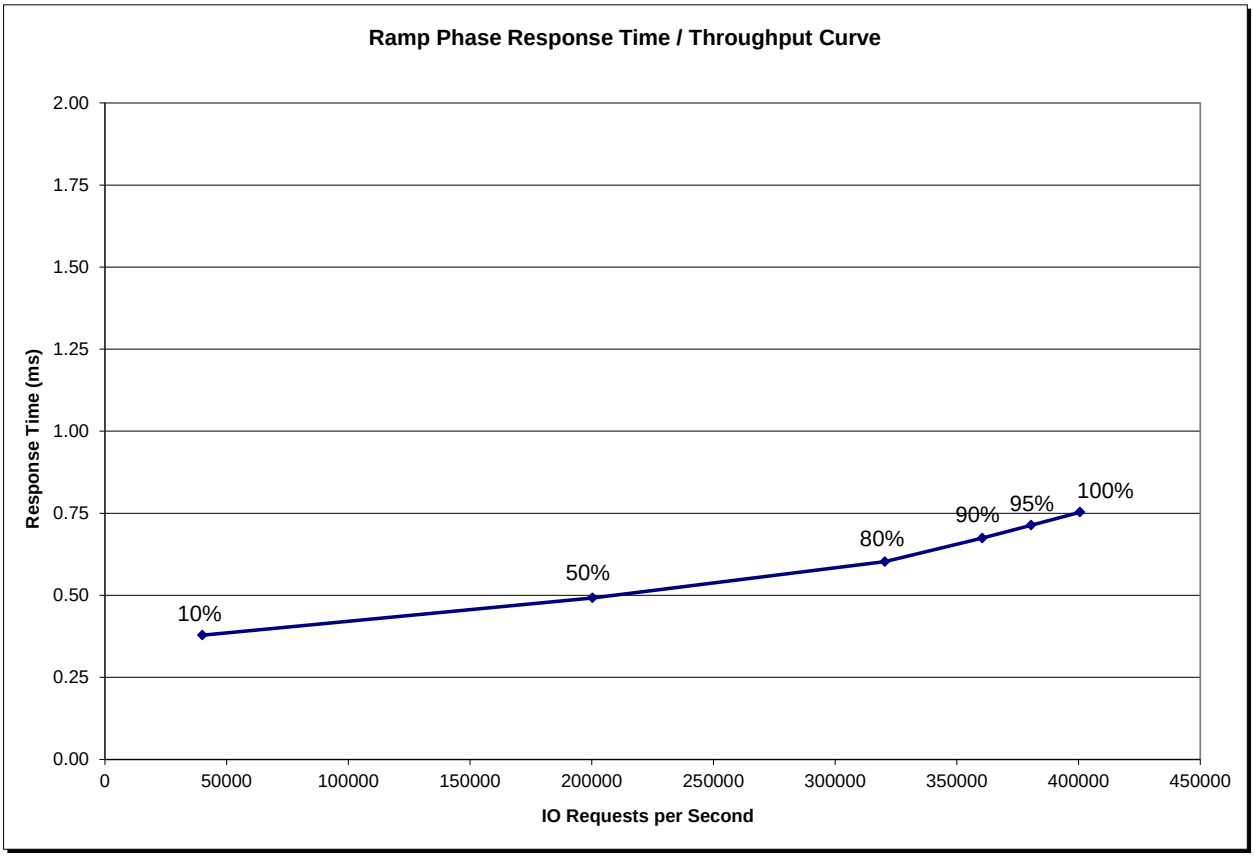
Unused Storage Ratio: Total Unused Capacity *(1,918.626 GB)* divided by Physical Storage Capacity *(10,002.419 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 22-23.

Response Time – Throughput Curve

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

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



Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	40,046.55	200,314.88	320,467.29	360,458.56	380,547.56	400,587.11
Average Response Time (ms):						
All ASUs	0.38	0.49	0.60	0.67	0.71	0.75
ASU-1	0.37	0.49	0.60	0.67	0.71	0.74
ASU-2	0.42	0.55	0.68	0.76	0.80	0.84
ASU-3	0.38	0.48	0.58	0.65	0.69	0.74
Reads	0.41	0.54	0.67	0.74	0.78	0.82
Writes	0.36	0.46	0.56	0.63	0.67	0.71

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

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

Priced Storage Configuration Pricing

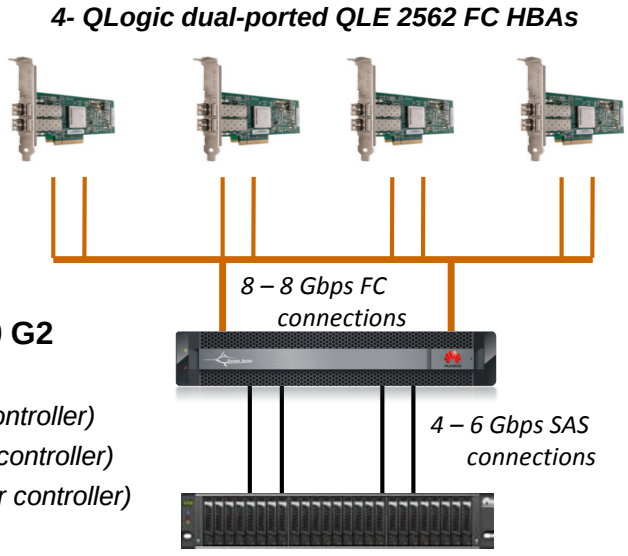
PART #	DESCRIPTION	QTY	Net Price	Ext
	Dorado2100 G2 Main Equipment			
	Storage Processor Enclosure			
STTZ03STTS	OceanStor Dorado2100 G2 High Performance Solid State Storage System-5.0TB(AC,25*200GB SLC SSD,600K IOPS,48Gbps Bandwidth,8*8G FC Port,with HW Solid-state Storage System Software,SPE51C0225)	1	$89,446.00	$89,446.00
	Disk Enclosure			
STTZ05DAE25	High Performance Solid State Storage System Disk Enclosure-5.0TB(2U,AC,25*200GB SLC,with HW SAS in Band Management Software,DAE12525U2)	1	$80,640.00	$80,640.00
	Installation Material			
SS-OP-D-LC-M-3	Patchcord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m	8	$13.00	$104.00
mini-SAS-3	Outsourcing Cable,External Mini SAS Cable,3.0m,External Mini SAS 26 Pin Plug,28AWG*8P BLACK(S),External Mini SAS 26 Pin Plug,Key2,4,6	1	$74.00	$74.00
	Software			
LIC-Dorado-ISM02	HW Integrated Storage Manager-Device Management License for Dorado	1		
	Third Party			
N8GHBA000	QLOGIC QLE2562 HBA Card,PCIE,8Gbps DualPort ,Fiber Channel Multimode LC Optic Interface,English Manual,Driver CD	4	$1,698.00	$6,792.00
	Product Support Service			
0235G7ES_88134ULJ_1	OceanStor Dorado2100 G2 High Performance Solid State Storage System-5.0TB(AC,25*200GB SLC SSD,600K IOPS,48Gbps Bandwidth,8*8G FC Port,with HW Solid-state Storage System Software,SPE51C0225)_Warranty Upgrade To Hi-Care Onsite Premier 24x7x4H Engineer Onsite Service_3 Year(s)	1	$26,297.00	$26,297.00
0235G7EW_88134ULJ_1	High Performance Solid State Storage System Disk Enclosure-5.0TB(2U,AC,25*200GB SLC,with HW SAS in Band Management Software,DAE12525U2)_Warranty Upgrade To Hi-Care Onsite Premier 24x7x4H Engineer Onsite Service_3 Year(s)	1	$23,709.00	$23,709.00
	TOTAL			**$227,062.00**

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

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

Huawei Technologies Co., Ltd. only sells its products to third-party resellers, who in turn, sell those products to U.S. customers. The above pricing, which also includes the required three-year maintenance and support, was obtained from one of those third-party resellers. See page 72 (*Appendix F: Third-Party Quotation*) for a copy of the third-party reseller quotation.

Priced Storage Configuration Diagram



Huawei OceanStor Dorado2100 G2

dual controllers - Active-Active

48 GB memory/cache (24 GB per controller)

8 – 8 Gbps FC connections (4 per controller)

4 – 6 Gbps SAS connections (2 per controller)

25 – 200 GB SSD disk drives

1 – Disk Enclosure

25 – 200 GB SSD disk drives

50 – 200 GB SSD disk drives

25 – disk drives in the controller enclosure

25 – disk drives in the disk enclosure

Priced Storage Configuration Components

Priced Storage Configuration:
4 – Qlogic dual-port QLE2562 FC HBAs
Huawei OceanStor Dorado2100 G2 **dual-controllers – Active Active** 48 GB memory/cache *(24 GB per controller)* 8 – 8 Gbps FC front-end ports *(4 per controller)* *(8 – 8 Gbps connections used)* 4 – 24 Gbps SAS backend ports *(2 per controller)* *(4 – 6 Gbps connections used)* 25 – 200 GB SSD disk drives
1 – Disk Enclosure 25 – 200 GB SSD disk drives
50 – 200 GB SSD disk drives *25 – SSD disk drives in the controller enclosure* *25 – SSD disk drives in the disk enclosure*

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

CONFIGURATION INFORMATION

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

Clause 9.4.3.4.1

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

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 19 *(Benchmark Configuration/Tested Storage Configuration Diagram)*.

Storage Network Configuration

Clause 9.4.3.4.1

…

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

Clause 9.4.3.4.2

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

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

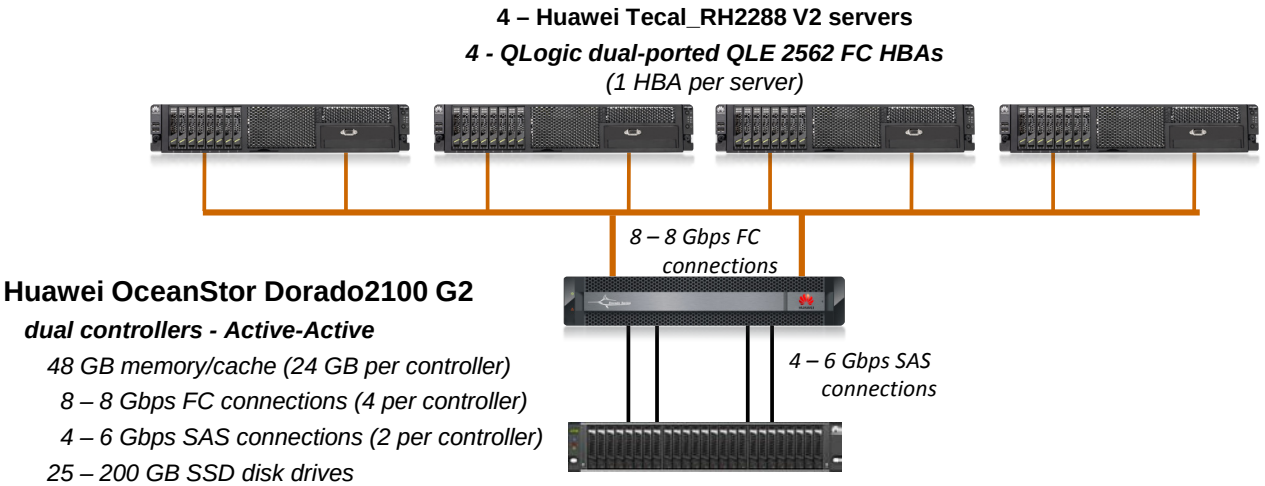
Host System(s) and Tested Storage Configuration (TSC) Table of Components

Clause 9.4.3.4.3

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

The Host System(s) and TSC table of components may be found on page 19 *(Host Systems and Tested Storage Configuration Components)*.

Benchmark Configuration/Tested Storage Configuration Diagram



Host Systems and Tested Storage Configuration Components

Host Systems:	Tested Storage Configuration (TSC):
4 – Huawei Tecal RH 2288 V2 servers each with: 2 – Intel® Xeon® E5-2660 CPUs 2.20 GHz, 20 MB L3 cache 256 GB main memory Red Hat Enterprise Linux Server release 5.5 x86_64 LVM version 2.02.56(1) RHEL5 (2010-02-08) expect version 5.43.0-5.1 PCIe	4 – Qlogic dual-port QLE2562 FC HBAs *(1 HBA per server)*
	Huawei OceanStor Dorado2100 G2 **dual-controllers – Active Active** 48 GB memory/cache *(24 GB per controller)* 8 – 8 Gbps FC front-end ports *(4 per controller)* *(8 – 8 Gbps connections used)* 4 – 24 Gbps SAS backend ports *(2 per controller)* *(4 – 6 Gbps connections used)* 25 – 200 GB SSD disk drives
	1 – Disk Enclosure 25 – 200 GB SSD disk drives
	50 – 200 GB SSD disk drives *25 – SSD disk drives in the controller enclosure* *25 – SSD disk drives in the disk enclosure*

Customer Tunable Parameters and Options

Clause 9.4.3.5.1

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

Appendix B: Customer Tunable Parameters and Options on page 63 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

Tested Storage Configuration (TSC) Description

Clause 9.4.3.5.2

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

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

Appendix C: Tested Storage Configuration (TSC) Creation on page 64 contains the detailed information that describes how to create and configure the logical TSC.

SPC-1 Workload Generator Storage Configuration

Clause 9.4.3.5.3

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

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

ASU Pre-Fill

Clause 5.3.3

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

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

SPC-1 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1 storage capacities and mappings used in the Tested Storage Configuration. *SPC-1 Data Repository Definitions* on page 59 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.4.3.6.1

Two tables and four charts documenting the storage capacities and relationships of the SPC-1 Storage Hierarchy (Clause 2.1) shall be included in the FDR. … The capacity value in each chart may be listed as an integer value, for readability, rather than the decimal value listed in [the table below].

SPC-1 Storage Capacities

The Physical Storage Capacity consisted of 10,002.419 GB distributed over 50 solid state disks (SSDs), each with a formatted capacity of 200.048 GB. There was 31.126 GB (0.31%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 82.678 GB (0.83%) of the Physical Storage Capacity. There was 1,887.500 GB (98.86%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100.00% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) of Unused Storage within the Addressable Storage Capacity. The Data Protection *(Mirroring)* capacity was 4,744.796 GB of which 3,801.046 GB was utilized. The total Unused Storage capacity was 1,918.626 GB.

