SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

HUAWEI TECHNOLOGIES CO., LTD.
HUAWEI OCEANSTOR™ S5600T

SPC-1 V1.12

Submitted for Review: August 25, 2011
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First Edition – August 2011

Trademarks

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Appendix F: Third Party Quotation *(cont.)* 83

AUDIT CERTIFICATION

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

August 25, 2011

The SPC Benchmark 1™ Reported Data listed below for the Huawei Symantec Oceanspace™ S5600T were produced in compliance with the SPC Benchmark 1™ v1.12 Remote Audit requirements.

SPC Benchmark 1™ v1.12 Reported Data	
Tested Storage Product (TSP) Name: Huawei Symantec Oceanspace™ S5600T	
Metric	**Reported Result**
SPC-1 IOPS™	102,471.66
SPC-1 Price-Performance	$2.73/SPC-1 IOPS™
Total ASU Capacity	35,945.185 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$279,914.53

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with 1.12 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by information supplied by Huawei Symantec Technologies Co., Ltd.:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters that were changed from default values.

Storage Performance Council
643 Bair Island Road, Suite 103
Redwood City, CA 94062
AuditService@storageperformance.org
650.556.9384

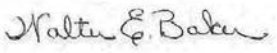
AUDIT CERTIFICATION *(CONT.)*

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

Audit Notes:

There were no audit notes or exceptions.

Respectfully,



Walter E. Baker
SPC Auditor

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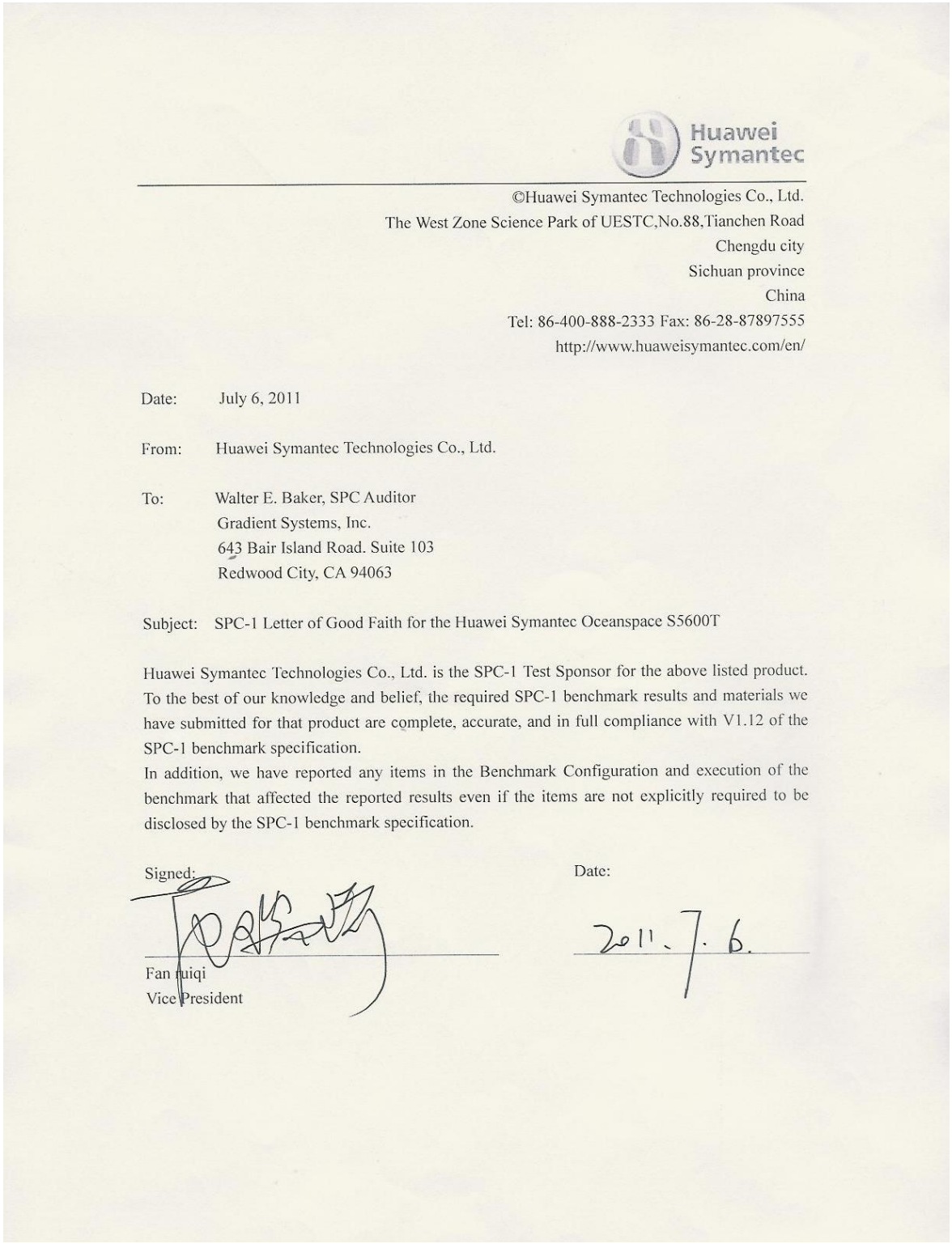
LETTER OF GOOD FAITH



Huawei Symantec

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

Date: July 6, 2011

From: Huawei Symantec Technologies Co., Ltd.

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

Subject: SPC-1 Letter of Good Faith for the Huawei Symantec Oceanspace S5600T

Huawei Symantec Technologies Co., Ltd. is the SPC-1 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V1.12 of the SPC-1 benchmark specification.

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

Signed:

Fan Yuiqi
Vice President

Date: 2011.7.6.

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Eric He – eric.heji@huawei.com No. 1899, Xiyuan Road Chengdu, 611731 P.R. China Phone: 0086 65281927 FAX: 0086 28 64696419
Test Sponsor Alternate Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Jarvis Wang – wangyaohui@huawei.com No. 1899, Xiyuan Road Chengdu, 611731 P.R. China Phone: 86 28 65281956 FAX: 86 28 64696419
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.12
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	August 25, 2011
Date the FDR was submitted to the SPC	August 25, 2011
Date revised FDR was submitted to the SPC Updated company name, logo and product name to reflect the complete acquisition of Huawei Symantec by Huawei Technologies Co., Ltd.	December 13, 2012
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	August 25, 2011

Tested Storage Product (TSP) Description

Huawei's OceanStor™ S5000T series (T for short) are new generation of middle-range storage systems. Based on powerful hardware specifications, it consolidates multiple industry leading technologies including TurboModule that provides high density and hot swap I/O modules, and TurboBoost, which includes high-performance enhancements such as the new generation PCI-E 2.0 bus technology, SAS 2.0 high-speed I/O channel technology, multi-core CPUs, and multi-channel memory. The T series products can meet the requirements of large scale database including OLTP/OLAP, HPC, digital media,

internet service providers, backup, disaster recovery, data migration and other scenarios.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Huawei OceanStor™ S5600T	
Metric	**Reported Result**
SPC-1 IOPS™	102,471.66
SPC-1 Price-Performance™	$2.73/SPC-1 IOPS™
Total ASU Capacity	35,945.185 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$279,914.53

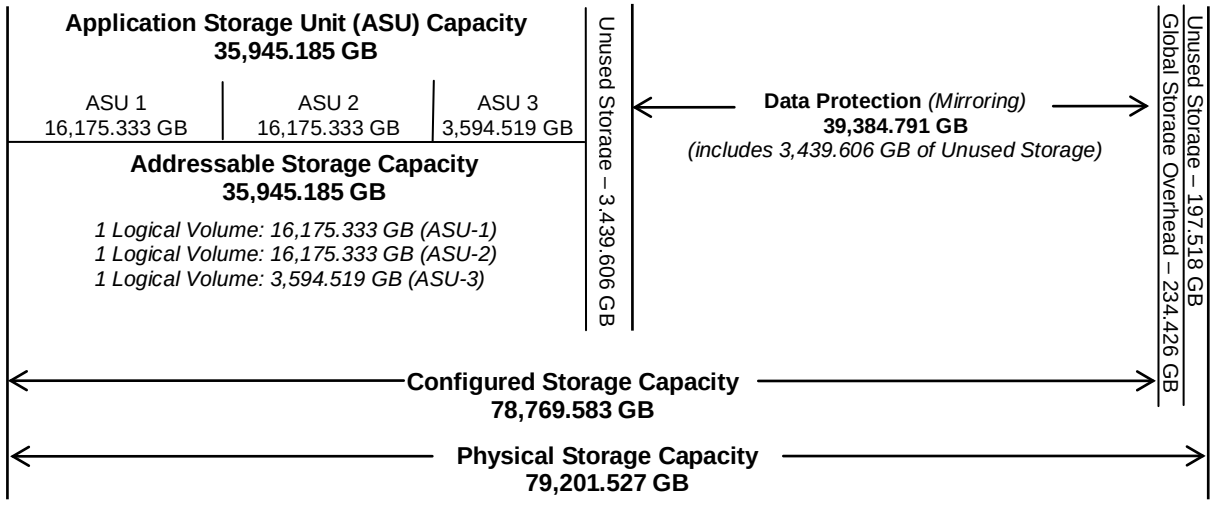
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

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

Storage Capacities, Relationships, and Utilization

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



SPC-1 Storage Capacity Utilization	
Application Utilization	45.38%
Protected Application Utilization	95.11%
Unused Storage Ratio	8.94%

Application Utilization: Total ASU Capacity *(35,945.185 GB)* divided by Physical Storage Capacity *(79,201.527 GB)*