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

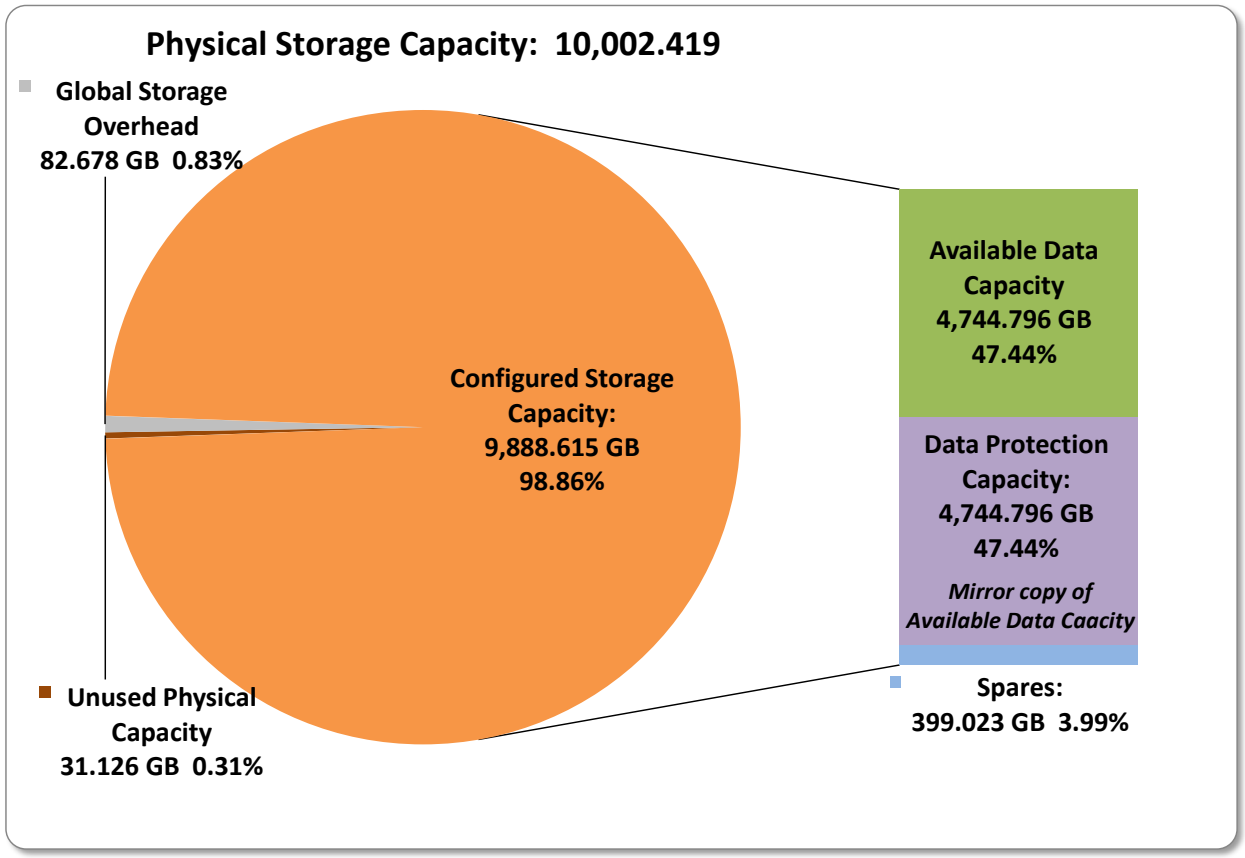
SPC-1 Storage Capacities

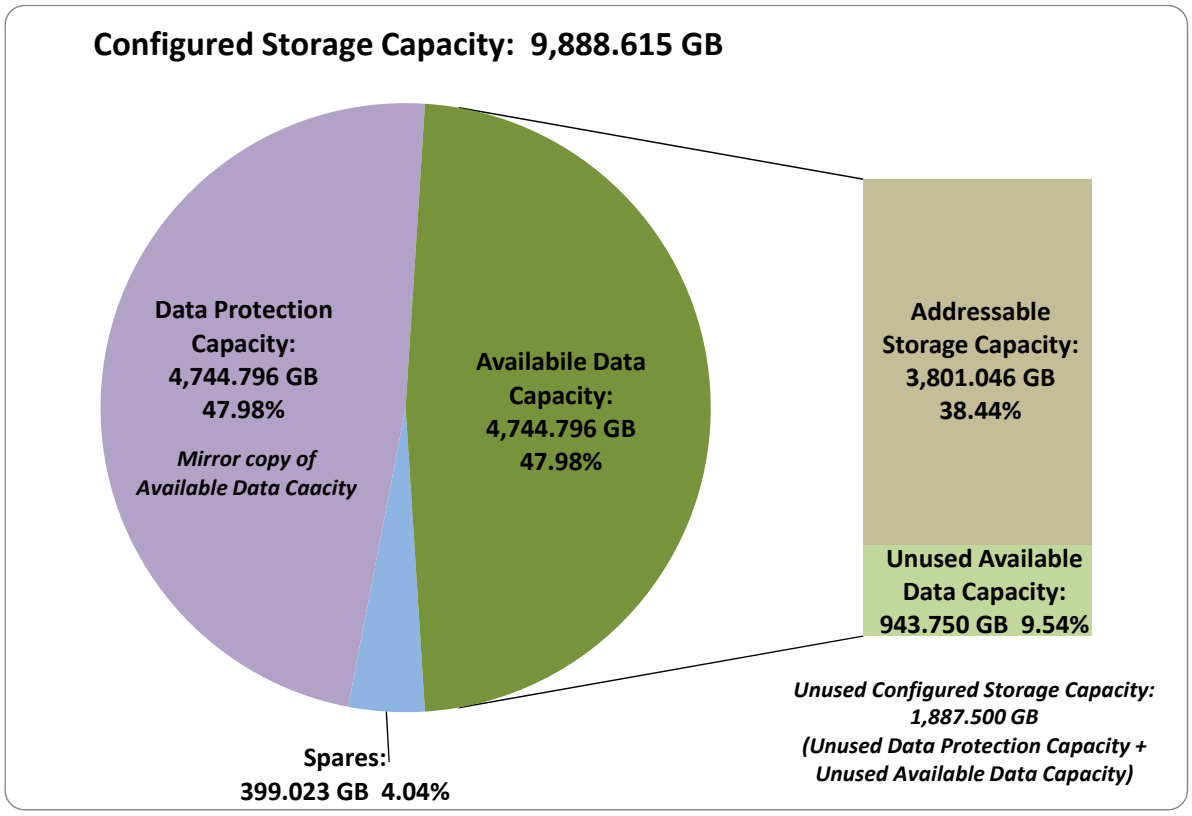
Storage Hierarchy Component	Units	Capacity
Total ASU Capacity	Gigabytes (GB)	3,801.046
Addressable Storage Capacity	Gigabytes (GB)	3,801.046
Configured Storage Capacity	Gigabytes (GB)	9,888.615
Physical Storage Capacity	Gigabytes (GB)	10,002.419
Data Protection *(Mirroring)*	Gigabytes (GB)	4,744.796
Required Storage *(spares, overhead)*	Gigabytes (GB)	399.023
Global Storage Overhead	Gigabytes (GB)	82.678
Total Unused Storage	Gigabytes (GB)	1,918.626

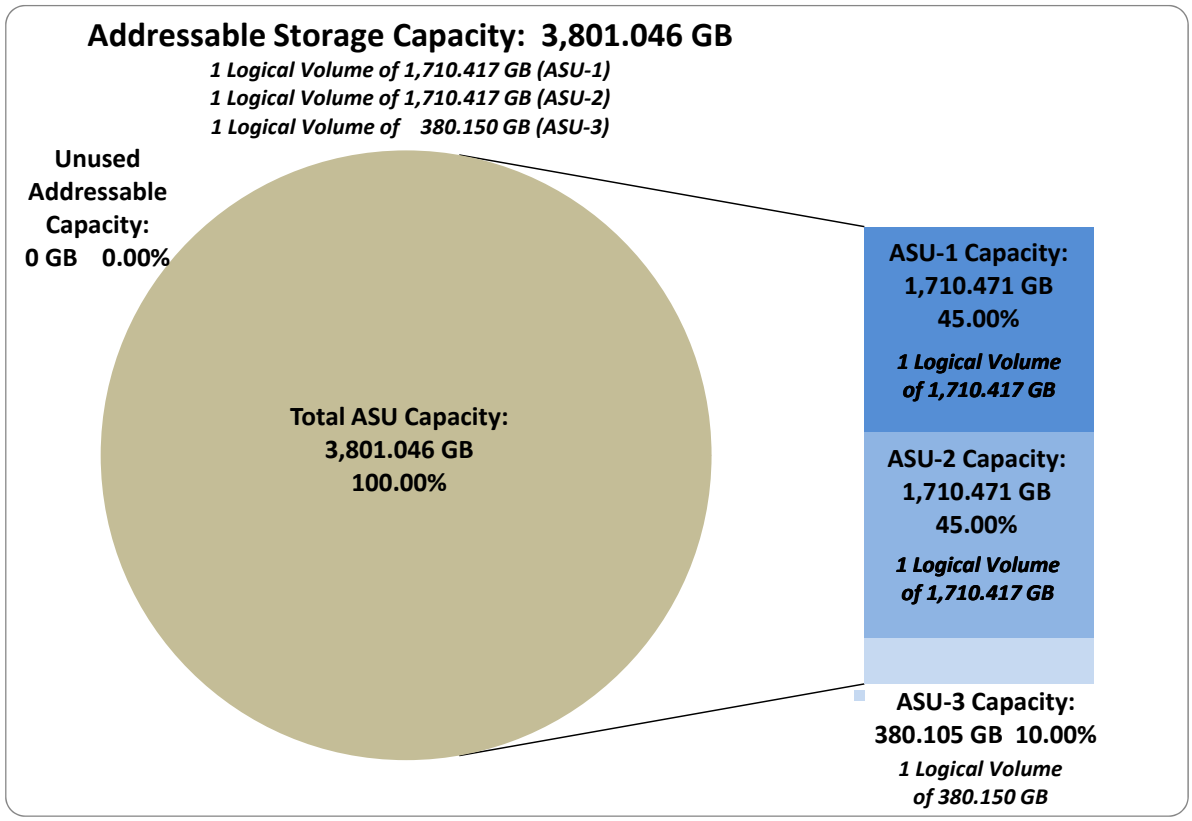
SPC-1 Storage Hierarchy Ratios

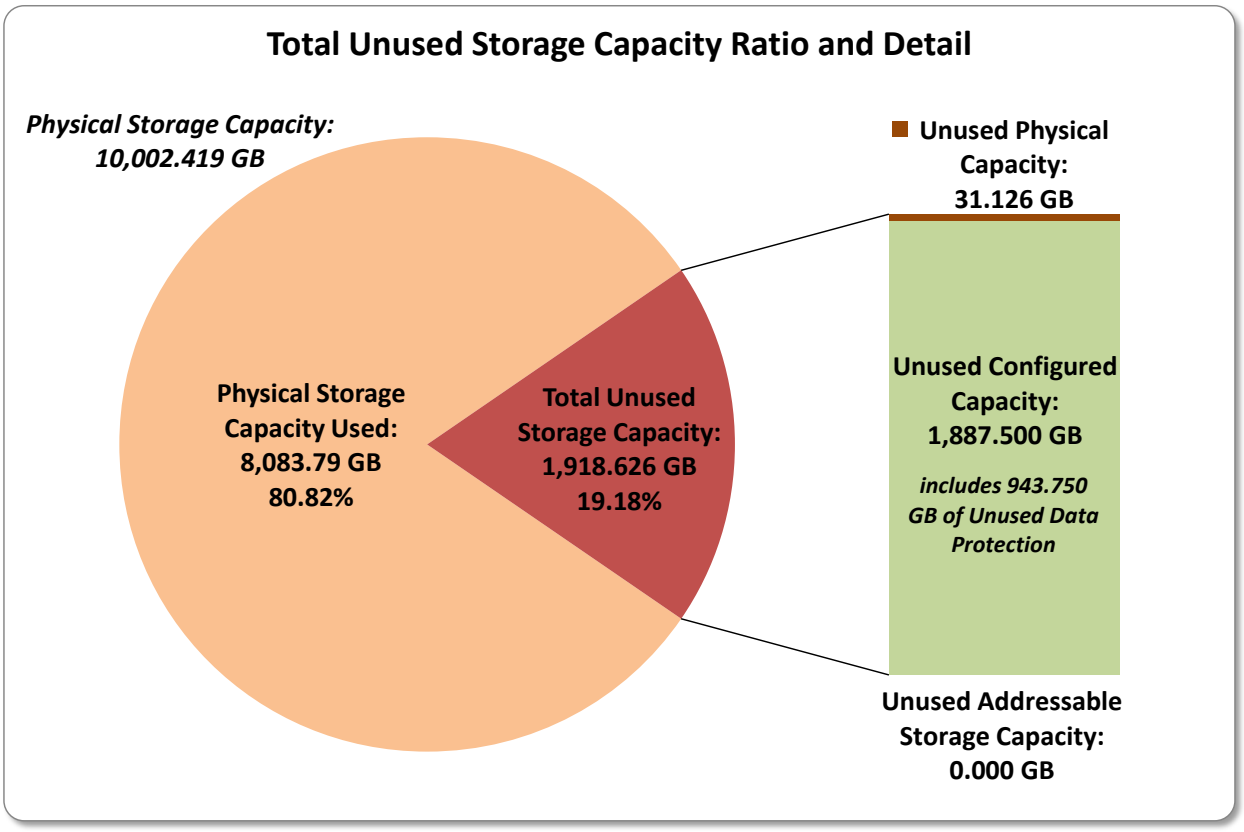
	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	38.44%	38.00%
Required for Data Protection *(Mirroring)*		47.95%	47.40%
Addressable Storage Capacity		38.44%	38.00%
Required Storage *(spares and overhead)*		4.04%	3.99%
Configured Storage Capacity			98.86%
Global Storage Overhead			0.83%
Unused Storage:			
Addressable	0.00%		
Configured		23.12%	
Physical			0.31%

SPC-1 Storage Capacity Charts




Configured Storage Capacity: 9,888.615 GB
Data Protection Capacity: 4,744.796 GB 47.98%
Mirror copy of Available Data Caacity
Availabile Data Capacity: 4,744.796 GB 47.98%
Addressable Storage Capacity: 3,801.046 GB 38.44%
Unused Available Data Capacity: 943.750 GB 9.54%
Unused Configured Storage Capacity: 1,887.500 GB
(Unused Data Protection Capacity + Unused Available Data Capacity)
Spares: 399.023 GB 4.04%


Addressable Storage Capacity: 3,801.046 GB
1 Logical Volume of 1,710.417 GB (ASU-1)
1 Logical Volume of 1,710.417 GB (ASU-2)
1 Logical Volume of 380.150 GB (ASU-3)
Unused Addressable Capacity: 0 GB 0.00%
Total ASU Capacity: 3,801.046 GB 100.00%
ASU-1 Capacity: 1,710.471 GB 45.00%
1 Logical Volume of 1,710.417 GB
ASU-2 Capacity: 1,710.471 GB 45.00%
1 Logical Volume of 1,710.417 GB
ASU-3 Capacity: 380.105 GB 10.00%
1 Logical Volume of 380.150 GB



Storage Capacity Utilization

Clause 9.4.3.6.2

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

Clause 2.8.1

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

Clause 2.8.2

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

Clause 2.8.3

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

SPC-1 Storage Capacity Utilization	
Application Utilization	38.00%
Protected Application Utilization	76.00%
Unused Storage Ratio	19.18%

Logical Volume Capacity and ASU Mapping

Clause 9.4.3.6.3

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

Logical Volume Capacity and Mapping		
ASU-1 (1,710.471 GB)	**ASU-2 (1,710.471 GB)**	**ASU-3 (380.105 GB)**
1 Logical Volume 1,710.471 GB per Logical Volume (1,710.471 GB used per Logical Volume)	1 Logical Volume 1,710.471 GB per Logical Volume (1,710.471 GB used per Logical Volume)	1 Logical Volume 380.105 GB per Logical Volume (380.105 GB used per Logical Volume)

The Data Protection Level used for all Logical Volumes was **Protected 2** using ***Mirroring*** as described on page 11. See "ASU Configuration" in the **IOPS Test Results File** for more detailed configuration information.

SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. *Appendix A: SPC-1 Glossary* on page 60 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

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

SPC-1 Tests, Test Phases, and Test Runs

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

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

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

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

"Ramp-Up" Test Runs

Clause 5.3.13

In order to warm-up caches or perform the initial ASU data migration in a multi-tier configuration, a Test Sponsor may perform a series of "Ramp-Up" Test Runs as a substitute for an initial, gradual Ramp-Up.

Clause 5.3.13.3

The "Ramp-Up" Test Runs will immediately precede the Primary Metrics Test as part of the uninterrupted SPC-1 measurement sequence.

Clause 9.4.3.7.1

If a series of "Ramp-Up" Test Runs were included in the SPC-1 measurement sequence, the FDR shall report the duration (ramp-up and measurement interval), BSU level, SPC-1 IOPS and average response time for each "Ramp-Up" Test Run in an appropriate table.

There were no "Ramp-Up" Test Runs in this set of benchmark measurements.

Primary Metrics Test – Sustainability Test Phase

Clause 5.4.4.1.1

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

Clause 5.4.4.1.2

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

Clause 5.4.4.1.4

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

Clause 9.4.3.7.2

For the Sustainability Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

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

Sustainability Test Results File

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

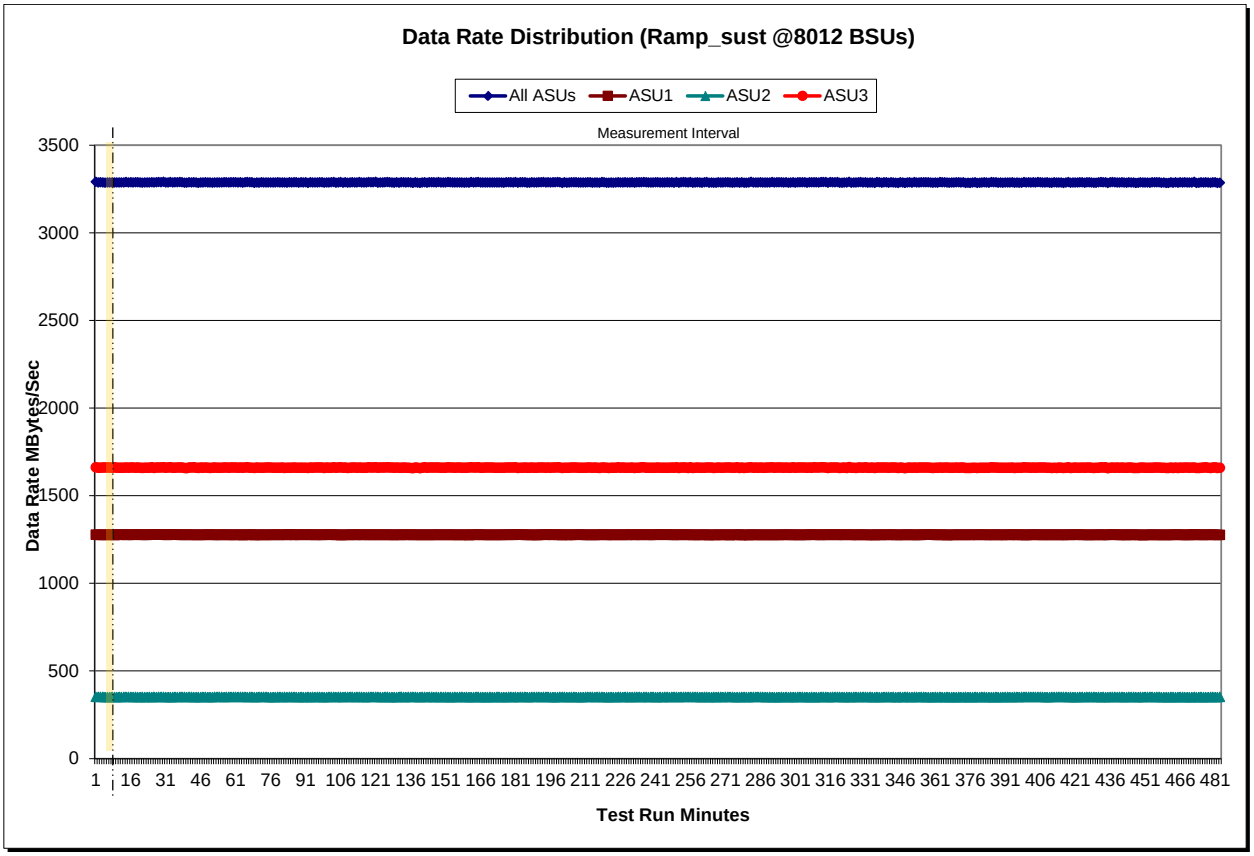
Sustainability Test Results File

Sustainability – Data Rate Distribution Data (MB/second)

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

Sustainability Data Rate Table

Sustainability – Data Rate Distribution Graph

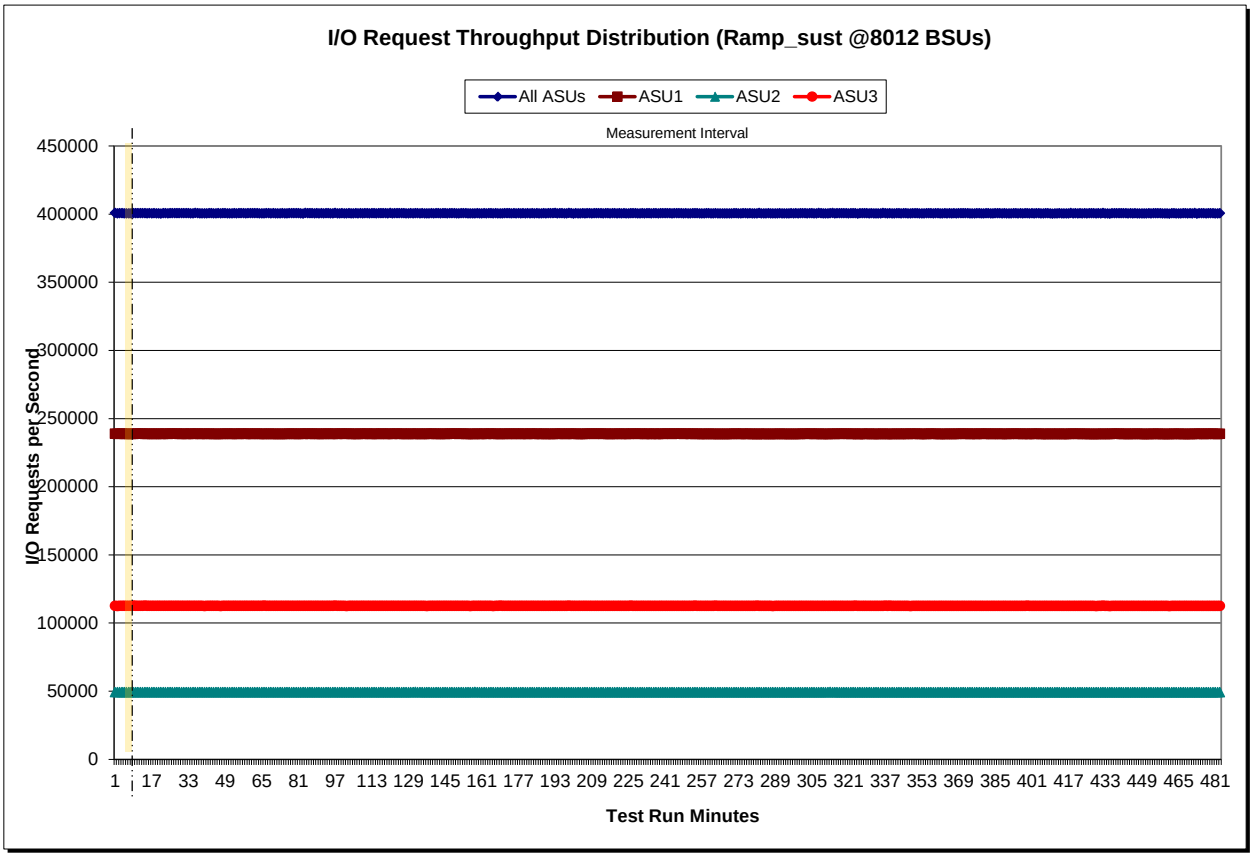


Sustainability – I/O Request Throughput Distribution Data

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

Sustainability I/O Request Throughput Table

Sustainability – I/O Request Throughput Distribution Graph

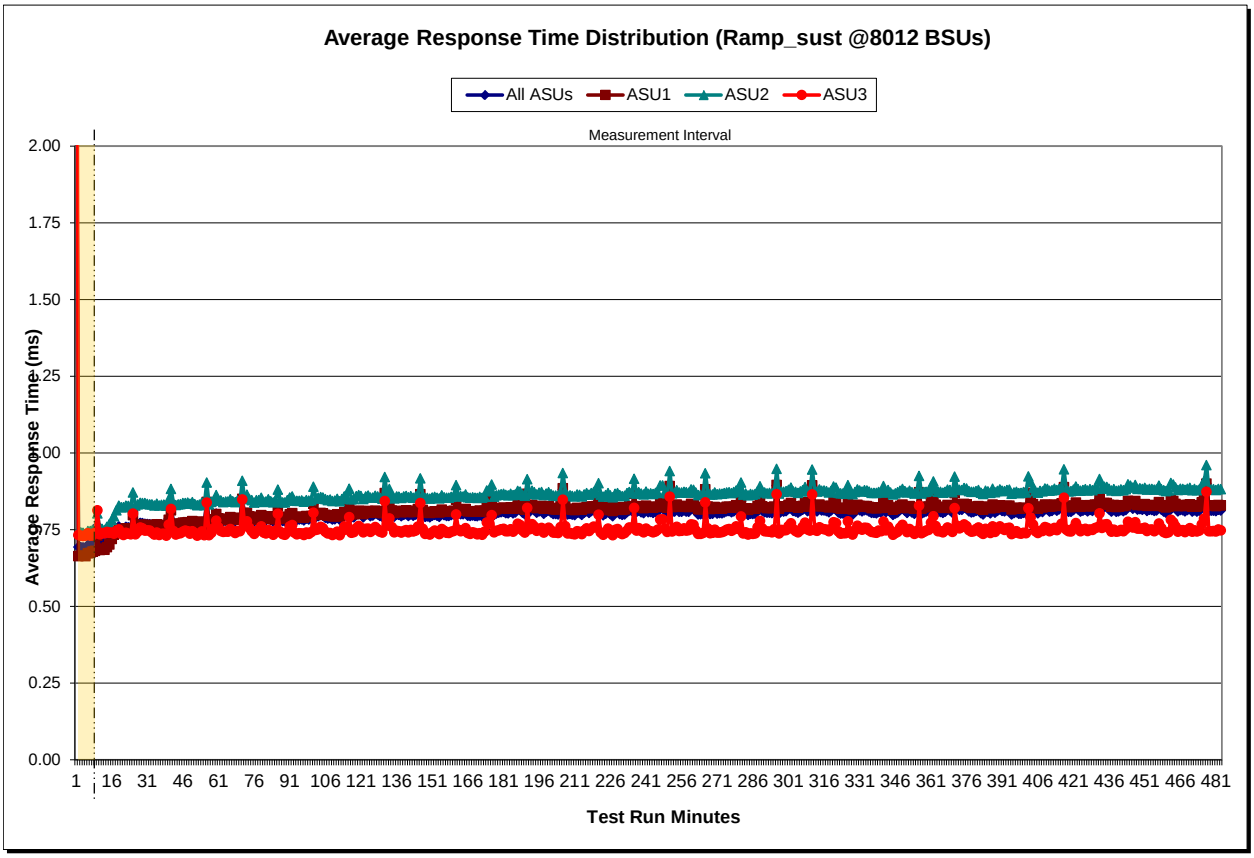


Sustainability – Average Response Time (ms) Distribution Data

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

Sustainability Average Response Time Table

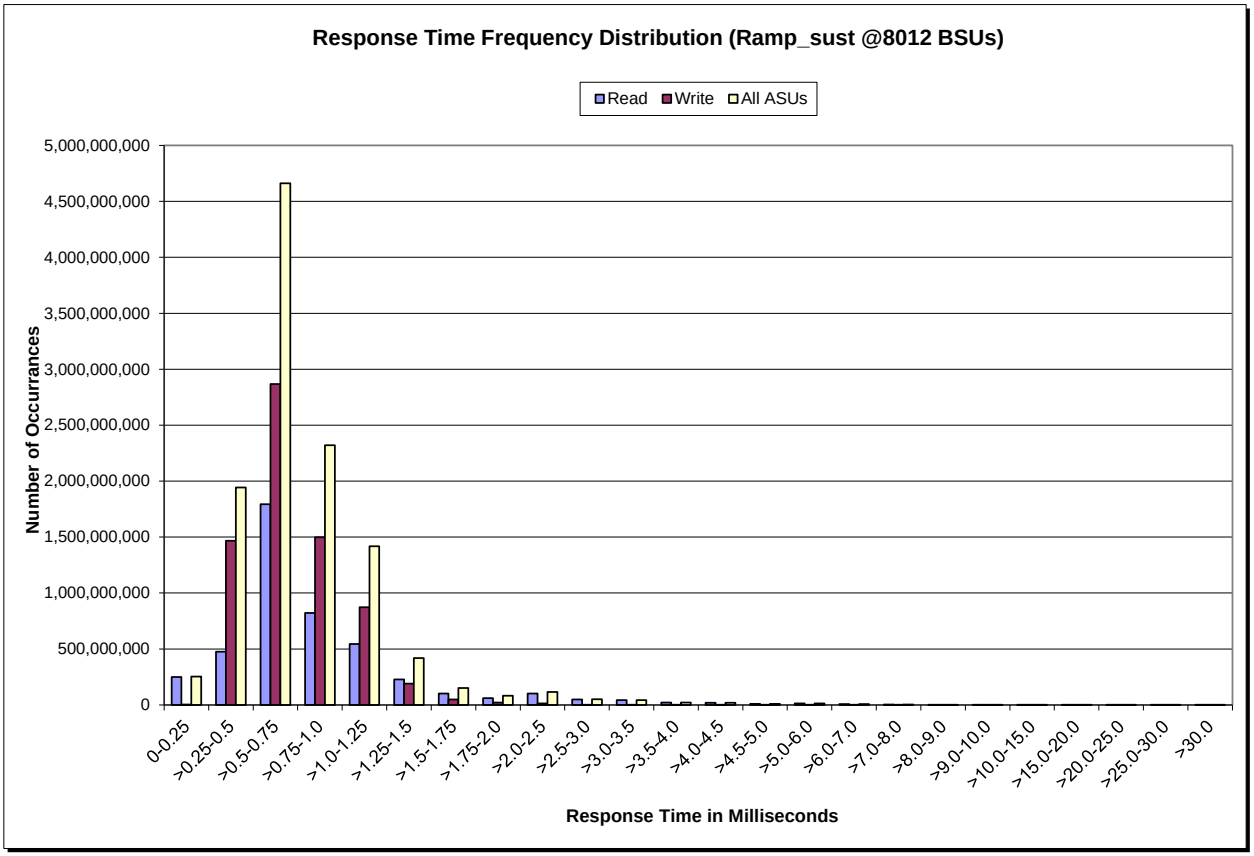
Sustainability – Average Response Time (ms) Distribution Graph



Sustainability – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	249,011,194	476,003,727	1,792,868,603	822,489,971	544,223,224	228,524,441	101,651,190	60,322,862
Write	3,783,409	1,466,293,337	2,868,545,746	1,498,355,090	873,283,561	190,102,920	48,704,325	21,766,120
All ASUs	252,794,603	1,942,297,064	4,661,414,349	2,320,845,061	1,417,506,785	418,627,361	150,355,515	82,088,982
ASU1	243,253,699	1,136,786,934	2,773,977,791	1,294,116,300	786,983,138	256,735,944	101,200,292	57,268,126
ASU2	8,422,595	221,044,330	578,081,999	281,359,115	176,004,647	59,420,392	23,846,348	13,712,677
ASU3	1,118,309	584,465,800	1,309,354,559	745,369,646	454,519,000	102,471,025	25,308,875	11,108,179
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	102,466,888	49,350,681	42,809,368	20,997,383	19,417,769	10,261,470	13,966,388	7,016,810
Write	12,946,583	1,587,858	425,146	168,935	77,815	41,280	71,877	42,901
All ASUs	115,413,471	50,938,539	43,234,514	21,166,318	19,495,584	10,302,750	14,038,265	7,059,711
ASU1	87,196,335	39,996,794	34,181,495	16,760,680	15,462,909	8,161,245	11,118,522	5,582,978
ASU2	21,568,218	10,127,075	8,837,556	4,321,629	3,993,602	2,121,376	2,885,548	1,456,039
ASU3	6,648,918	814,670	215,463	84,009	39,073	20,129	34,195	20,694
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	3,654,142	1,987,736	1,137,512	1,796,834	235,811	90,525	39,649	24,428
Write	29,785	30,788	35,443	274,108	85,397	31,284	32,671	479,528
All ASUs	3,683,927	2,018,524	1,172,955	2,070,942	321,208	121,809	72,320	503,956
ASU1	2,908,728	1,588,534	917,217	1,554,751	228,294	88,850	47,113	227,571
ASU2	761,001	415,508	239,391	387,151	52,292	18,126	9,916	52,580
ASU3	14,198	14,482	16,347	129,040	40,622	14,833	15,291	223,805

Sustainability – Response Time Frequency Distribution Graph



Sustainability – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.15.2

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

Clause 5.3.15.3

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

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

Primary Metrics Test – IOPS Test Phase

Clause 5.4.4.2

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

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

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

Clause 9.4.3.7.3

For the IOPS Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

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

IOPS Test Results File

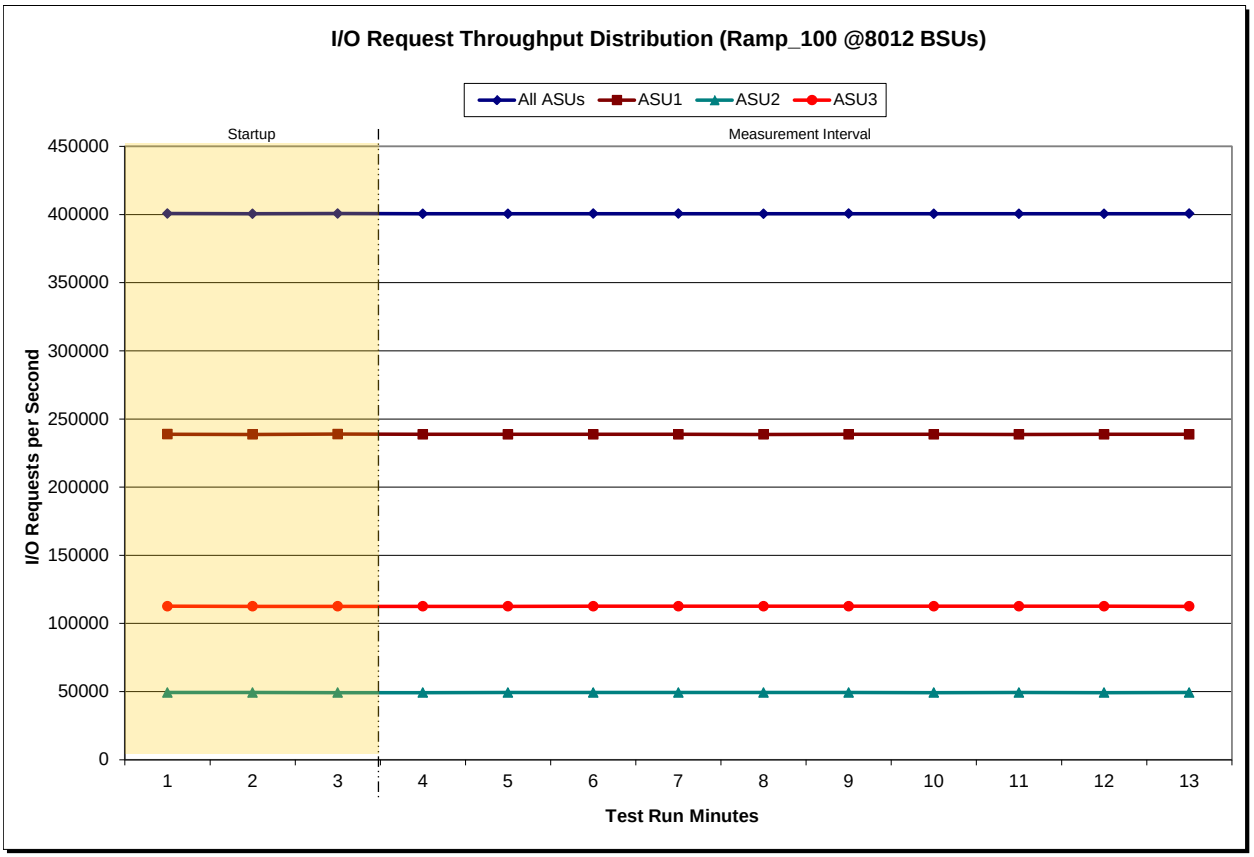
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:20:13	14:23:14	0-2	0:03:01
Measurement Interval	14:23:14	14:33:14	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	400,705.27	238,809.93	49,271.97	112,623.37
1	400,530.70	238,697.07	49,278.05	112,555.58
2	400,702.60	238,929.47	49,236.58	112,536.55
3	400,536.13	238,727.08	49,253.33	112,555.72
4	400,540.38	238,752.93	49,264.92	112,522.53
5	400,647.87	238,708.37	49,297.17	112,642.33
6	400,631.25	238,756.32	49,275.32	112,599.62
7	400,580.83	238,679.93	49,310.08	112,590.82
8	400,660.08	238,772.10	49,299.98	112,588.00
9	400,552.60	238,709.65	49,260.57	112,582.38
10	400,563.37	238,669.17	49,292.32	112,601.88
11	400,549.28	238,705.77	49,252.85	112,590.67
12	400,609.28	238,765.10	49,308.98	112,535.20
Average	***400,587.11***	***238,724.64***	***49,281.55***	***112,580.92***