Protected Application Utilization: (Total ASU Capacity *(35,945.185 GB)* plus total Data Protection Capacity *(39,384.791 GB)* minus unused Data Protection Capacity *(2.894 GB)* divided by Physical Storage Capacity *(79,201.527 GB)*

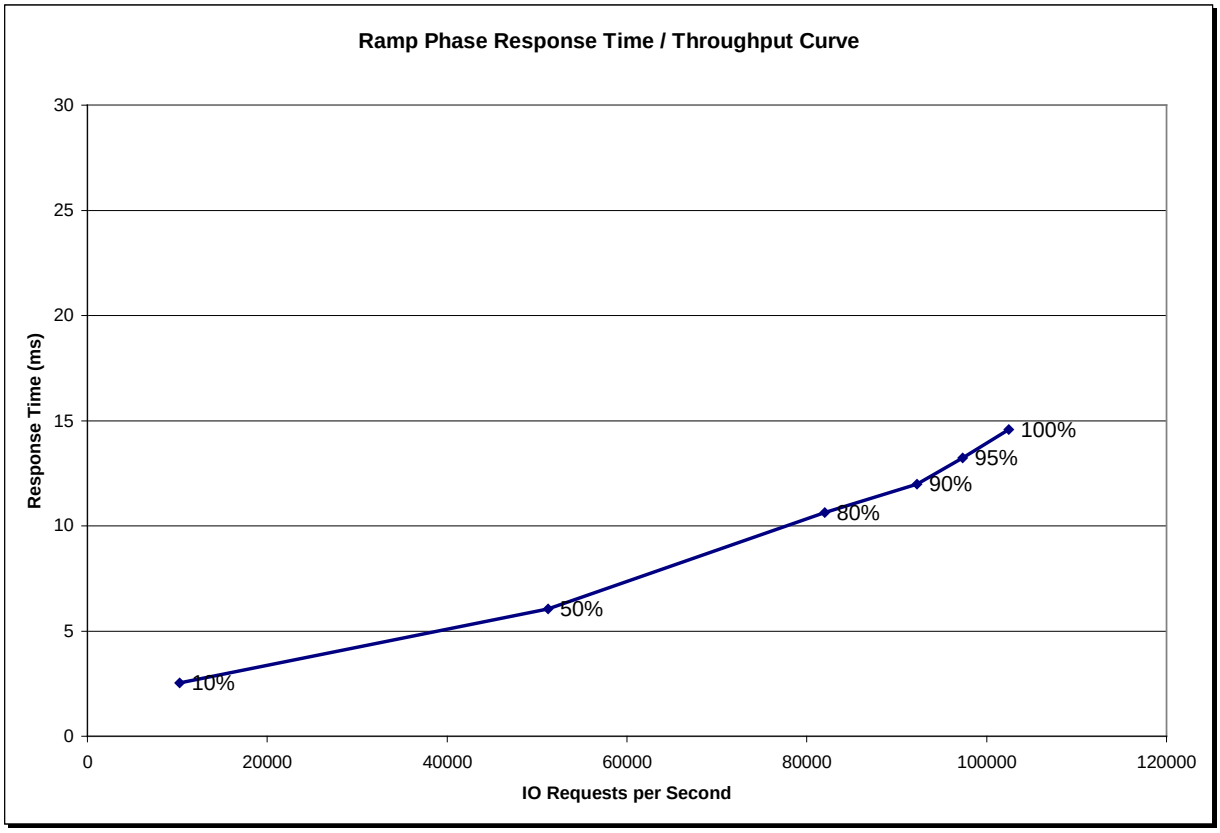
Unused Storage Ratio: Total Unused Capacity *(7,076.730 GB)* divided by Physical Storage Capacity *(79,201.527 GB)* and may not exceed 45%.

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

Response Time – Throughput Curve

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

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



Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	10,257.85	51,241.49	81,999.01	92,264.61	97,341.69	102,471.66
Average Response Time (ms):						
All ASUs	2.53	6.05	10.64	11.98	13.24	14.59
ASU-1	3.14	6.62	11.28	12.84	14.28	15.76
ASU-2	3.04	8.36	16.89	21.24	25.75	29.86
ASU-3	1.02	3.82	6.56	6.10	5.56	5.42
Reads	5.42	12.01	21.12	24.50	27.64	30.54
Writes	0.66	2.17	3.82	3.83	3.86	4.20

Priced Storage Configuration Pricing

Part #	Description	Quantity	Unit Price(USD)	Total Price(USD)
S5600TBB	S5600T, dual controllers, AC, 48GB cache,with UPS Cache Protected Module,without Front-End & Back-End Port	1	20,474.00	20,474.00
SDE35U4BB	DAE12435U4-03 Disk Enclosure(4U,220V AC,SAS Expansion Module,24X3.5" HD Slots without Disk Unit,with HS SAS in Band Management Software),with 2 SAS 1M Cables	11	3,292.00	36,212.00
STIO6GSAS	2*24Gbps SAS-wide I/O modules(2 ports each) backend expansion for JBOD	6	1,052.00	6,312.00
STIO8GFC	4*8Gbps Fibre Channel I/O modules(4 ports each)	4	1,304.00	5,216.00
SHD35SA300	3.5 inch 300GB 15K RPM SAS	240	473.00	113,520.00
SHD35SA600	3.5 inch 600GB 15K RPM SAS	12	756.00	9,072.00
S5000MP	S5000T Multi-Path Software (specify WIN, LINUX, AIX)	1	682.00	682.00
S5600ISM	ISM Software License for S5600T (ESSENTIAL)	1	2,728.00	2,728.00
S5000SSLC	Storage Array Control System Software License for S5000T (ESSENTIAL) - No Charge	1	0.00	0.00
	Patch Cord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m - No Charge	12	0.00	0.00
	Purchased Cable,MiniSAS Cable,Key246,3m - No Charge	1	0.00	0.00
	External Mini-SAS Cable - 26-pin 4x Mini-SAS (SFF-8088) to 26-pin 4x Mini-SAS (SFF-8088)	2	147.00	294.00
Warranty Uplift Option(3 Years)				
TSGS5600AIO	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	1	7,578.00	7,578.00
TSGSTJ4SA60	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	11	4,823.00	53,053.00
Third Party				
QLE2562-CK	QLogic Dual Port 8Gb Fibre Channel to PCI Express Host Bus Adapter (QLE2562-CK)	6	2,598.00	15,588.00
5042A6U	Lenovo ThinkCentre M75e 5042 Tower	1	549.00	549.00
With Sales Tax (4.1%) Colorado Only			**Total**	**279,914.53**

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

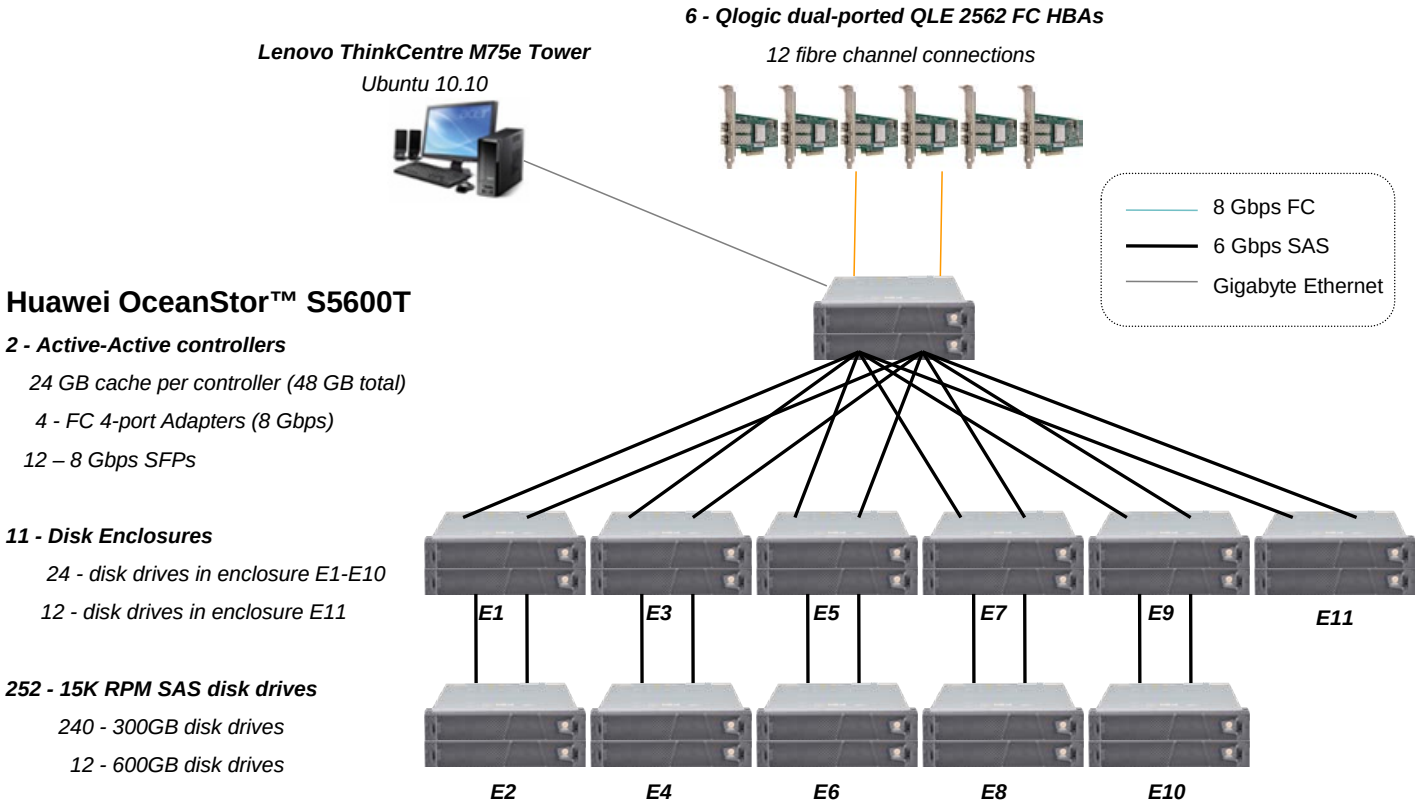
- Acknowledgement of new and existing problems with four (4) hours.
- Onsite present of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Price Storage Configuration that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

Huawei Technologies Co., Ltd. only sells its products to third-party resellers, who in turn, sell those products to U.S. customers. The above pricing, which also includes the required three-year maintenance and support, was obtained from one of those third-party resellers. See page 81 *("Appendix F: Third Party Quotation")* for a copy of the third-party reseller quotation.