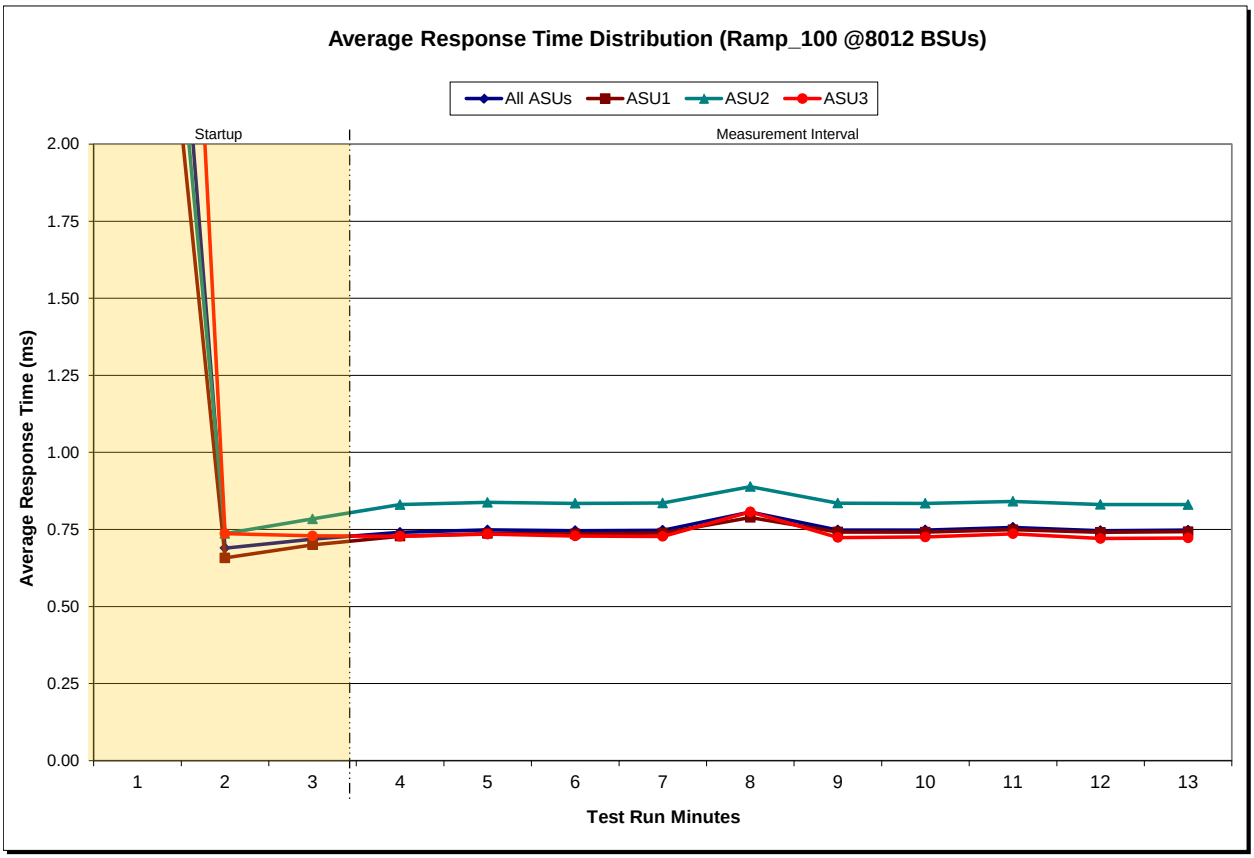
IOPS Test Run – I/O Request Throughput Distribution Graph



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

8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:20:13	14:23:14	0-2	0:03:01
Measurement Interval	14:23:14	14:33:14	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	4.29	3.47	3.81	6.24
1	0.69	0.66	0.74	0.74
2	0.72	0.70	0.78	0.73
3	0.74	0.73	0.83	0.73
4	0.75	0.74	0.84	0.73
5	0.75	0.74	0.83	0.73
6	0.75	0.74	0.84	0.73
7	0.81	0.79	0.89	0.81
8	0.75	0.74	0.84	0.72
9	0.75	0.74	0.83	0.73
10	0.76	0.75	0.84	0.74
11	0.75	0.74	0.83	0.72
12	0.75	0.74	0.83	0.72
Average	***0.75***	***0.74***	***0.84***	***0.74***

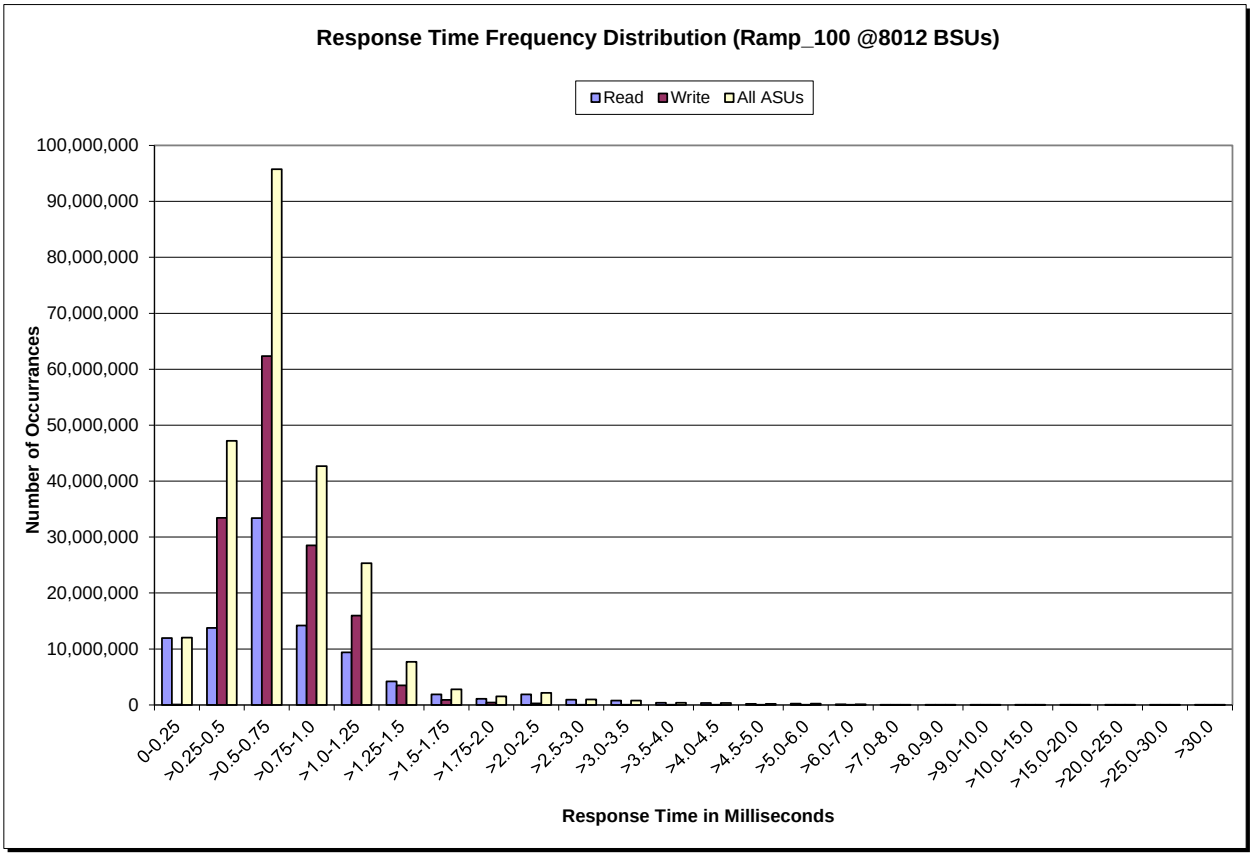
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	11,946,160	13,753,712	33,392,397	14,188,143	9,383,293	4,207,020	1,862,486	1,083,537
Write	74,239	33,443,034	62,366,329	28,502,514	15,961,238	3,510,745	914,800	423,867
All ASUs	12,020,399	47,196,746	95,758,726	42,690,657	25,344,531	7,717,765	2,777,286	1,507,404
ASU1	11,739,833	28,742,842	54,621,789	22,975,358	13,683,422	4,635,542	1,820,824	1,014,593
ASU2	258,514	5,085,190	12,444,357	5,387,453	3,298,654	1,179,842	483,988	276,379
ASU3	22,052	13,368,714	28,692,580	14,327,846	8,362,455	1,902,381	472,474	216,432
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	1,892,994	922,910	783,242	385,419	354,822	186,863	241,106	105,504
Write	266,216	36,719	9,689	4,360	2,428	1,386	2,449	1,360
All ASUs	2,159,210	959,629	792,931	389,779	357,250	188,249	243,555	106,864
ASU1	1,571,880	729,052	607,150	298,709	275,137	145,502	189,326	83,550
ASU2	450,689	211,787	180,774	88,906	80,928	42,078	53,020	22,647
ASU3	136,641	18,790	5,007	2,164	1,185	669	1,209	667
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	46,567	21,575	10,735	17,119	3,008	2,837	1,354	829
Write	1,038	1,486	1,419	10,247	3,205	1,202	1,434	16,880
All ASUs	47,605	23,061	12,154	27,366	6,213	4,039	2,788	17,709
ASU1	37,619	17,982	9,286	18,597	3,879	2,916	1,741	8,032
ASU2	9,487	4,385	2,201	4,000	806	566	366	1,868
ASU3	499	694	667	4,769	1,528	557	681	7,809

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
240,351,916	240,334,207	17,709

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.15.2

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

Clause 5.3.15.3

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

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

Primary Metrics Test – Response Time Ramp Test Phase

Clause 5.4.4.3

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

The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 15.

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

Clause 9.4.3.7.4

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

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

SPC-1 Workload Generator Input Parameters

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

Response Time Ramp Test Results File

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

95% Load Level

90% Load Level

80% Load Level

50% Load Level

10% Load Level

Response Time Ramp Distribution (IOPS) Data

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

100% Load Level - 8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:20:13	14:23:14	0-2	0:03:01
Measurement Interval	14:23:14	14:33:14	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	400,705.27	238,809.93	4.93E+04	112,623.37
1	400,530.70	238,697.07	4.93E+04	112,555.58
2	400,702.60	238,929.47	4.92E+04	112,536.55
3	400,536.13	238,727.08	4.93E+04	112,555.72
4	400,540.38	238,752.93	4.93E+04	112,522.53
5	400,647.87	238,708.37	4.93E+04	112,642.33
6	400,631.25	238,756.32	49,275.32	112,599.62
7	400,580.83	238,679.93	49,310.08	112,590.82
8	400,660.08	238,772.10	49,299.98	112,588.00
9	400,552.60	238,709.65	49,260.57	112,582.38
10	400,563.37	238,669.17	49,292.32	112,601.88
11	400,549.28	238,705.77	49,252.85	112,590.67
12	400,609.28	238,765.10	49,308.98	112,535.20
Average	***400,587.11***	***238,724.64***	***49,281.55***	***112,580.92***

95% Load Level - 7,611 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:33:50	14:36:51	0-2	0:03:01
Measurement Interval	14:36:51	14:46:51	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	380,750.25	226,961.08	46,815.90	106,973.27
1	380,481.42	226,730.05	46,788.60	106,962.77
2	380,415.67	226,748.53	46,782.23	106,884.90
3	380,674.67	226,863.95	46,846.75	106,963.97
4	380,633.18	226,888.28	46,778.12	106,966.78
5	380,657.55	226,845.52	46,837.82	106,974.22
6	380,466.07	226,858.57	46,759.52	106,847.98
7	380,336.62	226,754.30	46,777.32	106,805.00
8	380,476.28	226,774.32	46,755.40	106,946.57
9	380,676.12	226,849.98	46,811.17	107,014.97
10	380,436.07	226,755.57	46,746.57	106,933.93
11	380,503.18	226,764.58	46,842.10	106,896.50
12	380,615.82	226,865.30	46,811.67	106,938.85
Average	***380,547.56***	***226,822.04***	***46,796.64***	***106,928.88***

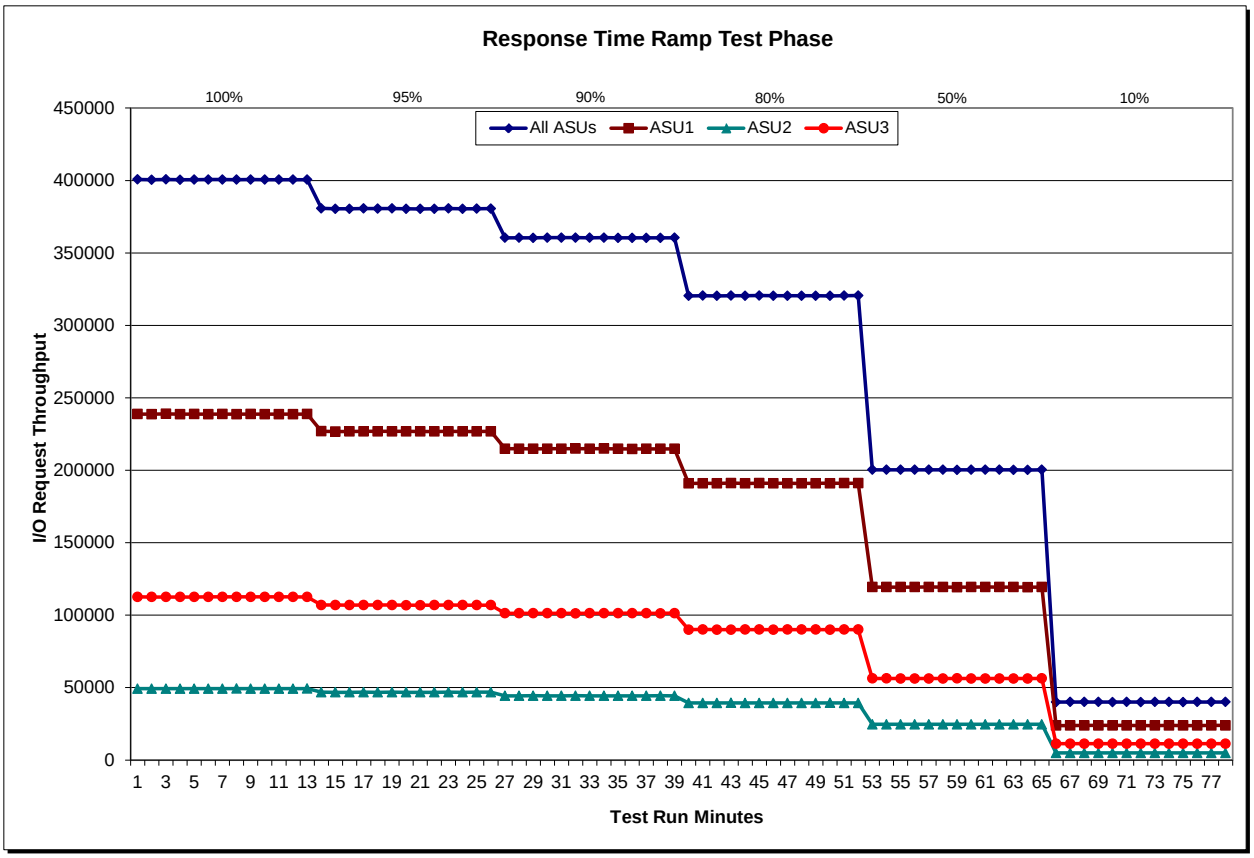
90% Load Level - 7,210 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:47:25	14:50:26	0-2	0:03:01
Measurement Interval	14:50:26	15:00:26	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	360,471.03	214,874.20	44,322.77	101,274.07
1	360,503.40	214,847.32	44,348.90	101,307.18
2	360,393.75	214,749.27	44,368.90	101,275.58
3	360,516.83	214,891.13	44,346.87	101,278.83
4	360,514.12	214,892.22	44,339.25	101,282.65
5	360,553.50	214,927.10	44,388.25	101,238.15
6	360,451.95	214,829.00	44,351.13	101,271.82
7	360,556.13	214,920.40	44,338.37	101,297.37
8	360,383.90	214,773.05	44,309.67	101,301.18
9	360,390.38	214,715.63	44,336.93	101,337.82
10	360,374.93	214,790.92	44,320.58	101,263.43
11	360,377.38	214,787.95	44,376.55	101,212.88
12	360,466.45	214,770.47	44,306.05	101,389.93
Average	***360,458.56***	***214,829.79***	***44,341.37***	***101,287.41***