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

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

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration:
Lenovo ThinkCenter M75e Tower *(Ubuntu 10.10)* used for configuration management
6 – Qlogic dual-port QLE2562 FC HBAs
Huawei OceanStor™ S5600T **2 - Active-Active controllers** 24 GB cache per controller *(48 GB total)* 4 – Fibre Channel 4-port adapters (8 Gbps) 16 – 8 Gbps front-end connections (*12 used)* 12 – 8 Gbps SFPs 6 – SAS backend connections per controller *(12 total, 12 used)*
11 – Disk Enclosures 24 – 3.5” HD slots per enclosure 2 –SAS 1m cables per enclosure 24 – disk drives in 10 enclosures 12 – disk drives in 1 enclosure
252 – 15K RPM SAS disk drives 240 – 300 GB disk drives 12 – 600 GB disk drives

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

CONFIGURATION INFORMATION

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

Clause 9.4.3.4.1

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

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

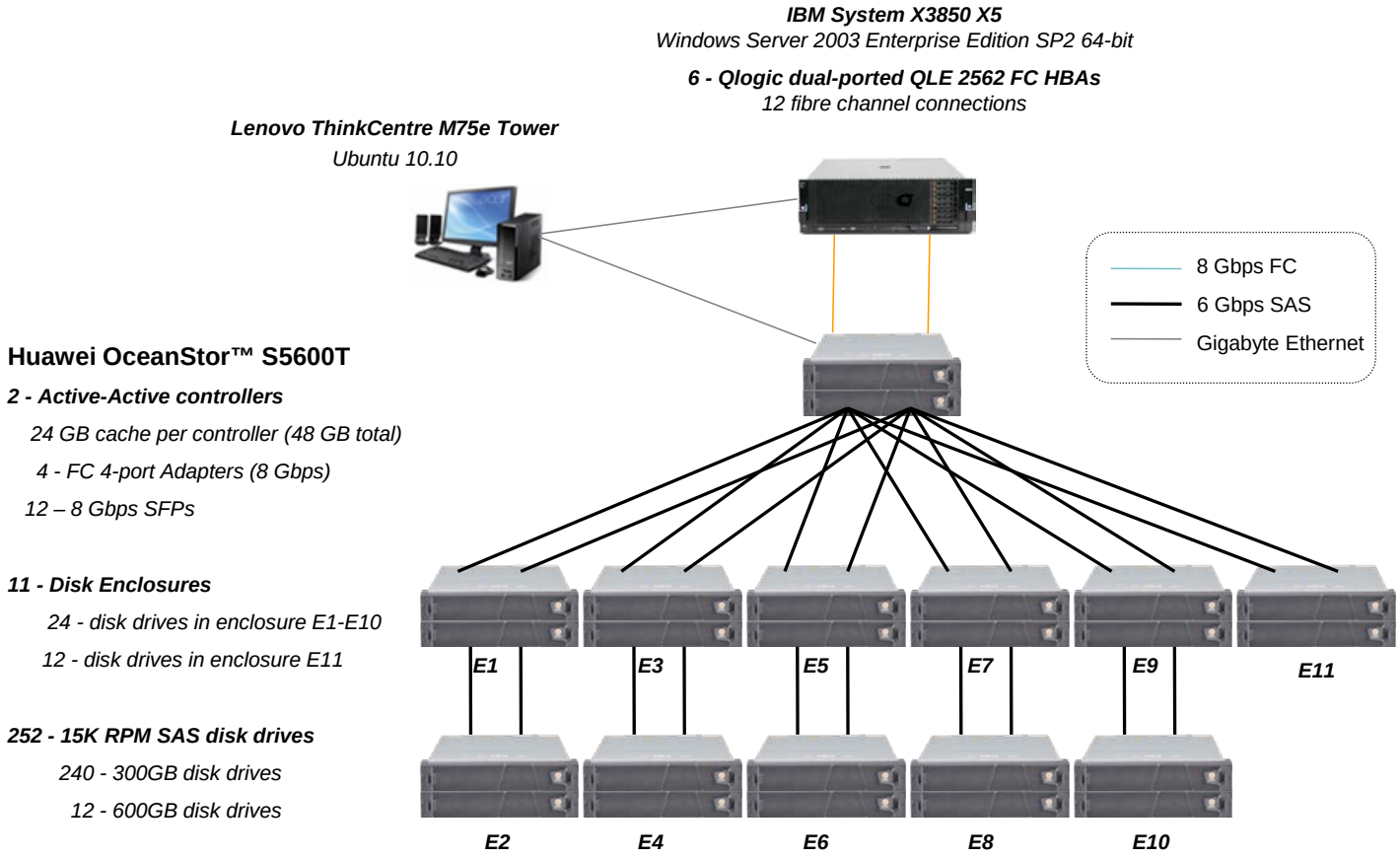
Host System and Tested Storage Configuration (TSC) Table of Components

Clause 9.4.3.4.3

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

The Host System and TSC table of components may be found on page 20 *(Host System(s) and Tested Storage Configuration Components).*

Benchmark Configuration/Tested Storage Configuration Diagram



Host System(s) and Tested Storage Configuration Components

Host System:	Tested Storage Configuration (TSC):
IBM System x3850 X5 Server with:	Lenovo ThinkCenter M75e Tower *(Ubuntu 10.10)* used for configuration management
4 – Intel Xeon X7542 2.66 GHz 6 Core Processor with 18 MB L3 cache	6 – Qlogic dual-port QLE2562 FC HBAs
32 GB main memory	**Huawei OceanStor™ S5600T** **2 - Active-Active controllers** 24 GB cache per controller *(48 GB total)* 4 – Fibre Channel 4-port adapters (8 Gbps) 16 – 8 Gbps front-end connections (*12 used)* 12 – 8 Gbps SFPs 6 – SAS backend connections per controller *(12 total, 12 used)*
Windows Server 2003 Enterprise Edition 64-bit with SP2	11 – Disk Enclosures 24 – 3.5" HD slots per enclosure 2 –SAS 1m cables per enclosure 24 – disk drives in 10 enclosures 12 – disk drives in 1 enclosure
PCIe	252 – 15K RPM SAS disk drives 240 – 300 GB disk drives 12 – 600 GB disk drives

Customer Tunable Parameters and Options

Clause 9.4.3.5.1

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

"Appendix B: Customer Tunable Parameters and Options" on page 64 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 65 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 76.

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 60 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.4.3.6.1

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

SPC-1 Storage Capacities

SPC-1 Storage Capacities		
Storage Hierarchy Component	**Units**	**Capacity**
Total ASU Capacity	Gigabytes (GB)	35,945.185
Addressable Storage Capacity	Gigabytes (GB)	35,945.185
Configured Storage Capacity	Gigabytes (GB)	78,769.583
Physical Storage Capacity	Gigabytes (GB)	79,201.527
Data Protection *(Mirroring)*	Gigabytes (GB)	39,384.791
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	234.426
Total Unused Storage	Gigabytes (GB)	7,076.730

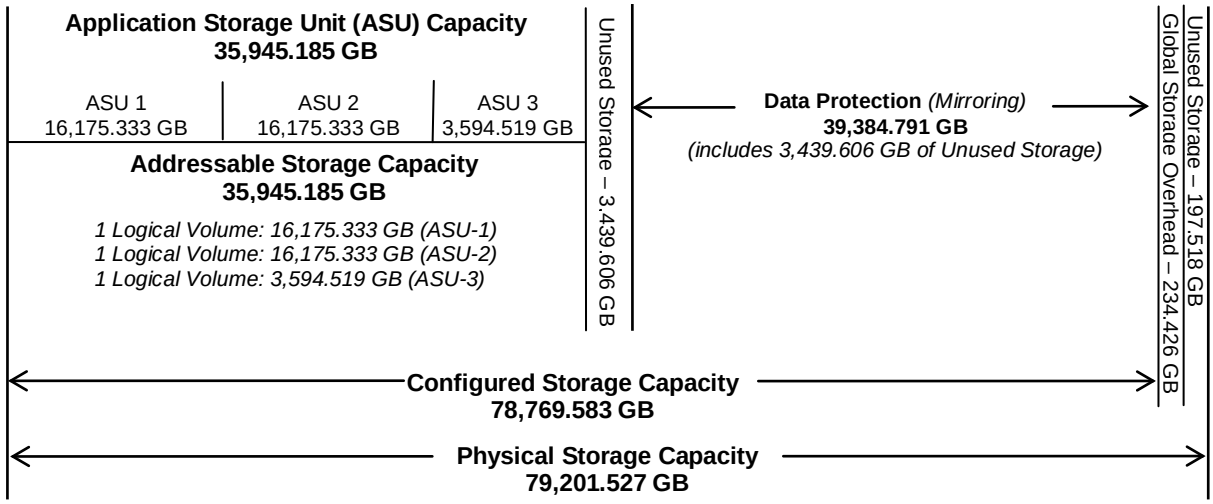
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	100.00%	45.63%	45.38%
Required for Data Protection *(Mirrored)*		50.00%	49.73%
Addressable Storage Capacity		45.63%	45.38%
Required Storage		0.00%	0.00%
Configured Storage Capacity			99.45%
Global Storage Overhead			0.30%
Unused Storage:			
Addressable	0.00%		
Configured		8.73%	
Physical			0.25%

The Physical Storage Capacity consisted of 79,201.527 GB distributed over 240 disk drives, each with a formatted capacity of 300.00 GB and 12 disk drives, each with a formatted capacity of 600.127 GB. There was 197.518 GB (0.25%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 234.426 GB (0.30%) of the Physical Storage Capacity. There was 6,879.212 GB (8.73%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) of Unused Storage within the Addressable Storage Capacity. The Data Protection *(Mirroring)* capacity was 39,384.791 GB of which 39,381.897 GB was utilized. The total Unused Storage was 7,076.730 GB.