80% Load Level - 6,409 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:00:56	15:03:57	0-2	0:03:01
Measurement Interval	15:03:57	15:13:57	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	320,377.33	190,953.72	39,407.37	90,016.25
1	320,551.00	191,020.97	39,424.77	90,105.27
2	320,366.73	190,953.57	39,410.95	90,002.22
3	320,534.02	191,125.67	39,431.22	89,977.13
4	320,402.67	190,954.35	39,409.05	90,039.27
5	320,595.15	191,106.87	39,411.65	90,076.63
6	320,451.70	191,021.23	39,414.88	90,015.58
7	320,404.03	190,978.88	39,376.37	90,048.78
8	320,400.60	190,899.30	39,418.85	90,082.45
9	320,438.07	190,978.50	39,400.82	90,058.75
10	320,364.17	190,971.05	39,435.35	89,957.77
11	320,495.48	191,050.40	39,401.75	90,043.33
12	320,587.02	191,101.58	39,419.13	90,066.30
Average	***320,467.29***	***191,018.78***	***39,411.91***	***90,036.60***

50% Load Level - 4,006 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:14:19	15:17:20	0-2	0:03:01
Measurement Interval	15:17:20	15:27:20	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	200,327.43	119,382.88	24,643.73	56,300.82
1	200,344.78	119,340.57	24,654.72	56,349.50
2	200,333.40	119,395.42	24,652.98	56,285.00
3	200,341.40	119,400.58	24,675.55	56,265.27
4	200,368.35	119,438.57	24,641.02	56,288.77
5	200,313.50	119,399.80	24,637.33	56,276.37
6	200,239.38	119,306.07	24,628.52	56,304.80
7	200,346.23	119,399.42	24,657.30	56,289.52
8	200,396.10	119,482.13	24,648.30	56,265.67
9	200,328.90	119,394.42	24,644.85	56,289.63
10	200,241.72	119,385.42	24,620.25	56,236.05
11	200,195.50	119,299.40	24,660.92	56,235.18
12	200,377.67	119,407.55	24,655.77	56,314.35
Average	***200,314.88***	***119,391.34***	***24,646.98***	***56,276.56***

10% Load Level - 801 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:27:32	15:30:33	0-2	0:03:01
Measurement Interval	15:30:33	15:40:33	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	40,011.70	23,834.17	4,915.33	11,262.20
1	40,058.08	23,849.80	4,930.98	11,277.30
2	40,076.98	23,893.02	4,931.05	11,252.92
3	40,080.18	23,889.35	4,915.08	11,275.75
4	40,030.82	23,862.95	4,914.90	11,252.97
5	40,038.43	23,867.80	4,924.28	11,246.35
6	40,024.42	23,851.13	4,921.62	11,251.67
7	40,048.87	23,845.00	4,933.15	11,270.72
8	40,060.33	23,889.77	4,928.48	11,242.08
9	40,016.20	23,845.83	4,929.42	11,240.95
10	40,043.03	23,851.03	4,943.22	11,248.78
11	40,068.77	23,880.02	4,928.95	11,259.80
12	40,054.40	23,884.72	4,921.63	11,248.05
Average	***40,046.55***	***23,866.76***	***4,926.07***	***11,253.71***

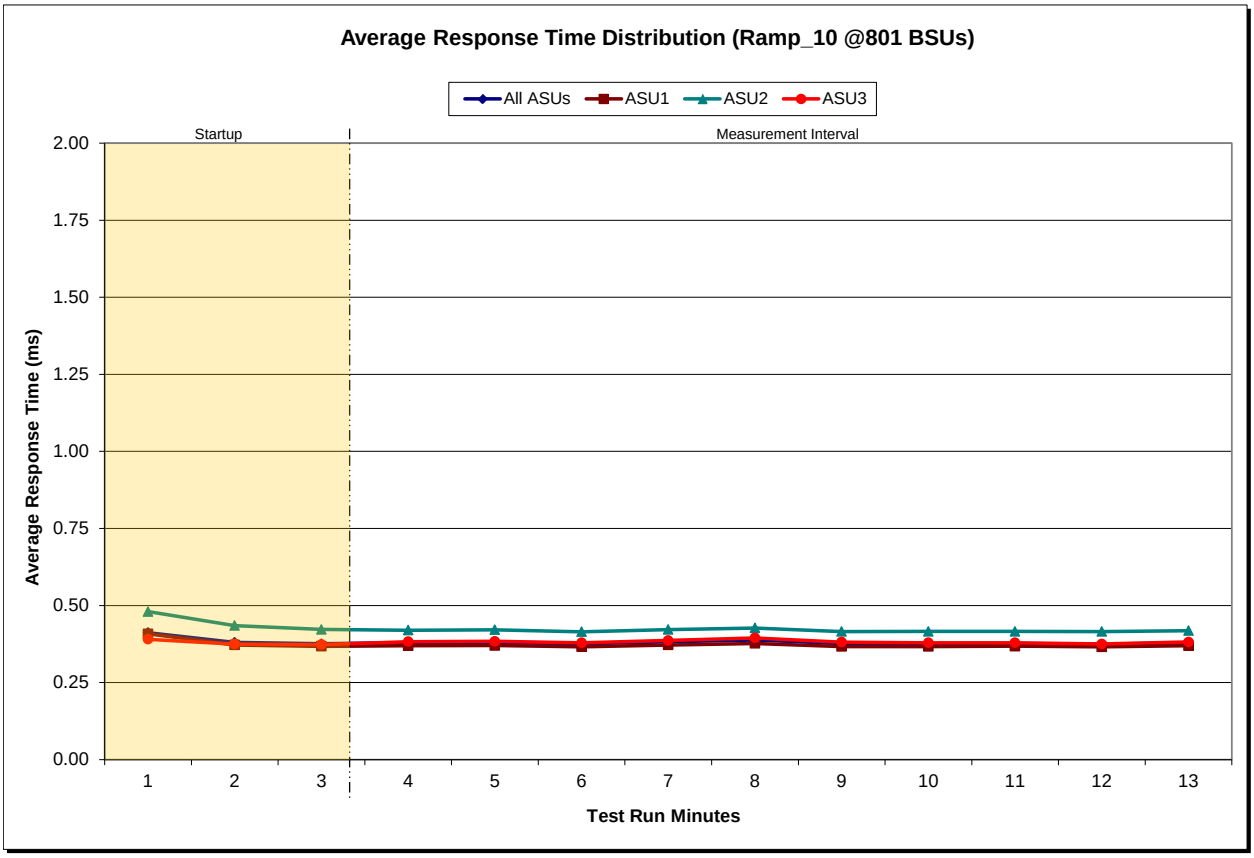
Response Time Ramp Distribution (IOPS) Graph



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

801 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:27:32	15:30:33	0-2	0:03:01
Measurement Interval	15:30:33	15:40:33	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.41	0.41	0.48	0.39
1	0.38	0.37	0.43	0.37
2	0.38	0.37	0.42	0.37
3	0.38	0.37	0.42	0.38
4	0.38	0.37	0.42	0.38
5	0.38	0.37	0.41	0.38
6	0.38	0.37	0.42	0.39
7	0.39	0.38	0.43	0.39
8	0.38	0.37	0.42	0.38
9	0.38	0.37	0.42	0.38
10	0.38	0.37	0.42	0.38
11	0.37	0.37	0.42	0.38
12	0.38	0.37	0.42	0.38
Average	***0.38***	***0.37***	***0.42***	***0.38***

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



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

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.15.2

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

Clause 5.3.15.3

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2811	0.0700	0.2099	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.001	0.003	0.001	0.007	0.003	0.004	0.001

Repeatability Test

Clause 5.4.5

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

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

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

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

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

Clause 9.4.3.7.5

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

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

SPC-1 Workload Generator Input Parameters

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

Repeatability Test Results File

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

	SPC-1 IOPS™
Primary Metrics	***400,587.11***
Repeatability Test Phase 1	400,605.30
Repeatability Test Phase 2	400,569.53

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

	SPC-1 LRT™
Primary Metrics	***0.38 ms***
Repeatability Test Phase 1	0.38 ms
Repeatability Test Phase 2	0.38 ms

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

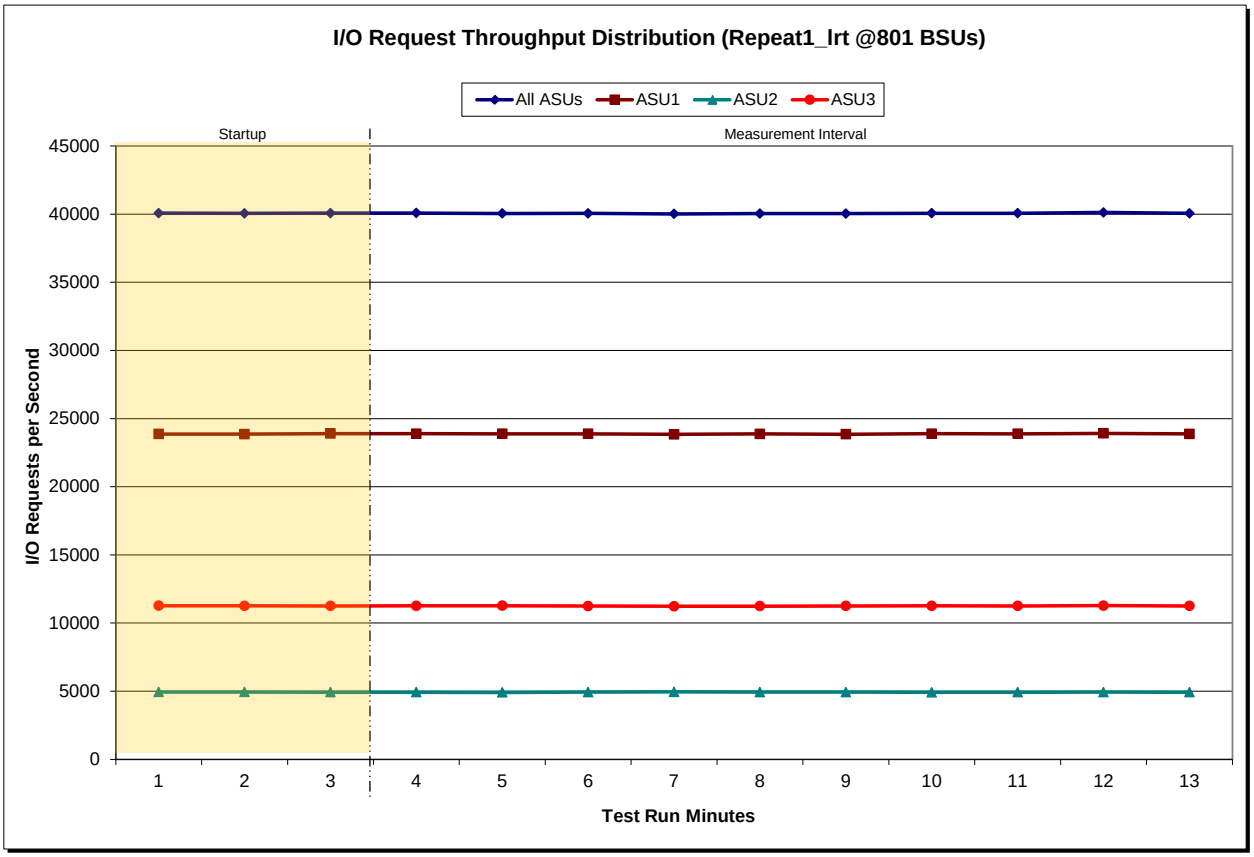
A link to the test result file generated from each Repeatability Test Run is listed below.

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

Repeatability 1 LRT – I/O Request Throughput Distribution Data

801 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:40:55	15:43:55	0-2	0:03:00
Measurement Interval	15:43:55	15:53:55	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	40,068.33	23,867.17	4,934.38	11,266.78
1	40,054.82	23,855.33	4,942.03	11,257.45
2	40,071.97	23,897.13	4,921.90	11,252.93
3	40,078.95	23,893.30	4,925.95	11,259.70
4	40,051.98	23,878.75	4,907.83	11,265.40
5	40,058.17	23,883.58	4,926.52	11,248.07
6	40,016.50	23,842.10	4,942.77	11,231.63
7	40,038.35	23,874.43	4,927.30	11,236.62
8	40,038.13	23,849.10	4,933.75	11,255.28
9	40,067.22	23,893.55	4,911.82	11,261.85
10	40,063.12	23,880.92	4,925.48	11,256.72
11	40,117.23	23,914.88	4,926.88	11,275.47
12	40,056.03	23,877.22	4,925.60	11,253.22
Average	***40,058.57***	***23,878.78***	***4,925.39***	***11,254.40***

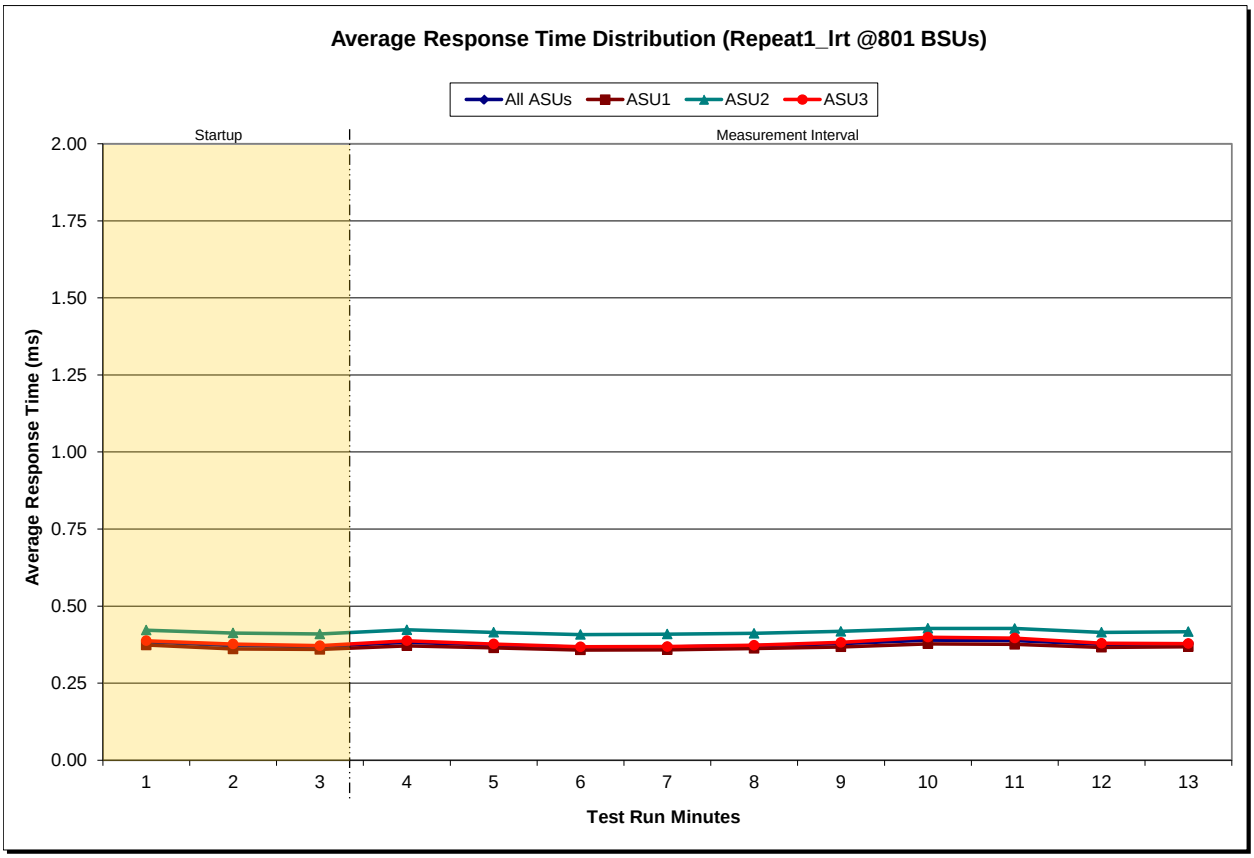
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