SPC-1 Storage Capacities and Relationships Illustration

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



Logical Volume Capacity and ASU Mapping

Clause 9.4.3.6.3

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

Logical Volume Capacity and Mapping		
ASU-1 (16,175.333 GB)	**ASU-2 (16,175.333 GB)**	**ASU-3 (3,594.519 GB)**
1 Logical Volume 16,175.333 GB per Logical Volume (16,175.333 used per Logical Volume)	1 Logical Volume 16,175.333 GB per Logical Volume (16,175.333 used per Logical Volume)	1 Logical Volume 3,594.519 GB per Logical Volume (3,594.519 used per Logical Volume)

The Data Protection Level used for all Logical Volumes was "Mirrored" as described on page 12. See "ASU Configuration" in the **IOPS Test Results File** for more detailed configuration information.

Storage Capacity Utilization

Clause 9.4.3.6.2

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

Clause 2,8.1

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

Clause 2,8.2

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

Clause 2,8.3

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

SPC-1 Storage Capacity Utilization	
Application Utilization	45.38%
Protected Application Utilization	95.11%
Unused Storage Ratio	8.94%

SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. "SPC-1 Test Execution Definitions" on page 61 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

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

SPC-1 Tests, Test Phases, and Test Runs

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

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

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

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

Primary Metrics Test – Sustainability Test Phase

Clause 5.4.4.1.1

The Sustainability Test Phase has exactly one Test Run and shall demonstrate the maximum sustainable I/O Request Throughput within at least a continuous three (3) hour Measurement Interval. This Test Phase also serves to insure that the TSC has reached Steady State prior to reporting the final maximum I/O Request Throughput result (SPC-1 IOPS™).

Clause 5.4.4.1.2

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

Clause 5.4.4.1.4

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

Clause 9.4.3.7.1

For the Sustainability Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 77.

Sustainability Test Results File

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

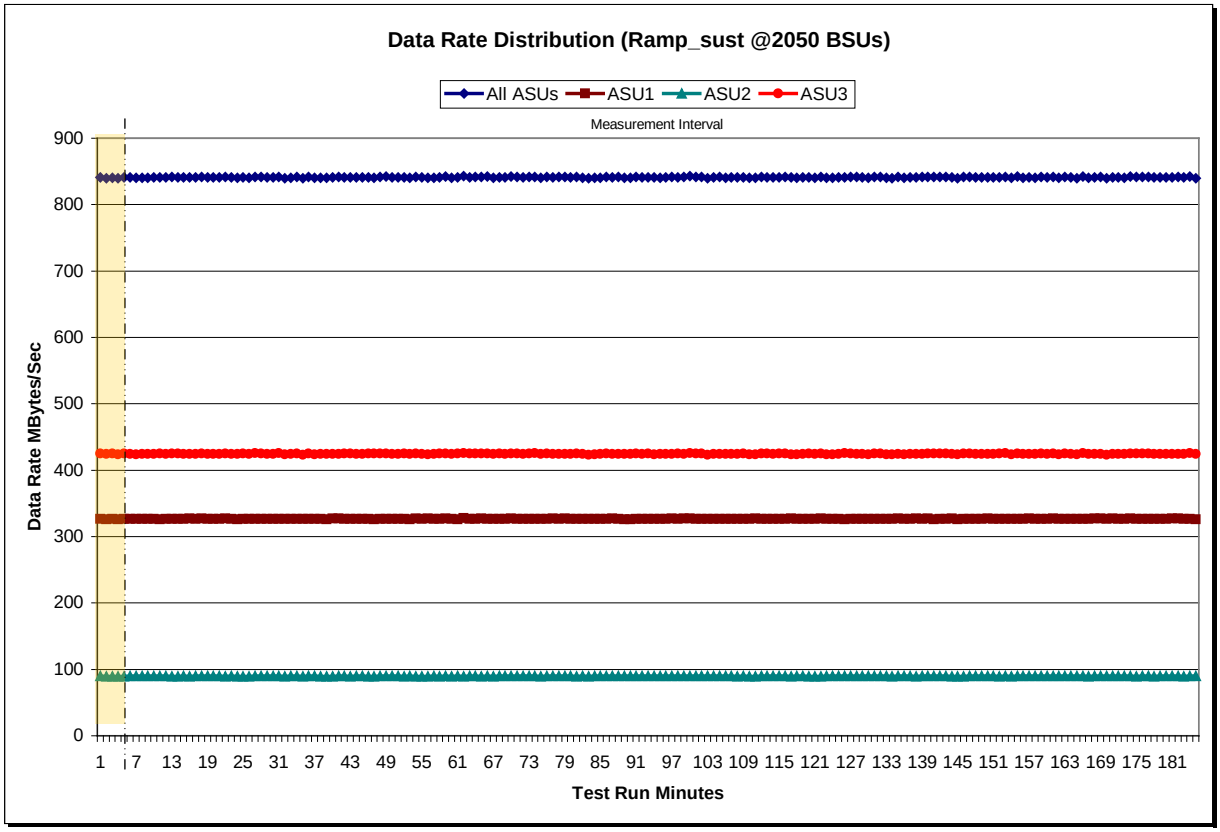
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	19:23:23	19:28:23	0-4	0:05:00
Measurement Interval	19:28:23	22:28:23	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	841.16	326.34	89.86	424.96	63	841.60	326.76	89.91	424.93	126	841.72	326.77	90.17	424.78
1	840.04	326.19	89.71	424.14	64	841.68	327.16	89.36	425.16	127	841.41	326.79	89.95	424.66
2	840.67	326.50	89.43	424.74	65	842.27	326.87	90.25	425.14	128	840.78	326.35	89.76	424.66
3	839.47	326.22	89.66	423.59	66	840.22	326.47	89.62	424.12	129	840.50	326.76	89.79	423.95
4	841.35	326.87	89.73	424.74	67	841.21	326.54	89.83	424.84	130	841.51	326.72	90.06	424.73
5	840.86	326.81	89.88	424.17	68	840.78	326.48	89.78	424.52	131	841.57	326.68	89.92	424.97
6	840.47	326.70	89.86	423.91	69	842.11	327.01	89.91	425.20	132	840.66	326.72	89.93	424.01
7	840.70	326.57	89.79	424.33	70	841.57	326.68	90.05	424.83	133	839.99	326.59	89.54	423.86
8	840.63	326.38	89.82	424.43	71	841.06	326.85	89.88	424.32	134	841.45	326.99	89.93	424.53
9	840.84	326.63	89.79	424.42	72	841.60	326.70	89.89	425.00	135	840.12	326.29	89.96	423.87
10	841.16	326.16	89.98	425.02	73	841.95	326.45	89.97	425.53	136	840.96	326.54	89.80	424.63
11	841.07	326.57	89.91	424.59	74	840.34	326.43	89.68	424.23	137	841.11	327.12	89.67	424.32
12	841.65	326.78	89.71	425.16	75	841.68	326.78	90.13	424.76	138	841.52	326.68	90.26	424.58
13	841.32	326.61	89.72	424.99	76	841.16	326.92	89.89	424.35	139	841.85	326.92	89.83	425.10
14	841.01	326.63	89.79	424.58	77	841.44	326.61	90.15	424.68	140	841.46	326.22	90.08	425.16
15	841.24	327.15	89.74	424.35	78	841.40	327.00	89.87	424.54	141	841.62	326.77	89.94	424.91
16	841.17	326.79	89.85	424.52	79	841.05	326.69	89.94	424.42	142	841.93	326.44	90.29	425.21
17	841.76	326.90	89.89	424.98	80	841.37	326.44	89.72	425.21	143	840.84	326.91	89.66	424.28
18	840.81	326.47	89.86	424.49	81	840.57	326.38	89.77	424.42	144	839.82	326.21	89.55	424.06
19	841.09	326.42	89.98	424.69	82	839.59	326.58	89.69	423.32	145	841.64	326.83	89.70	425.12
20	840.98	326.55	89.95	424.48	83	840.43	326.48	90.06	423.90	146	841.42	326.55	90.01	424.86
21	841.64	327.14	89.58	424.92	84	840.62	326.60	89.83	424.18	147	840.95	326.55	89.94	424.46
22	840.84	326.82	89.76	424.25	85	841.76	326.64	89.97	425.15	148	840.94	326.52	90.02	424.40
23	840.65	326.19	89.74	424.72	86	841.31	326.94	89.82	424.55	149	841.20	326.93	89.93	424.34
24	840.87	326.53	89.60	424.73	87	841.58	326.78	90.10	424.71	150	840.86	326.67	89.88	424.31
25	840.51	326.74	89.37	424.39	88	840.41	326.17	90.10	424.15	151	840.94	326.46	89.52	424.96
26	841.62	326.29	89.88	425.44	89	840.34	326.11	90.09	424.14	152	841.90	326.61	89.80	425.49
27	841.44	326.45	89.89	425.10	90	841.40	326.45	89.94	425.00	153	840.08	326.39	89.63	424.06
28	841.07	326.74	89.76	424.57	91	841.09	326.41	90.19	424.49	154	842.02	326.73	90.32	424.97
29	840.97	326.51	89.81	424.65	92	841.18	326.36	89.92	424.90	155	840.60	326.38	90.07	424.15
30	841.85	326.30	89.83	425.72	93	840.89	326.84	90.10	423.95	156	841.25	326.91	89.79	424.55
31	840.04	326.37	89.61	424.06	94	840.69	326.47	89.80	424.42	157	840.37	326.34	89.88	424.16
32	840.50	326.54	89.80	424.16	95	841.04	326.52	89.85	424.66	158	841.61	326.74	89.93	424.94
33	841.45	326.50	89.83	425.12	96	841.68	327.03	89.93	424.72	159	840.92	326.35	90.04	424.53
34	839.74	326.60	89.70	423.43	97	841.06	326.31	89.84	424.90	160	841.92	327.09	89.77	425.06
35	841.53	326.71	90.05	424.77	98	841.75	327.20	90.10	424.45	161	840.25	326.48	89.91	423.85
36	840.56	326.81	89.94	423.81	99	842.76	327.07	90.07	425.63	162	841.62	326.55	90.02	425.05
37	840.47	326.63	89.73	424.11	100	841.39	326.67	89.84	424.87	163	840.87	326.33	89.88	424.66
38	840.10	326.18	89.71	424.21	101	841.46	326.50	89.89	425.07	164	839.85	326.51	89.79	423.55
39	841.20	327.18	89.44	424.58	102	839.93	326.53	89.97	423.43	165	842.39	326.65	90.13	425.62
40	841.64	327.01	90.01	424.62	103	841.05	326.58	90.03	424.43	166	840.62	326.71	89.61	424.30
41	841.35	326.34	89.83	425.18	104	841.49	326.84	89.97	424.68	167	841.13	326.93	89.78	424.42
42	841.21	326.53	89.66	425.02	105	840.57	326.35	89.81	424.41	168	841.68	327.00	90.10	424.59
43	840.99	326.42	89.97	424.60	106	840.89	326.55	89.81	424.53	169	839.77	326.31	90.12	423.34
44	841.16	326.65	89.96	424.55	107	840.75	326.78	89.69	424.28	170	841.34	326.91	89.97	424.47
45	841.31	326.78	89.73	424.80	108	841.34	326.73	89.85	424.77	171	840.74	326.48	89.83	424.43
46	840.70	326.12	89.72	424.86	109	840.09	326.61	89.66	423.82	172	840.30	326.38	89.76	424.16
47	841.40	326.53	89.91	424.96	110	840.62	327.01	89.55	424.06	173	842.27	327.00	89.98	425.29
48	842.03	326.69	90.07	425.26	111	841.54	326.67	89.86	425.00	174	841.52	326.89	89.73	424.90
49	840.74	326.40	90.00	424.34	112	841.07	326.40	89.87	424.80	175	841.59	326.70	89.92	424.98
50	841.30	326.88	90.05	424.37	113	840.91	326.72	90.05	424.14	176	841.77	326.74	90.19	424.85
51	841.19	326.53	89.56	425.10	114	841.17	326.41	89.82	424.94	177	840.82	326.72	89.68	424.42
52	840.39	326.17	89.86	424.36	115	841.56	326.83	89.89	424.84	178	841.02	326.65	89.75	424.62
53	841.71	326.99	89.64	425.08	116	840.86	327.19	89.66	424.02	179	841.03	326.52	89.94	424.56
54	840.94	326.72	89.70	424.52	117	840.14	326.55	89.88	423.71	180	841.31	326.97	89.99	424.35
55	840.46	327.05	89.48	423.93	118	840.82	326.44	89.86	424.52	181	841.76	327.03	90.07	424.66
56	840.70	326.45	89.83	424.42	119	840.82	326.28	89.60	424.94	182	840.93	326.77	89.64	424.52
57	841.31	326.76	89.72	424.83	120	840.27	326.58	89.50	424.19	183	842.41	326.74	90.15	425.52
58	842.03	327.07	90.06	424.90	121	841.83	326.89	89.72	425.22	184	839.86	325.89	89.76	424.20
59	840.24	326.52	89.63	424.09	122	840.61	326.69	89.97	423.95					
60	841.22	326.19	89.93	425.10	123	840.49	326.75	89.82	423.93					
61	843.12	327.56	89.67	425.89	124	840.77	326.54	89.77	424.46					
62	841.01	326.34	89.93	424.74	125	841.28	325.62	89.88	425.78					