801 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:40:55	15:43:55	0-2	0:03:00
Measurement Interval	15:43:55	15:53:55	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.38	0.37	0.42	0.39
1	0.37	0.36	0.41	0.38
2	0.37	0.36	0.41	0.37
3	0.38	0.37	0.42	0.39
4	0.37	0.36	0.41	0.38
5	0.37	0.36	0.41	0.37
6	0.37	0.36	0.41	0.37
7	0.37	0.36	0.41	0.37
8	0.38	0.37	0.42	0.38
9	0.39	0.38	0.43	0.40
10	0.39	0.38	0.43	0.40
11	0.38	0.37	0.41	0.38
12	0.38	0.37	0.42	0.38
Average	***0.38***	***0.37***	***0.42***	***0.38***

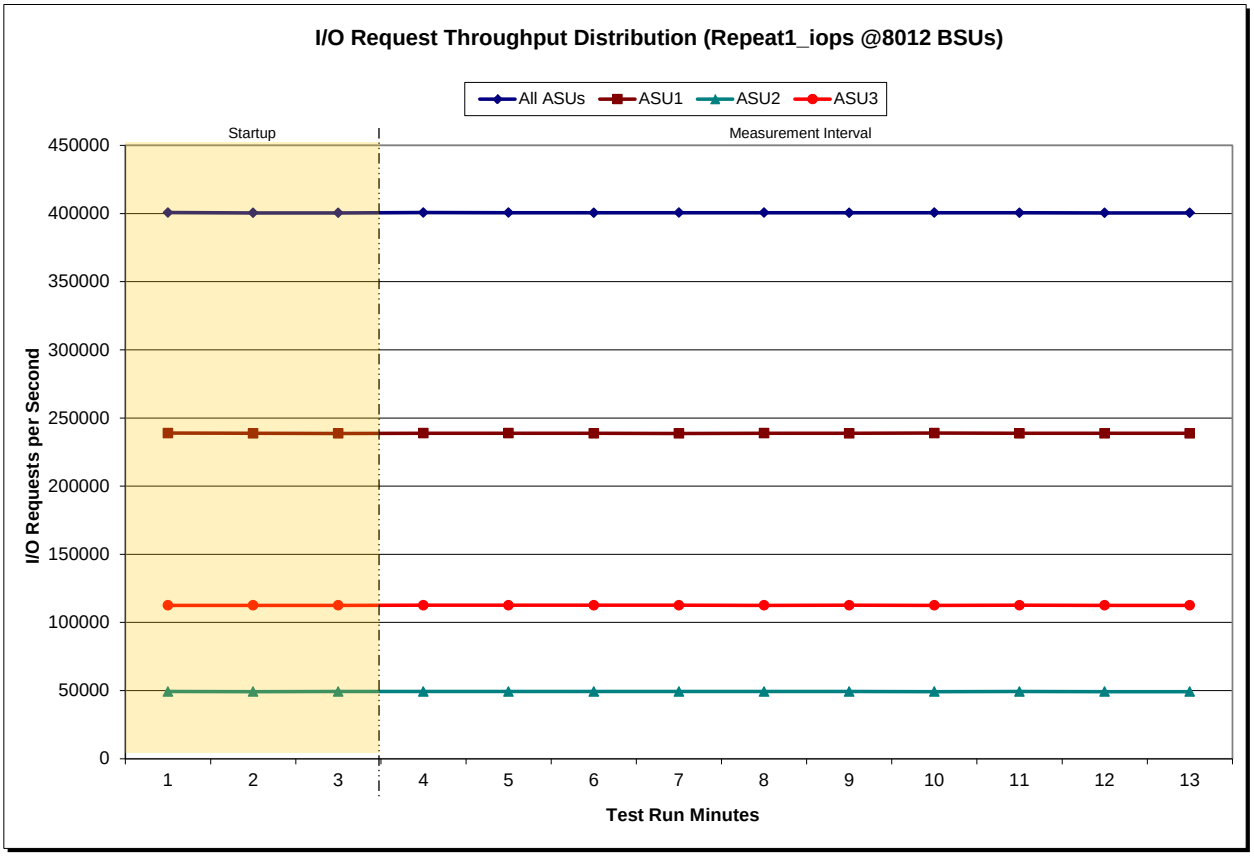
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:54:34	15:57:35	0-2	0:03:01
Measurement Interval	15:57:35	16:07:35	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	400,761.50	238,871.43	49,327.67	112,562.40
1	400,516.45	238,734.67	49,215.57	112,566.22
2	400,483.75	238,684.60	49,276.07	112,523.08
3	400,721.07	238,797.57	49,325.88	112,597.62
4	400,670.53	238,816.30	49,269.18	112,585.05
5	400,581.95	238,710.62	49,291.47	112,579.87
6	400,613.72	238,699.08	49,298.35	112,616.28
7	400,665.33	238,801.23	49,327.33	112,536.77
8	400,544.88	238,700.48	49,267.12	112,577.28
9	400,653.48	238,870.33	49,230.30	112,552.85
10	400,581.70	238,709.33	49,268.85	112,603.52
11	400,517.02	238,735.52	49,244.63	112,536.87
12	400,503.30	238,712.23	49,239.32	112,551.75
Average	***400,605.30***	***238,755.27***	***49,276.24***	***112,573.79***

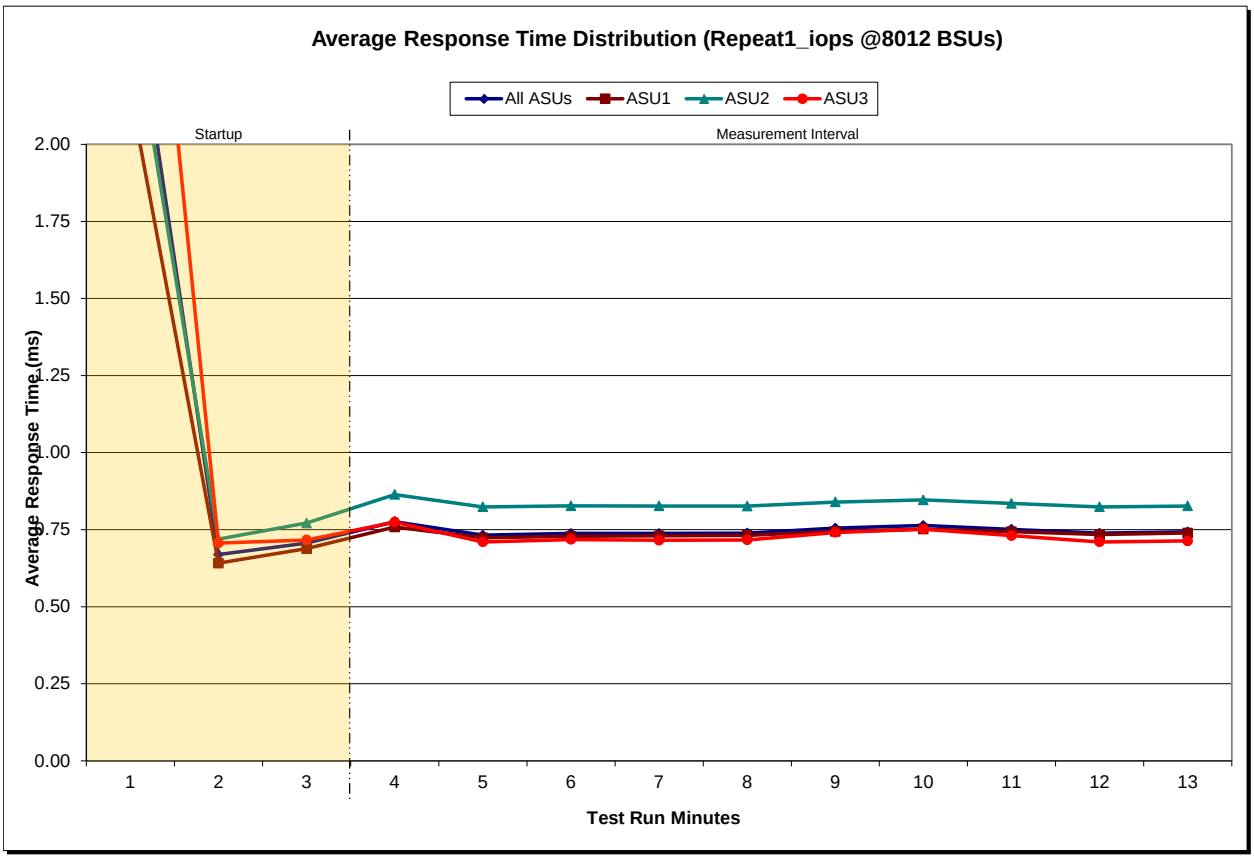
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:54:34	15:57:35	0-2	0:03:01
Measurement Interval	15:57:35	16:07:35	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.59	2.17	2.47	3.54
1	0.67	0.64	0.72	0.71
2	0.71	0.69	0.77	0.72
3	0.78	0.76	0.86	0.77
4	0.73	0.72	0.82	0.71
5	0.74	0.73	0.83	0.72
6	0.74	0.73	0.83	0.72
7	0.74	0.73	0.83	0.72
8	0.75	0.74	0.84	0.74
9	0.76	0.75	0.85	0.75
10	0.75	0.74	0.83	0.73
11	0.74	0.73	0.82	0.71
12	0.74	0.74	0.83	0.71
Average	***0.75***	***0.74***	***0.83***	***0.73***

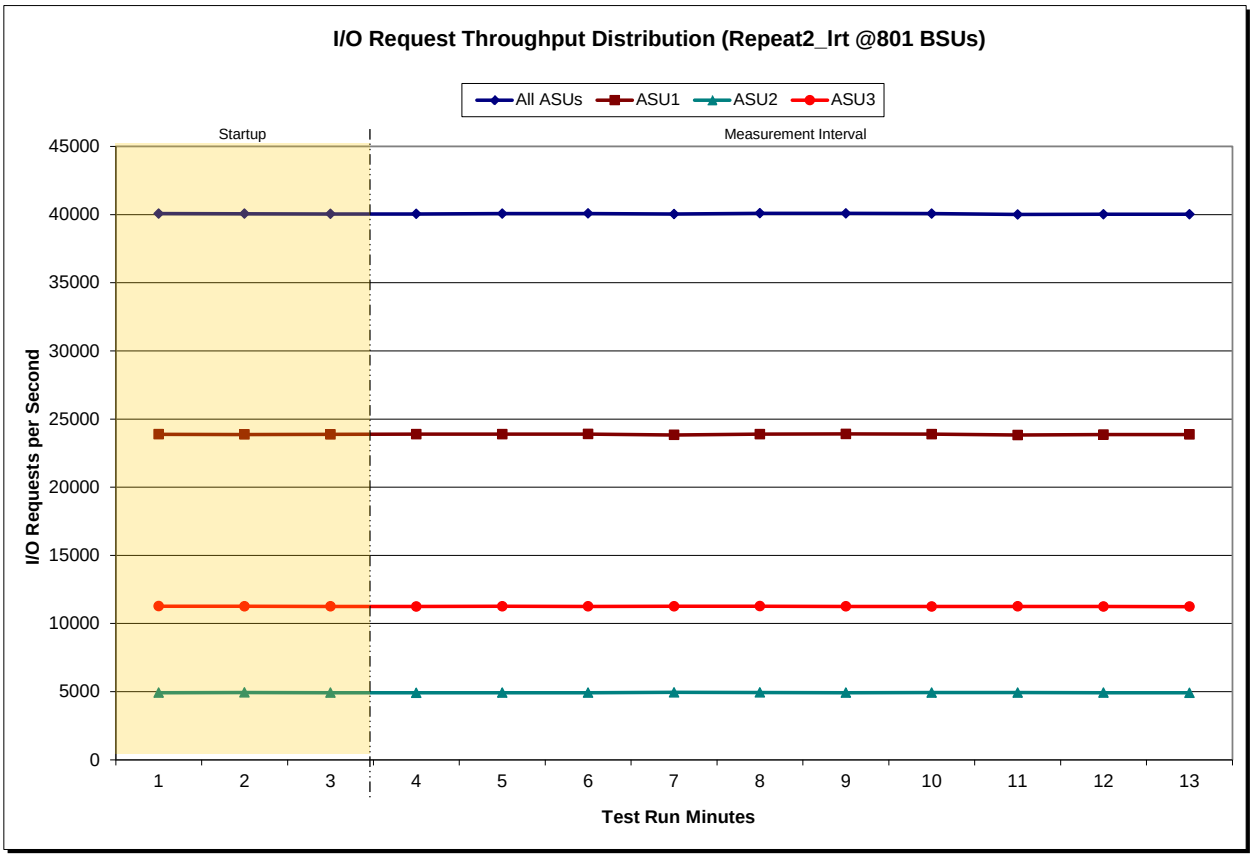
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

801 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:07:54	16:10:54	0-2	0:03:00
Measurement Interval	16:10:54	16:20:54	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	40,071.87	23,884.20	4,918.70	11,268.97
1	40,060.97	23,863.57	4,938.92	11,258.48
2	40,047.55	23,875.22	4,922.52	11,249.82
3	40,050.67	23,890.92	4,913.82	11,245.93
4	40,072.88	23,893.18	4,919.70	11,260.00
5	40,079.80	23,901.52	4,924.22	11,254.07
6	40,041.65	23,834.83	4,945.50	11,261.32
7	40,097.70	23,893.13	4,937.53	11,267.03
8	40,089.68	23,908.22	4,925.48	11,255.98
9	40,070.82	23,894.02	4,930.07	11,246.73
10	40,011.15	23,825.90	4,933.23	11,252.02
11	40,022.95	23,854.30	4,926.20	11,242.45
12	40,022.95	23,869.60	4,915.32	11,238.03
Average	***40,056.03***	***23,876.56***	***4,927.11***	***11,252.36***

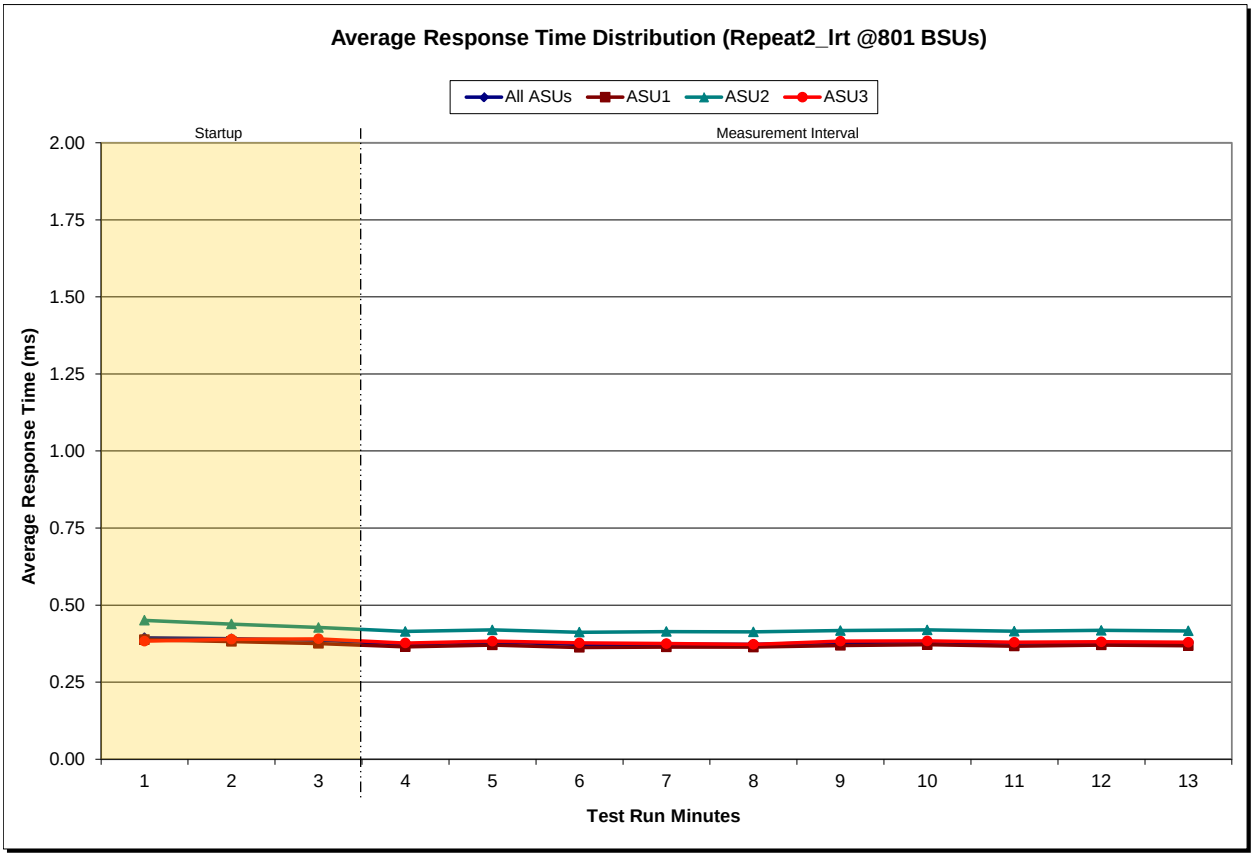
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