Sustainability – Data Rate Distribution Graph

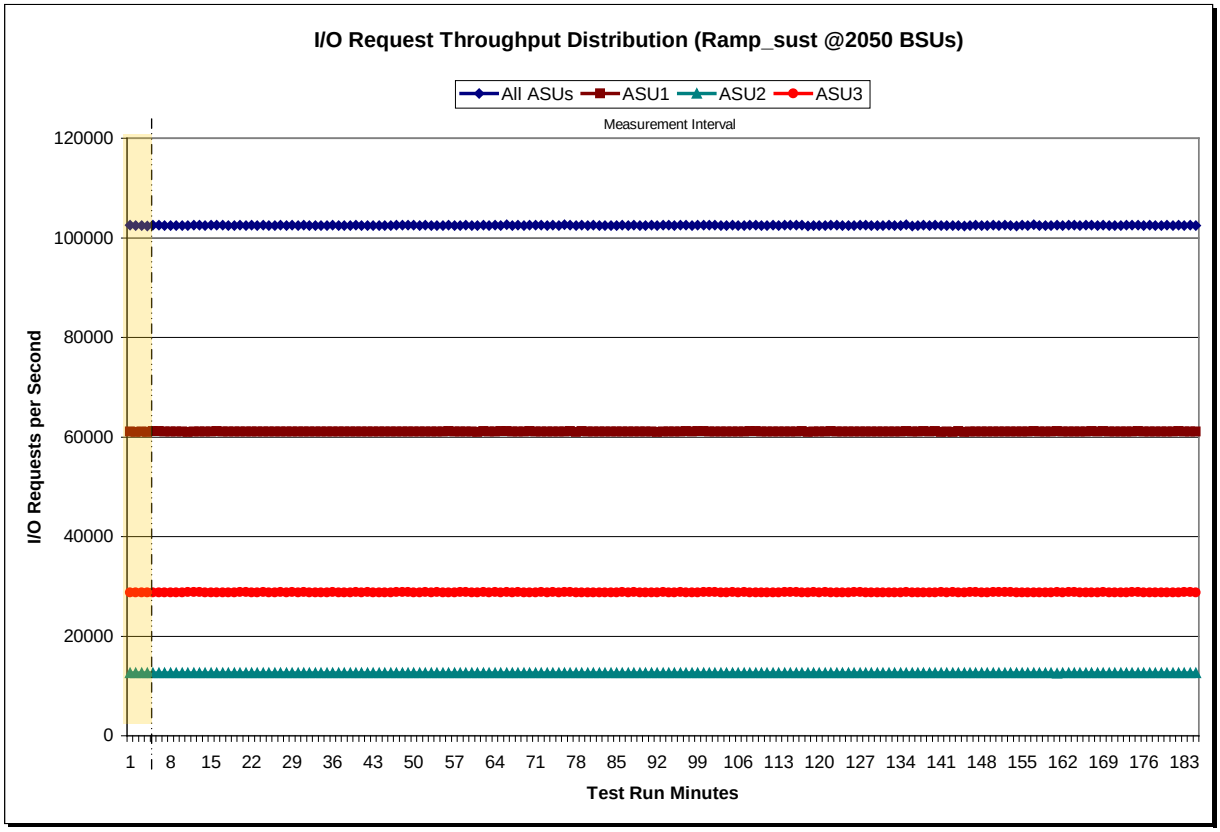


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	19:23:23	19:28:23	0-4	0:05:00
Measurement Interval	19:28:23	22:28:23	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	102,518.25	61,097.97	12,612.35	28,807.93	63	102,544.78	61,105.57	12,619.95	28,819.27	126	102,525.00	61,102.13	12,609.55	28,813.32
1	102,430.35	61,022.60	12,595.72	28,812.03	64	102,500.50	61,124.83	12,579.73	28,795.93	127	102,509.25	61,104.55	12,603.80	28,800.90
2	102,455.58	61,078.43	12,586.45	28,790.70	65	102,603.87	61,133.20	12,625.57	28,845.10	128	102,439.80	61,046.48	12,615.17	28,778.15
3	102,338.77	60,997.85	12,598.35	28,742.57	66	102,454.92	61,079.50	12,595.53	28,779.88	129	102,452.77	61,089.02	12,609.63	28,754.12
4	102,514.15	61,124.45	12,594.63	28,795.07	67	102,530.23	61,085.85	12,608.88	28,835.50	130	102,479.37	61,075.13	12,617.35	28,786.88
5	102,565.95	61,151.83	12,629.78	28,784.33	68	102,463.52	61,073.98	12,614.05	28,775.48	131	102,511.40	61,103.17	12,619.90	28,788.33
6	102,504.32	61,102.52	12,623.53	28,778.27	69	102,545.68	61,141.80	12,598.72	28,805.17	132	102,486.88	61,091.08	12,621.82	28,773.98
7	102,472.53	61,074.50	12,600.40	28,797.63	70	102,529.40	61,119.80	12,616.50	28,793.10	133	102,490.55	61,105.90	12,595.78	28,788.87
8	102,499.72	61,072.20	12,620.98	28,806.53	71	102,538.38	61,109.33	12,614.43	28,814.62	134	102,600.35	61,156.08	12,629.38	28,814.88
9	102,478.03	61,094.37	12,589.08	28,794.58	72	102,491.27	61,077.47	12,617.75	28,796.05	135	102,413.10	61,037.13	12,599.92	28,776.05
10	102,450.08	61,027.68	12,605.07	28,817.33	73	102,513.15	61,069.38	12,612.10	28,831.67	136	102,485.20	61,111.00	12,603.18	28,771.02
11	102,525.82	61,104.50	12,606.37	28,814.95	74	102,453.18	61,049.77	12,605.50	28,797.92	137	102,515.82	61,125.88	12,596.98	28,792.95
12	102,542.18	61,111.27	12,601.15	28,829.77	75	102,594.12	61,122.32	12,627.78	28,844.02	138	102,469.62	61,080.82	12,616.62	28,772.18
13	102,494.30	61,086.18	12,598.80	28,809.32	76	102,569.37	61,129.23	12,613.88	28,826.25	139	102,557.60	61,155.08	12,605.78	28,796.73
14	102,514.05	61,119.93	12,594.72	28,799.40	77	102,444.38	61,036.48	12,615.42	28,792.48	140	102,443.80	61,025.83	12,602.17	28,815.80
15	102,552.00	61,136.55	12,616.62	28,798.83	78	102,557.78	61,142.42	12,630.70	28,784.67	141	102,482.12	61,063.28	12,609.70	28,809.13
16	102,534.57	61,111.45	12,621.53	28,801.58	79	102,475.37	61,081.47	12,603.05	28,790.85	142	102,462.73	61,024.48	12,621.92	28,816.33
17	102,478.35	61,069.10	12,604.80	28,804.45	80	102,518.73	61,092.10	12,620.57	28,806.07	143	102,474.82	61,128.83	12,579.97	28,766.02
18	102,435.30	61,059.95	12,599.13	28,776.22	81	102,441.52	61,065.17	12,595.25	28,781.10	144	102,404.02	61,016.42	12,584.15	28,803.45
19	102,522.05	61,080.38	12,625.45	28,816.22	82	102,447.92	61,049.47	12,619.83	28,778.62	145	102,496.38	61,063.63	12,615.35	28,817.40
20	102,481.53	61,063.42	12,605.97	28,812.15	83	102,456.32	61,062.50	12,635.08	28,758.73	146	102,541.93	61,102.18	12,623.73	28,816.02
21	102,509.02	61,116.63	12,583.62	28,808.77	84	102,467.28	61,078.33	12,613.82	28,775.13	147	102,481.13	61,064.40	12,615.00	28,801.73
22	102,447.67	61,051.70	12,588.55	28,807.42	85	102,538.80	61,105.88	12,608.90	28,824.02	148	102,448.43	61,052.23	12,612.02	28,784.18
23	102,526.60	61,112.57	12,601.65	28,812.38	86	102,480.77	61,104.47	12,586.83	28,789.47	149	102,529.10	61,089.42	12,612.82	28,826.87
24	102,459.47	61,062.38	12,588.47	28,808.62	87	102,537.72	61,078.72	12,632.87	28,826.13	150	102,491.88	61,060.98	12,612.62	28,818.28
25	102,478.15	61,105.27	12,590.78	28,782.10	88	102,480.78	61,072.63	12,616.73	28,791.42	151	102,524.72	61,101.63	12,598.87	28,824.22
26	102,524.27	61,095.25	12,615.85	28,813.17	89	102,470.47	61,071.85	12,603.73	28,794.88	152	102,474.05	61,061.48	12,586.48	28,826.08
27	102,490.73	61,094.38	12,594.00	28,802.35	90	102,508.55	61,098.25	12,619.37	28,790.93	153	102,412.82	61,039.20	12,598.67	28,774.95
28	102,511.35	61,085.28	12,592.80	28,833.27	91	102,426.07	61,035.57	12,609.00	28,781.50	154	102,538.05	61,088.72	12,650.42	28,798.92
29	102,495.45	61,084.53	12,605.38	28,805.53	92	102,530.70	61,095.43	12,606.67	28,828.60	155	102,501.48	61,084.03	12,613.20	28,804.25
30	102,519.80	61,071.15	12,616.67	28,831.98	93	102,517.10	61,121.92	12,613.85	28,781.33	156	102,602.35	61,196.08	12,611.47	28,794.80
31	102,468.78	61,097.52	12,579.47	28,791.80	94	102,491.05	61,084.90	12,604.25	28,801.90	157	102,469.13	61,075.10	12,618.10	28,775.93
32	102,466.75	61,077.32	12,601.88	28,787.55	95	102,509.38	61,062.37	12,621.68	28,825.33	158	102,467.63	61,091.18	12,588.68	28,787.77
33	102,489.47	61,091.87	12,593.93	28,803.67	96	102,554.47	61,129.88	12,619.80	28,804.78	159	102,478.85	61,058.45	12,630.78	28,789.62
34	102,421.65	61,071.10	12,591.38	28,759.17	97	102,449.60	61,052.93	12,586.88	28,809.78	160	102,529.93	61,147.60	12,569.35	28,812.98
35	102,542.55	61,111.13	12,613.70	28,817.72	98	102,552.30	61,169.98	12,633.30	28,749.02	161	102,486.23	61,075.02	12,616.57	28,794.65
36	102,504.13	61,105.38	12,619.73	28,779.02	99	102,566.60	61,133.48	12,619.75	28,813.37	162	102,526.98	61,089.60	12,622.97	28,814.42
37	102,479.58	61,086.88	12,605.92	28,786.78	100	102,530.33	61,063.33	12,618.52	28,848.48	163	102,517.38	61,094.32	12,602.52	28,820.55
38	102,424.62	61,070.18	12,586.75	28,767.68	101	102,505.83	61,082.25	12,597.73	28,825.85	164	102,436.80	61,080.13	12,603.97	28,752.70
39	102,507.73	61,093.42	12,598.13	28,816.18	102	102,440.00	61,073.57	12,603.35	28,763.08	165	102,531.58	61,103.15	12,621.53	28,806.90
40	102,502.87	61,113.28	12,587.43	28,802.15	103	102,499.97	61,099.85	12,621.97	28,778.15	166	102,514.80	61,127.07	12,599.38	28,788.35
41	102,493.55	61,037.73	12,596.33	28,859.48	104	102,539.73	61,088.85	12,632.43	28,818.45	167	102,491.20	61,109.75	12,597.03	28,784.42
42	102,458.77	61,081.43	12,577.18	28,800.15	105	102,472.08	61,088.35	12,614.20	28,769.53	168	102,570.55	61,131.08	12,624.70	28,814.77
43	102,481.78	61,063.02	12,625.67	28,793.10	106	102,496.33	61,074.22	12,606.53	28,815.58	169	102,478.00	61,097.27	12,628.48	28,752.25
44	102,478.90	61,089.50	12,607.12	28,782.28	107	102,513.17	61,135.35	12,602.63	28,775.18	170	102,458.07	61,072.10	12,614.10	28,771.87
45	102,462.70	61,085.45	12,592.12	28,785.13	108	102,590.30	61,165.93	12,626.50	28,797.87	171	102,494.30	61,118.32	12,597.68	28,778.30
46	102,513.42	61,088.28	12,592.08	28,833.05	109	102,448.20	61,079.63	12,601.53	28,767.03	172	102,528.80	61,104.88	12,616.40	28,807.52
47	102,530.07	61,098.38	12,611.03	28,820.65	110	102,485.08	61,076.18	12,622.50	28,786.40	173	102,519.83	61,083.78	12,612.27	28,823.78
48	102,523.17	61,086.78	12,615.35	28,821.03	111	102,530.98	61,121.90	12,602.12	28,806.97	174	102,576.35	61,151.53	12,601.87	28,822.95
49	102,507.62	61,069.82	12,641.87	28,795.93	112	102,480.60	61,088.63	12,591.65	28,800.32	175	102,499.28	61,122.75	12,593.27	28,783.27
50	102,472.80	61,109.38	12,614.13	28,749.28	113	102,521.62	61,083.97	12,606.60	28,831.05	176	102,542.63	61,110.92	12,622.30	28,809.42
51	102,544.75	61,098.25	12,616.68	28,829.82	114	102,515.60	61,074.70	12,613.27	28,827.63	177	102,472.88	61,088.72	12,585.72	28,798.45
52	102,441.05	61,053.75	12,595.37	28,791.93	115	102,562.80	61,106.82	12,612.40	28,843.58	178	102,484.30	61,075.00	12,604.50	28,804.80
53	102,492.65	61,085.32	12,594.93	28,812.40	116	102,540.50	61,143.15	12,593.50	28,803.85	179	102,509.20	61,112.20	12,623.57	28,773.43
54	102,504.85	61,090.15	12,609.90	28,804.80	117	102,380.40	61,013.10	12,599.87	28,767.43	180	102,460.57	61,085.32	12,590.73	28,784.52
55	102,532.33	61,130.77	12,599.62	28,801.95	118	102,495.05	61,064.95	12,608.68	28,821.42	181	102,589.18	61,167.62	12,623.02	28,798.55
56	102,447.60	61,084.40	12,612.48	28,750.72	119	102,440.25	61,049.70	12,589.03	28,801.52	182	102,503.17	61,098.55	12,592.33	28,812.28
57	102,497.82	61,081.52	12,596.92	28,819.38	120	102,494.77	61,086.42	12,594.63	28,813.72	183	102,522.25	61,062.00	12,628.77	28,831.48
58	102,551.30	61,112.03	12,617.22	28,822.05	121	102,543.35	61,143.15	12,606.90	28,793.30	184	102,427.67	61,047.23	12,602.52	28,777.92
59	102,458.67	61,068.20	12,607.30	28,783.17	122	102,533.23	61,116.37	12,619.18	28,797.68	***Average***	***102,498.71***	***61,090.82***	***12,607.86***	***28,800.03***
60	102,466.13	61,025.38	12,630.07	28,810.68	123	102,453.70	61,071.97	12,584.75	28,796.98					
61	102,588.92	61,176.97	12,596.18	28,815.77	124	102,462.18	61,079.25	12,596.97	28,785.97					
62	102,463.82	61,070.42	12,599.83	28,793.57	125	102,467.60	61,051.17	12,604.33	28,812.10					