801 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:07:54	16:10:54	0-2	0:03:00
Measurement Interval	16:10:54	16:20:54	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.39	0.39	0.45	0.38
1	0.39	0.38	0.44	0.39
2	0.39	0.38	0.43	0.39
3	0.37	0.36	0.41	0.38
4	0.38	0.37	0.42	0.38
5	0.37	0.36	0.41	0.38
6	0.37	0.36	0.41	0.37
7	0.37	0.36	0.41	0.37
8	0.38	0.37	0.42	0.38
9	0.38	0.37	0.42	0.38
10	0.38	0.37	0.42	0.38
11	0.38	0.37	0.42	0.38
12	0.38	0.37	0.42	0.38
Average	***0.38***	***0.37***	***0.42***	***0.38***

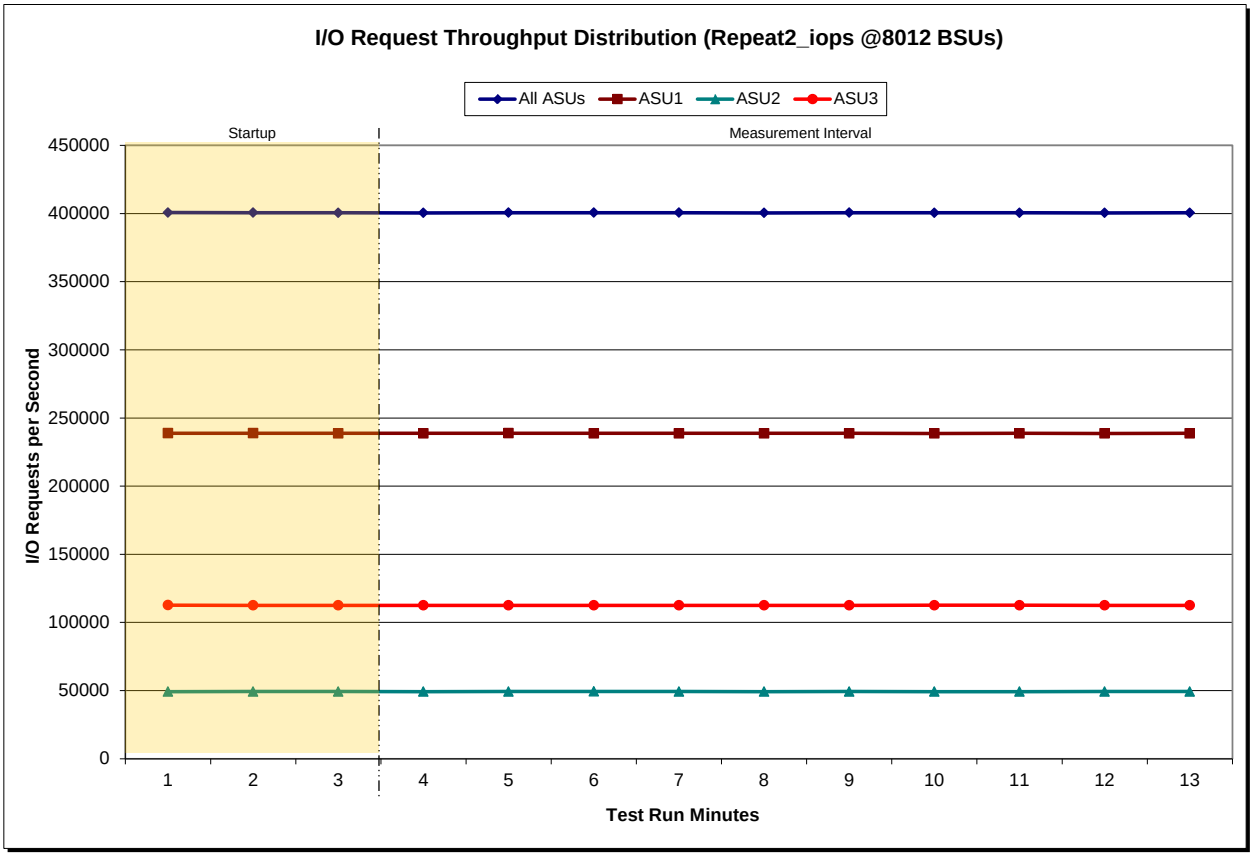
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:21:34	16:24:35	0-2	0:03:01
Measurement Interval	16:24:35	16:34:35	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	400,757.80	238,848.25	49,249.28	112,660.27
1	400,637.62	238,803.40	49,264.28	112,569.93
2	400,557.45	238,742.98	49,300.85	112,513.62
3	400,508.15	238,741.20	49,245.62	112,521.33
4	400,659.32	238,831.30	49,271.18	112,556.83
5	400,622.15	238,775.50	49,352.75	112,493.90
6	400,651.03	238,767.22	49,341.12	112,542.70
7	400,517.52	238,740.52	49,245.33	112,531.67
8	400,601.55	238,760.95	49,307.87	112,532.73
9	400,537.97	238,674.22	49,236.22	112,627.53
10	400,555.87	238,739.50	49,236.38	112,579.98
11	400,517.78	238,681.52	49,287.58	112,548.68
12	400,524.00	238,714.58	49,273.50	112,535.92
Average	***400,569.53***	***238,742.65***	***49,279.76***	***112,547.13***

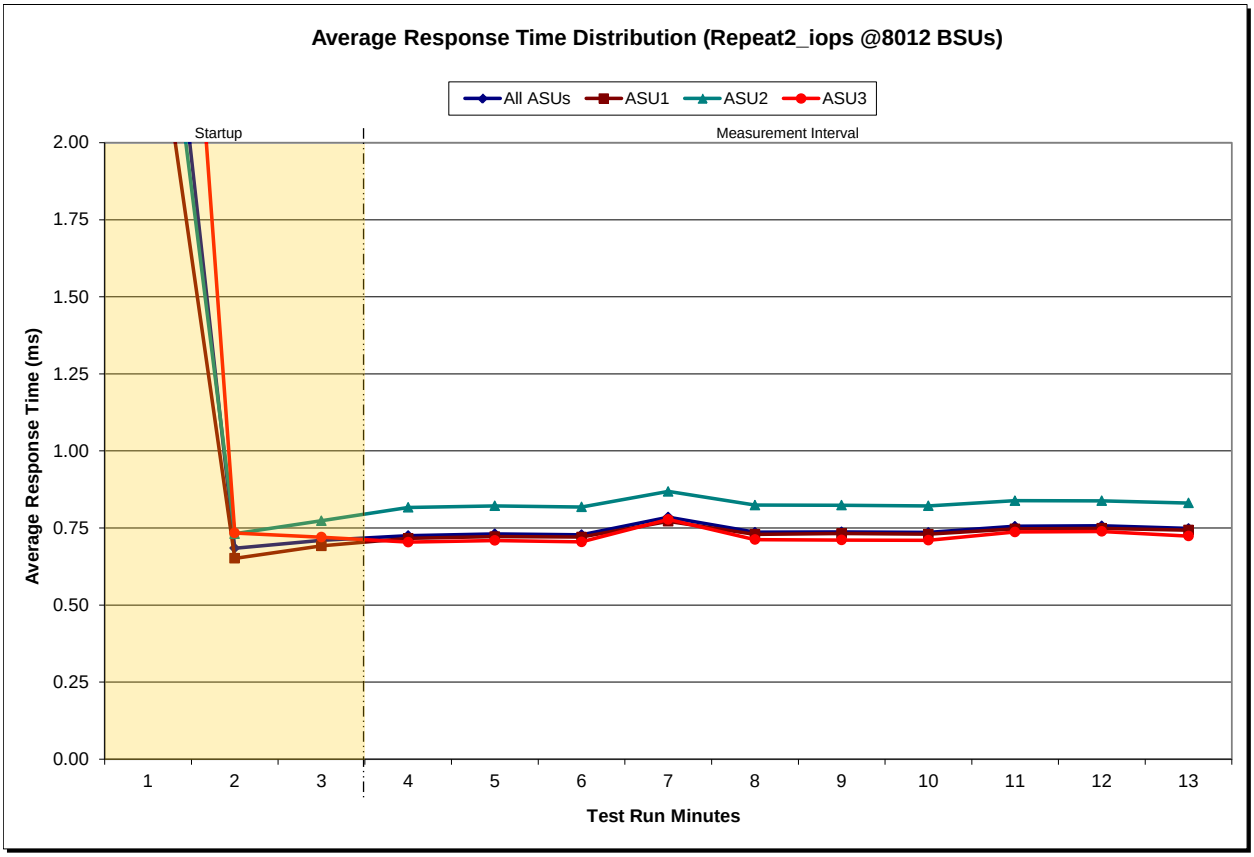
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

8,012 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:21:34	16:24:35	0-2	0:03:01
Measurement Interval	16:24:35	16:34:35	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3.22	2.62	2.98	4.60
1	0.68	0.65	0.73	0.73
2	0.71	0.69	0.77	0.72
3	0.73	0.72	0.82	0.70
4	0.73	0.72	0.82	0.71
5	0.73	0.72	0.82	0.70
6	0.79	0.77	0.87	0.78
7	0.74	0.73	0.82	0.71
8	0.74	0.73	0.82	0.71
9	0.74	0.73	0.82	0.71
10	0.76	0.75	0.84	0.74
11	0.76	0.75	0.84	0.74
12	0.75	0.74	0.83	0.72
Average	***0.74***	***0.74***	***0.83***	***0.72***

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



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

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.15.2

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

Clause 5.3.15.3

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2811	0.0700	0.2100	0.0180	0.0700	0.0350	0.2809
COV	0.003	0.001	0.002	0.001	0.005	0.003	0.002	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	0.2810
COV	0.001	0.000	0.001	0.000	0.002	0.001	0.001	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	0.0350	0.2810	0.0700	0.2101	0.0180	0.0700	0.0350	0.2809
COV	0.004	0.001	0.004	0.001	0.004	0.002	0.004	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	0.001	0.001	0.002	0.000

Data Persistence Test

Clause 6

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

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

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

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

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

Clause 9.4.3.8

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

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

SPC-1 Workload Generator Input Parameters

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

Data Persistence Test Results File

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

Persistence 1 Test Results File

Persistence 2 Test Results File

Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Run Number: 1	
Total Number of Logical Blocks Written	638,709
Total Number of Logical Blocks Verified	570.218
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	5 minutes
Size in bytes of each Logical Block	1,024
Number of Failed I/O Requests in the process of the Test	0

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

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

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

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 9.4.3.9

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

The Huawei OceanStor Dorado2100 G2 as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.4.3.3.6

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

Pricing information may be found in the Priced Storage Configuration Pricing section on page 16.

TESTED STORAGE CONFIGURATION (TSC) AND PRICED STORAGE CONFIGURATION DIFFERENCES

Clause 9.4.3.3.8

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

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 16.

ANOMALIES OR IRREGULARITIES

Clause 9.4.3.10

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

There were no anomalies or irregularities encountered during the SPC-1 Remote Audit of the Huawei OceanStor Dorado2100 G2.

APPENDIX A: SPC-1 GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SPC-1 Data Repository Definitions

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

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

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

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

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

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

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

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

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

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

SPC-1 Data Protection Levels

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

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

SPC-1 Test Execution Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

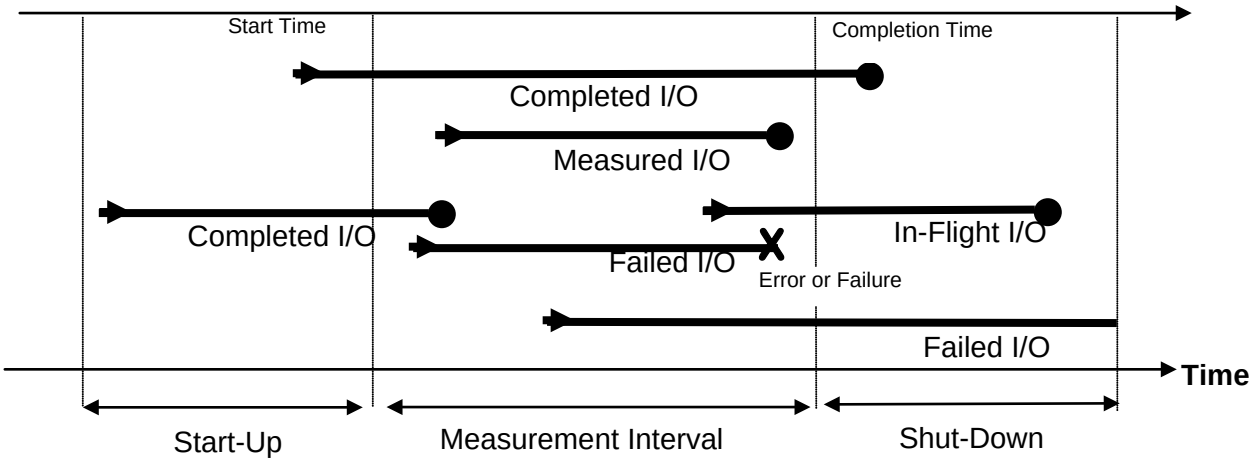
Steady State: The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant.

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

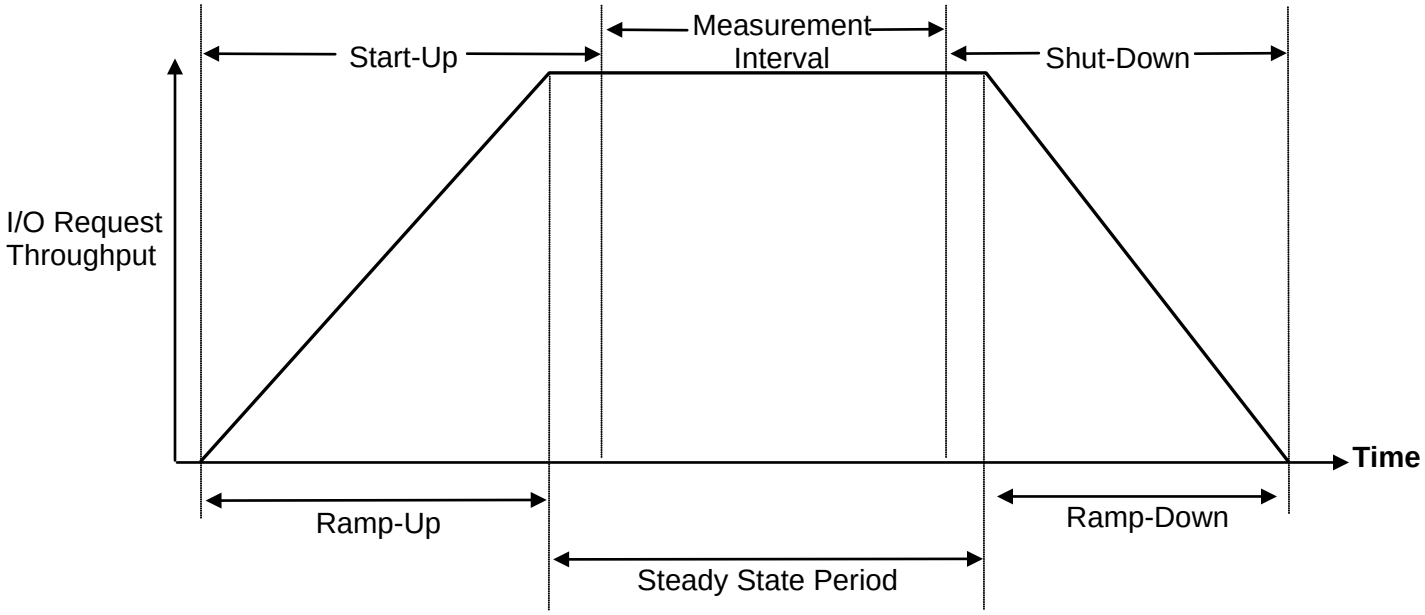
Test Run: The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have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

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

I/O Completion Types



SPC-1 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

Red Hat Enterprise Linux 5.5 (64-bit)

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

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

Step 1 Create Host Group and Hosts

Execute the following commands in OceanStor Dorado2100 G2 CLI to create one host group *HostGroup001*, and add *HostA* and *HostB* to the host group, then add 4 host FC ports WWNs to *HostA* and add the other 4 host FC ports WWNs to *HostB*.