Sustainability – I/O Request Throughput Distribution Graph

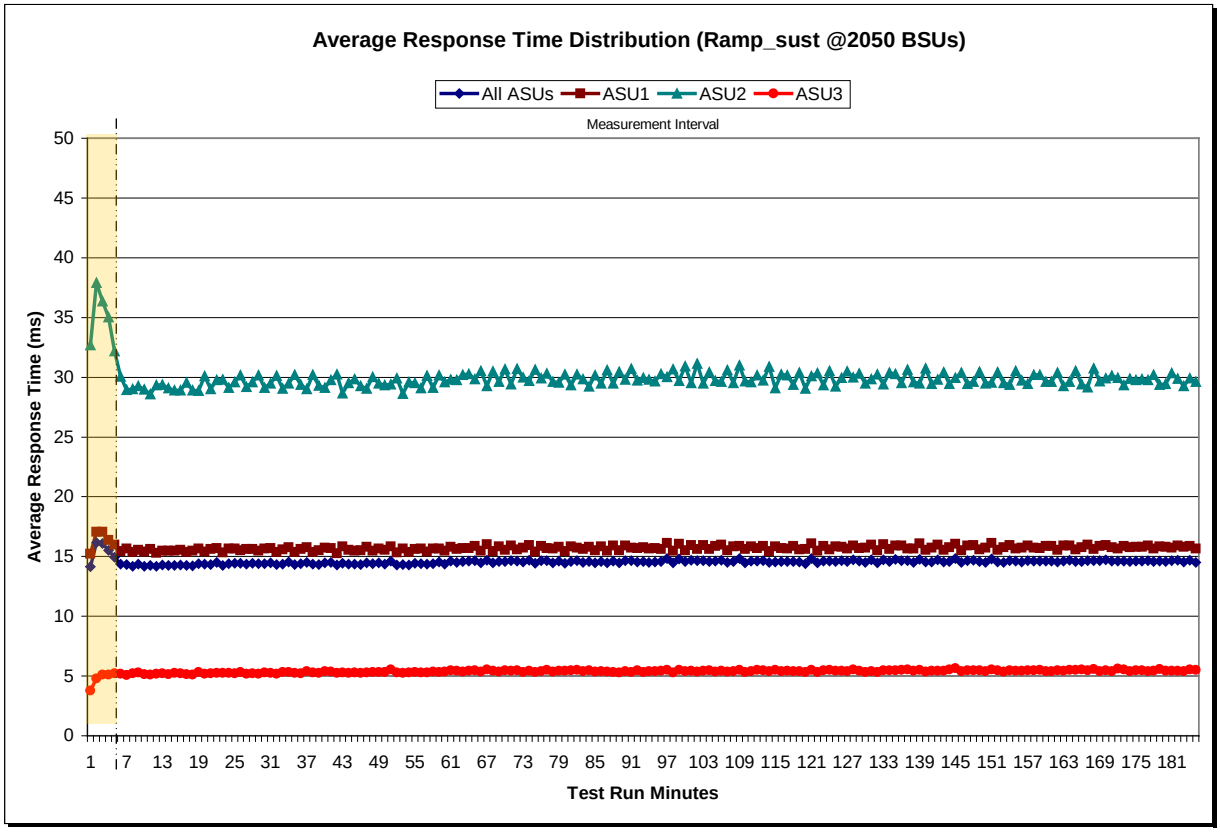


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	19:23:23	19:28:23	0-4	0:05:00
Measurement Interval	19:28:23	22:28:23	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	14.16	15.23	32.68	3.79	63	14.60	15.69	30.26	5.44	126	14.59	15.65	30.50	5.38
1	16.17	17.06	37.92	4.78	64	14.67	15.88	29.86	5.46	127	14.73	15.92	30.00	5.53
2	16.08	17.07	36.37	5.10	65	14.48	15.47	30.52	5.35	128	14.61	15.70	30.33	5.42
3	15.51	16.38	35.01	5.11	66	14.70	16.02	29.28	5.53	129	14.50	15.74	29.49	5.31
4	14.95	15.99	32.18	5.21	67	14.48	15.43	30.50	5.44	130	14.71	15.98	29.83	5.38
5	14.37	15.45	30.06	5.17	68	14.59	15.84	29.64	5.35	131	14.46	15.50	30.25	5.31
6	14.32	15.66	28.93	5.07	69	14.58	15.56	30.66	5.48	132	14.72	16.03	29.41	5.48
7	14.19	15.37	29.00	5.20	70	14.64	15.92	29.40	5.45	133	14.58	15.61	30.37	5.49
8	14.36	15.55	29.26	5.30	71	14.60	15.59	30.70	5.46	134	14.76	15.92	30.29	5.48
9	14.19	15.40	28.97	5.14	72	14.56	15.72	30.00	5.32	135	14.66	15.90	29.52	5.52
10	14.26	15.61	28.57	5.13	73	14.69	15.96	29.71	5.44	136	14.65	15.65	30.63	5.54
11	14.19	15.31	29.34	5.18	74	14.45	15.41	30.64	5.32	137	14.50	15.66	29.59	5.44
12	14.30	15.48	29.38	5.21	75	14.66	15.88	29.90	5.41	138	14.76	16.08	29.48	5.49
13	14.24	15.46	29.09	5.15	76	14.64	15.71	30.31	5.53	139	14.56	15.55	30.75	5.37
14	14.26	15.49	28.92	5.24	77	14.49	15.66	29.62	5.38	140	14.53	15.74	29.44	5.43
15	14.29	15.56	28.91	5.21	78	14.60	15.82	29.56	5.44	141	14.71	15.98	29.80	5.43
16	14.25	15.38	29.57	5.15	79	14.45	15.44	30.24	5.43	142	14.55	15.56	30.43	5.43
17	14.22	15.49	28.91	5.12	80	14.58	15.84	29.32	5.47	143	14.57	15.77	29.44	5.54
18	14.39	15.67	28.86	5.34	81	14.65	15.73	30.24	5.51	144	14.83	16.05	29.94	5.65
19	14.35	15.41	30.09	5.20	82	14.50	15.63	29.84	5.39	145	14.49	15.51	30.37	5.39
20	14.34	15.60	29.02	5.23	83	14.56	15.81	29.23	5.47	146	14.64	15.91	29.46	5.45
21	14.50	15.70	29.77	5.26	84	14.47	15.52	30.16	5.37	147	14.70	15.95	29.64	5.48
22	14.27	15.32	29.81	5.24	85	14.59	15.86	29.47	5.38	148	14.57	15.58	30.46	5.46
23	14.38	15.65	29.13	5.25	86	14.48	15.47	30.59	5.35	149	14.52	15.73	29.47	5.39
24	14.43	15.65	29.60	5.21	87	14.62	15.93	29.49	5.33	150	14.80	16.13	29.55	5.54
25	14.45	15.50	30.17	5.33	88	14.48	15.50	30.47	5.30	151	14.55	15.56	30.42	5.46
26	14.37	15.63	29.18	5.20	89	14.66	15.89	29.80	5.40	152	14.52	15.76	29.52	5.35
27	14.43	15.64	29.60	5.24	90	14.65	15.72	30.70	5.34	153	14.66	15.95	29.37	5.47
28	14.39	15.49	30.15	5.20	91	14.54	15.68	29.75	5.47	154	14.61	15.65	30.51	5.44
29	14.40	15.67	29.11	5.27	92	14.57	15.75	29.95	5.32	155	14.56	15.73	29.73	5.43
30	14.47	15.71	29.49	5.27	93	14.51	15.64	29.82	5.40	156	14.65	15.92	29.46	5.47
31	14.32	15.36	30.15	5.19	94	14.53	15.71	29.66	5.40	157	14.63	15.73	30.19	5.47
32	14.36	15.60	29.04	5.32	95	14.56	15.63	30.27	5.44	158	14.62	15.70	30.20	5.53
33	14.53	15.78	29.47	5.34	96	14.84	16.12	30.00	5.50	159	14.63	15.87	29.64	5.40
34	14.34	15.36	30.18	5.25	97	14.47	15.47	30.68	5.28	160	14.61	15.87	29.62	5.40
35	14.38	15.62	29.36	5.21	98	14.78	16.07	29.69	5.51	161	14.54	15.53	30.38	5.47
36	14.50	15.78	29.02	5.41	99	14.57	15.52	30.91	5.40	162	14.60	15.89	29.25	5.45
37	14.36	15.37	30.19	5.27	100	14.67	15.95	29.52	5.45	163	14.68	15.92	29.64	5.50
38	14.33	15.52	29.28	5.26	101	14.64	15.62	31.13	5.36	164	14.58	15.57	30.52	5.50
39	14.46	15.71	29.12	5.38	102	14.67	15.96	29.47	5.44	165	14.59	15.78	29.41	5.56
40	14.51	15.69	29.76	5.35	103	14.59	15.62	30.40	5.47	166	14.66	15.98	29.16	5.49
41	14.30	15.28	30.25	5.26	104	14.61	15.86	29.69	5.36	167	14.65	15.61	30.74	5.58
42	14.45	15.84	28.67	5.31	105	14.70	15.97	29.62	5.45	168	14.64	15.88	29.64	5.42
43	14.37	15.54	29.51	5.26	106	14.51	15.50	30.60	5.37	169	14.72	15.94	29.92	5.46
44	14.37	15.47	29.84	5.27	107	14.59	15.85	29.51	5.38	170	14.62	15.76	30.14	5.42
45	14.32	15.52	29.26	5.25	108	14.82	15.87	30.98	5.49	171	14.60	15.67	29.94	5.62
46	14.49	15.82	29.06	5.30	109	14.47	15.63	29.67	5.34	172	14.63	15.87	29.33	5.55
47	14.40	15.46	30.02	5.32	110	14.60	15.85	29.59	5.40	173	14.60	15.77	29.88	5.42
48	14.47	15.67	29.47	5.34	111	14.61	15.69	30.16	5.50	174	14.60	15.78	29.77	5.46
49	14.38	15.55	29.34	5.34	112	14.66	15.88	29.72	5.48	175	14.62	15.80	29.84	5.46
50	14.62	15.85	29.40	5.53	113	14.52	15.45	30.87	5.39	176	14.66	15.91	29.75	5.41
51	14.31	15.34	29.91	5.28	114	14.56	15.83	29.08	5.50	177	14.57	15.65	30.20	5.43
52	14.32	15.66	28.60	5.25	115	14.59	15.70	30.24	5.41	178	14.63	15.86	29.38	5.58
53	14.29	15.38	29.57	5.28	116	14.56	15.65	30.16	5.43	179	14.58	15.82	29.44	5.42
54	14.44	15.62	29.51	5.34	117	14.59	15.87	29.39	5.39	180	14.64	15.74	30.36	5.44
55	14.40	15.67	29.07	5.31	118	14.54	15.58	30.39	5.39	181	14.69	15.91	29.89	5.45
56	14.38	15.39	30.15	5.31	119	14.39	15.64	29.05	5.33	182	14.53	15.79	29.27	5.40
57	14.42	15.66	29.11	5.36	120	14.82	16.07	30.08	5.50	183	14.69	15.87	29.90	5.53
58	14.54	15.66	30.15	5.34	121	14.46	15.50	30.33	5.32	184	14.51	15.64	29.64	5.49
59	14.37	15.47	29.61	5.36	122	14.62	15.89	29.35	5.46	***Average***	***14.53***	***15.70***	***29.78***	***5.38***
60	14.63	15.81	29.81	5.46	123	14.60	15.59	30.54	5.52					
61	14.50	15.64	29.76	5.42	124	14.56	15.83	29.23	5.45					
62	14.57	15.69	30.19	5.38	125	14.64	15.82	29.94	5.43					