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

```
createhostgroup -n HostGroup001
addhost -group 1 -n HostA -t 0
addhost -group 1 -n HostB -t 0
addhostport -host 0 -type 1 -wwn 21000024ff4038d8 -n FCInitiator001
addhostport -host 0 -type 1 -wwn 21000024ff2c952a -n FCInitiator002
addhostport -host 0 -type 1 -wwn 21000024ff403952 -n FCInitiator003
addhostport -host 0 -type 1 -wwn 21000024ff372908 -n FCInitiator004
addhostport -host 1 -type 1 -wwn 21000024ff372909 -n FCInitiator005
addhostport -host 1 -type 1 -wwn 21000024ff2c952b -n FCInitiator006
addhostport -host 1 -type 1 -wwn 21000024ff403953 -n FCInitiator007
addhostport -host 1 -type 1 -wwn 21000024ff4038d9 -n FCInitiator008
```

Step 2 Create Pool and LUNs

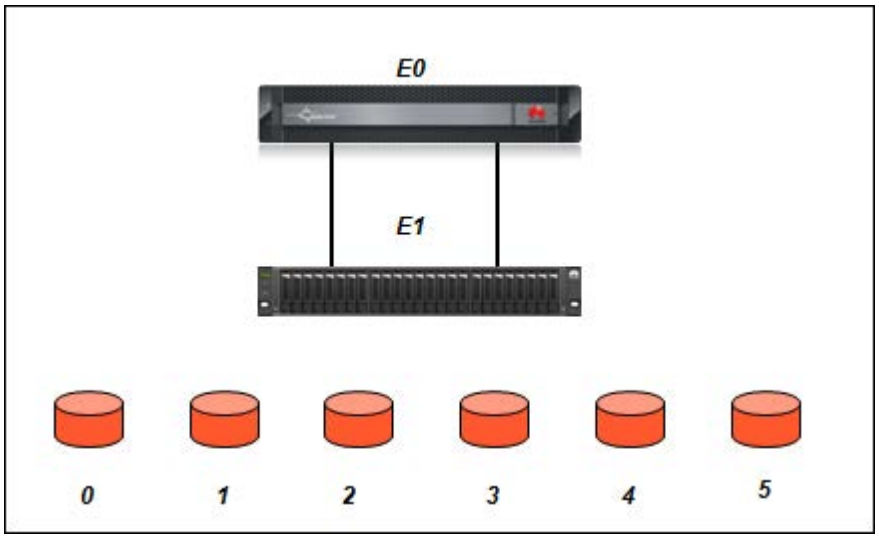
Execute the **mklun.sh** script on the Host System, which has **expect** installed. The script will create 1 Pool and 6 LUNs in the Pool, and map these LUNs to *HostGroup001*. The **setpool** command creates the Pool using 48 of the 50 SSD disks. The remaining 2 SSD disks were used as spares.

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

The ***createlun*** command creates six LUNs in the Pool and uses all of the available capacity for the LUNs. The ***addhostmap*** command maps a LUN to a host or a host group.

Four disks in the disk enclosure (E1) are used as "vault disks", with each disk reserving 13 GiB to save 'dirty' data in case of a power failure.

The Pool mapping is illustrated below.



Step 3 Create Volumes on the Master Host System

Execute the **mkvolume.sh** script on the Master Host System to create 3 logical volumes.

1. **Create Physical Volumes**

   Invoke ***pvcreate*** on each block device, creating 6 physical volumes

2. **Create Volume Groups**

   Create **vg0** using: /dev/sdb, /dev/sdc, /dev/sdd, /dev/sde, /dev/sdf, /dev/sdg.

3. **Create Logical Volumes**

   - Create 1 logical volume on **vg0** for ASU-1 with a capacity of 1,593 GiB.
   - Create 1 logical volume on **vg0** for ASU-2 with a capacity of 1,593 GiB.
   - Create 1 logical volume on **vg0** for ASU-3 with a capacity of 354 GiB..

4. **Scan Logical Volumes**

   Scan the logical volumes on the on the Master Host System. Invoke ssh to scan the physical volumes, volume groups and logical volumes on the second Host System.

Step 4 Change the scheduler on each block device

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

Referenced Scripts

mklun.sh

```
#!/bin/bash


stor=100.94.3.170
stor_user=admin
stor_pswd=Admin@storage

export LANG=C

echo "creating LUN ..."

expect <<__END_CREATE_LUN
     spawn ssh $stor_user@$stor
     set timeout 60
     expect {
            -re "assword" { send "$stor_pswd\n" }
            -re "yes/no" { send "yes\n"; exp_continue }
     }
     expect ">"

        send "setpool -l 10\n"
        expect ">"
     send_user "wait storage pool create finish\n"
        sleep 100
     send "showpool\r"
     expect ">"
        for { set lunid 0 } { \$lunid <= 5 } { incr lunid } {
            if [ expr \$lunid%2 ] {
                   set ctrl b
                         set host 1
            } else {
                   set ctrl a
                         set host 0
            }
                send "createlun -type 3 -n LUN-\$lunid -lunsize 736g -c \$ctrl -
wrtype 2\r"
            expect ">"
            sleep 1
            send "showlun -lun \$lunid\r"
            expect ">"
            send "addhostmap -devlun \$lunid -host \$host\r"
            expect ">"
            send "showhostmap -lun \$lunid\r"
            expect ">"
        }
     send "exit\r"
     expect "(y/n):"
     send "y\r"
     expect EOF
__END_CREATE_LUN
```

mkvolume.sh

```
pvcreate /dev/sdb
pvcreate /dev/sdc
pvcreate /dev/sdd
pvcreate /dev/sde
pvcreate /dev/sdf
pvcreate /dev/sdg

vgcreate vg0 /dev/sdb /dev/sdc /dev/sdd /dev/sde /dev/sdf /dev/sdg



lvcreate -n asu1  -i 6 -I 512 -L 1593g vg0

lvcreate -n asu2  -i 6 -I 512 -L 1593g vg0

lvcreate -n asu3  -i 6 -I 512 -L 354g vg0

./scheduler.sh
```

scheduler.sh

```
echo noop > /sys/block/sdb/queue/scheduler
echo noop > /sys/block/sdc/queue/scheduler
echo noop > /sys/block/sdd/queue/scheduler
echo noop > /sys/block/sde/queue/scheduler
echo noop > /sys/block/sdf/queue/scheduler
echo noop > /sys/block/sdg/queue/scheduler
```

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

ASU Pre-Fill

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

```
pattern=random
hd=default,vdbench=/root/vdbench,user=root,shell=ssh
hd=hd1,system=host1
sd=default,threads=32
sd=sd1,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu1,size=1710470725632
sd=sd2,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu2,size=1710470725632
sd=sd3,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu3,size=380104605696

wd=wd1,sd=(sd1),rdpct=0,seekpct=-1,xfersize=256K
wd=wd2,sd=(sd2),rdpct=0,seekpct=-1,xfersize=256K
wd=wd3,sd=(sd3),rdpct=0,seekpct=-1,xfersize=256K
rd=PREPASU1,wd=wd1,iorate=max,elapsed=360000,interval=10
rd=PREPASU2,wd=wd2,iorate=max,elapsed=360000,interval=10
rd=PREPASU3,wd=wd3,iorate=max,elapsed=360000,interval=10
```

Primary Metrics and Repeatability Tests

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

```
slaves=(slave1,slave2,slave3,slave4,slave5,slave6,slave7,slave8,slave9,slave10,slave
11,slave12,slave13,slave14,slave15,slave16,slave17,slave18,slave19,slave20,slave21,s
lave22,slave23,slave24,slave25,slave26,slave27,slave28,slave29,slave30,slave31,slave
32,slave33,slave34,slave35,slave36,slave37,slave38,slave39,slave40,slave41,slave42,s
lave43,slave44,slave45,slave46,slave47,slave48,slave49,slave50,slave51,slave52,slave
53,slave54,slave55,slave56,slave57,slave58,slave59,slave60,slave61,slave62,slave63,s
lave64,slave65,slave66,slave67,slave68,slave69,slave70,slave71,slave72,slave73,slave
74,slave75,slave76,slave77,slave78,slave79,slave80,slave81,slave82,slave83,slave84)

sd=asu1_1,lun=/dev/vg0/asu1,size=1710470725632
sd=asu2_1,lun=/dev/vg0/asu2,size=1710470725632
sd=asu3_1,lun=/dev/vg0/asu3,size=380104605696
```

SPC-1 Persistence Test Run 1

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

```
sd=asu1_1,lun=/dev/vg0/asu1,size=1710470725632

sd=asu2_1,lun=/dev/vg0/asu2,size=1710470725632

sd=asu3_1,lun=/dev/vg0/asu3,size=380104605696
```

SPC-2 Persistence Test

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

SPC-2 Persistence Test Run 1 *(write phase)*

```
host=localhost,jvms=12,maxstreams=300

sd=sd1,lun=/dev/vg0/asu1,size=1710470725632
sd=sd2,lun=/dev/vg0/asu2,size=1710470725632
sd=sd3,lun=/dev/vg0/asu3,size=380104605696

maxlatestart=1
reportinginterval=5
segmentlength=512m

rd=default,rampup=360,periods=180,measurement=300,runout=0,rampdown=0,buffers=1
rd=default,rdpct=0,xfersize=1024k
rd=TR1-101s_SPC-2-persist-w,streams=267
```

SPC-2 Persistence Test Run 2 *(read phase)*

```
host=localhost,jvms=8,maxstreams=300

sd=sd1,lun=/dev/vg0/asu1,size=1710470725632
sd=sd2,lun=/dev/vg0/asu2,size=1710470725632
sd=sd3,lun=/dev/vg0/asu3,size=380104605696

maxlatestart=1
reportinginterval=5
segmentlength=512m

maxpersistenceerrors=10

rd=default,buffers=1,rdpct=100,xfersize=1024k
rd=TR1-5s_SPC-2-persist-r
```

Slave JVMs

Each Slave JVM was invoked with a command and parameter file similar to the example listed below. The only difference in each file was ***host=*** parameter value, which was unique to each Slave JVM, e.g. **slave1**, **slave2**, **slave3**… .

```
master=host1
host=slave1
sd=asu1_1,lun=/dev/vg0/asu1,size=1710470725632
sd=asu2_1,lun=/dev/vg0/asu2,size=1710470725632
sd=asu3_1,lun=/dev/vg0/asu3,size=380104605696
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

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

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

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

```
#!/bin/sh

JAVA="/usr/java/jre1.7.0_06/bin/java -Xms4096m -Xmx4096m -Xss256k"
EXEDIR=/root/Dorado2100

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

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

N=1
for host in host1 host2 host3 host4
do
  ssh $host rm -rf $EXEDIR/output
  ssh $host rm -rf $EXEDIR/config
  ssh $host mkdir $EXEDIR/output
  ssh $host mkdir $EXEDIR/config
  for((i=1;i<=21;i++))
  do
    echo "start slave$N on $host"
    echo "master=host1" > $EXEDIR/config/slave$N.cfg
    echo "host=slave$N" >> $EXEDIR/config/slave$N.cfg

echo "sd=asu1_1,lun=/dev/vg0/asu1,size=1710470725632" >> $EXEDIR/config/slave$N.cfg
echo "sd=asu2_1,lun=/dev/vg0/asu2,size=1710470725632" >> $EXEDIR/config/slave$N.cfg
echo "sd=asu3_1,lun=/dev/vg0/asu3,size=380104605696" >> $EXEDIR/config/slave$N.cfg


 scp $EXEDIR/config/slave$N.cfg $host:$EXEDIR/config/slave$N.cfg
    ssh $host "$JAVA -cp $EXEDIR/../spc1 spc1 -f $EXEDIR/config/slave$N.cfg -o
$EXEDIR/output/slave$N" > /dev/null &
    N=$[N+1]
  done
done


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

```
$JAVA -cp ../spc1 metrics -b 8012 -t 28800
$JAVA -cp ../spc1 repeat1 -b 8012
$JAVA -cp ../spc1 repeat2 -b 8012

for host in host1 host2 host3 host4
do
  ssh $host killall java
done

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

$JAVA -cp ../spc1 persist1 -b 2003
../spc2/spc2 -f persist1.cfg -o persist1 -init
../spc2/spc2 -f persist1.cfg -o persist1

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

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

#$JAVA -cp ../spc1 persist2
../spc2/spc2 -f persist2.cfg -o persist2 -init
../spc2/spc2 -f persist2.cfg -o persist2
```

APPENDIX F: THIRD-PARTY QUOTATION

SoftNet Solutions

940 Hamlin Court, Sunnyvale, CA 94089
Phone # 408-542-0888 FAX # 408-542-0848

JG041813-17
2013/4/18 Quote Valid:90 Days

Please feel free to give me a call if you have any questions.
Thank you for your interest !

Thank you for your inquiry. We are pleased to quote as follows :

ITEM	PART #	DESCRIPTION	QTY	Net Price	Ext
		Dorado2100 G2 Main Equipment			
		Storage Processor Enclosure			
1	STTZ03STTS	OceanStor Dorado2100 G2 High Performance Solid State Storage System-5.0TB(AC,25*200GB SLC SSD,600K IOPS,48Gbps Bandwidth,8*8G FC Port,with HW Solid-state Storage System Software,SPE51C0225)	1	$89,446.00	$89,446.00
		Disk Enclosure			
2	STTZ05DAE25	High Performance Solid State Storage System Disk Enclosure-5.0TB(2U,AC,25*200GB SLC,with HW SAS in Band Management Software,DAE12525U2)	1	$80,640.00	$80,640.00
		Installation Material			
3	SS-OP-D-LC-M-3	Patchcord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m	8	$13.00	$104.00
4	mini-SAS-3	Outsourcing Cable,External Mini SAS Cable,3.0m,External Mini SAS 26 Pin Plug,28AWG*8P BLACK(S),External Mini SAS 26 Pin Plug,Key2,4,6	1	$74.00	$74.00
		Software			
5	LIC-Dorado-ISM02	HW Integrated Storage Manager-Device Management License for Dorado	1		
		Third Party			
6	N8GHBA000	QLOGIC QLE2562 HBA Card,PCIE,8Gbps DualPort ,Fiber Channel Multimode LC Optic Interface,English Manual,Driver CD	4	$1,698.00	$6,792.00
		Product Support Service			
7	0235G7ES_88134ULJ_1	OceanStor Dorado2100 G2 High Performance Solid State Storage System-5.0TB(AC,25*200GB SLC SSD,600K IOPS,48Gbps Bandwidth,8*8G FC Port,with HW Solid-state Storage System Software,SPE51C0225)_Warranty Upgrade To Hi-Care Onsite Premier 24x7x4H Engineer Onsite Service_3 Year(s)	1	$26,297.00	$26,297.00
8	0235G7EW_88134ULJ_1	High Performance Solid State Storage System Disk Enclosure-5.0TB(2U,AC,25*200GB SLC,with HW SAS in Band Management Software,DAE12525U2)_Warranty Upgrade To Hi-Care Onsite Premier 24x7x4H Engineer Onsite Service_3 Year(s)	1	$23,709.00	$23,709.00
		QUOTE TOTAL			**$227,062.00**

Quotation does not include tax and freight charges.

Terms : Net 30 Upon Credit Approval

Please Note : Quotation does not include applicable Sales Tax and/or Freight Charges.
PLEASE READ THIS QUOTATION CAREFULLY. THE TERMS AND CONDITIONS SET FORTH ON THIS FORM CONSTITUTES THE ENTIRE AGREEMENT BETWEEN THE SELLER AND BUYER. SELLER WILL NOT BE BOUND BY ANY TERMS OF BUYER'S ORDER THAT ARE INCONSISTENT WITH THE TERMS HEREIN.
THIS QUOTATION REFLECTS SOFTNET SOLUTIONS PRICES AND ESTIMATED DELIVERY DATES TO BUYER FOR THE NEXT NINETY (90) DAYS, UNLESS CONTRARY NOTICE IS GIVEN BY SOFTNET SOLUTIONS DURING SUCH NINETY (90) DAYS PERIOD. SHOULD BUYER PLACE AN ORDER FOR THE PRODUCTS SPECIFIED ABOVE, THE SALE SHALL BE SUBJECT SOLELY TO THE TERMS AND CONDITIONS CONTAINED ON THE FACE OF THIS FORM. TO PLACE AN ORDER, PLEASE SIGN THIS QUOTATION WHERE INDICATED AND RETURN A COPY TO SOFTNET SOLUTIONS. THIS QUOTE IS AUTHORIZED FOR THE USE OF THE ABOVE MENTIONED CUSTOMER ONLY. ANY UNAUTHORIZED POSSESSION OF THIS QUOTE SUBJECTS THE ABOVE CUSTOMER AND THE THIRD PARTY TO A LEGAL SUITE FROM SOFTNET SOLUTIONS. ALL SALES ARE FINAL.

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Signature **Date**