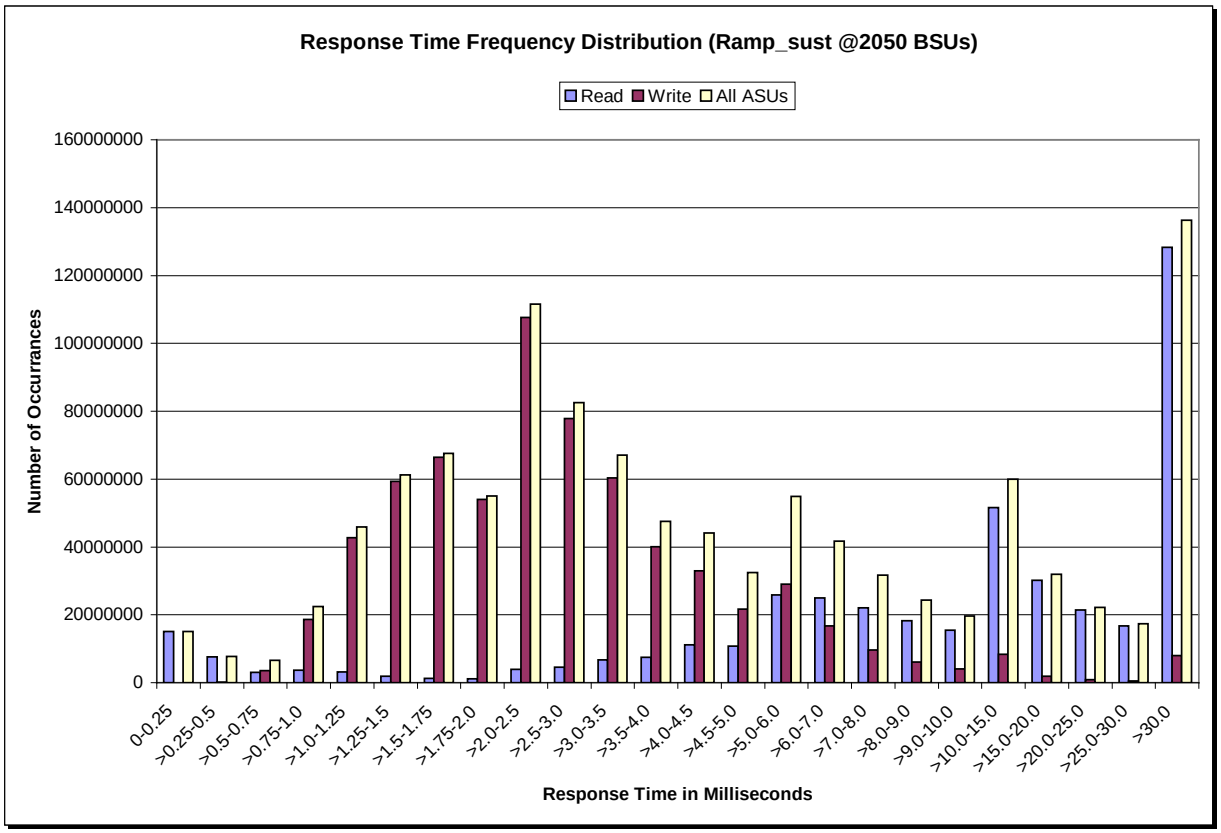
Sustainability – Average Response Time (ms) Distribution Graph



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	15,100,931	7,601,607	3,053,939	3,739,648	3,209,360	1,962,101	1,214,550	1,082,951
Write	147	117,831	3,570,192	18,641,775	42,731,045	59,320,218	66,410,690	53,971,159
All ASUs	15,101,078	7,719,438	6,624,131	22,381,423	45,940,405	61,282,319	67,625,240	55,054,110
ASU1	13,366,158	6,736,837	4,258,227	12,029,366	22,684,589	28,864,496	30,970,668	24,997,800
ASU2	1,734,885	938,238	975,410	2,888,825	5,390,540	6,797,929	7,228,576	5,761,111
ASU3	35	44,363	1,390,494	7,463,232	17,865,276	25,619,894	29,425,996	24,295,199
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	3,868,607	4,627,460	6,766,531	7,468,787	11,097,134	10,825,123	25,869,901	24,978,688
Write	107,644,602	77,853,113	60,323,092	40,067,604	33,026,676	21,628,522	29,041,071	16,702,152
All ASUs	111,513,209	82,480,573	67,089,623	47,536,391	44,123,810	32,453,645	54,910,972	41,680,840
ASU1	50,826,617	38,080,188	32,267,046	24,142,729	24,465,387	19,232,064	35,892,592	29,289,758
ASU2	11,300,439	8,104,377	6,377,010	4,352,848	3,848,729	2,818,643	4,949,033	4,231,338
ASU3	49,386,153	36,296,008	28,445,567	19,040,814	15,809,694	10,402,938	14,069,347	8,159,744
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	22,107,388	18,277,171	15,521,862	51,564,519	30,127,005	21,415,879	16,765,750	128,351,903
Write	9,575,125	6,087,757	4,111,946	8,364,898	1,851,765	830,252	551,385	7,962,745
All ASUs	31,682,513	24,364,928	19,633,808	59,929,417	31,978,770	22,246,131	17,317,135	136,314,648
ASU1	23,365,262	18,202,410	15,136,472	48,238,597	26,851,189	18,754,822	14,494,420	96,632,237
ASU2	3,596,246	3,140,730	2,441,605	7,370,047	4,046,423	2,926,174	2,401,355	32,544,027
ASU3	4,721,005	3,021,788	2,055,731	4,320,773	1,081,158	565,135	421,360	7,138,384

Sustainability – Response Time Frequency Distribution Graph



Sustainability – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.13.2

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

Clause 5.3.13.3

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

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

Primary Metrics Test – IOPS Test Phase

Clause 5.4.4.2

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

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

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

Clause 9.4.3.7.2

For the IOPS Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 77.

IOPS Test Results File

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

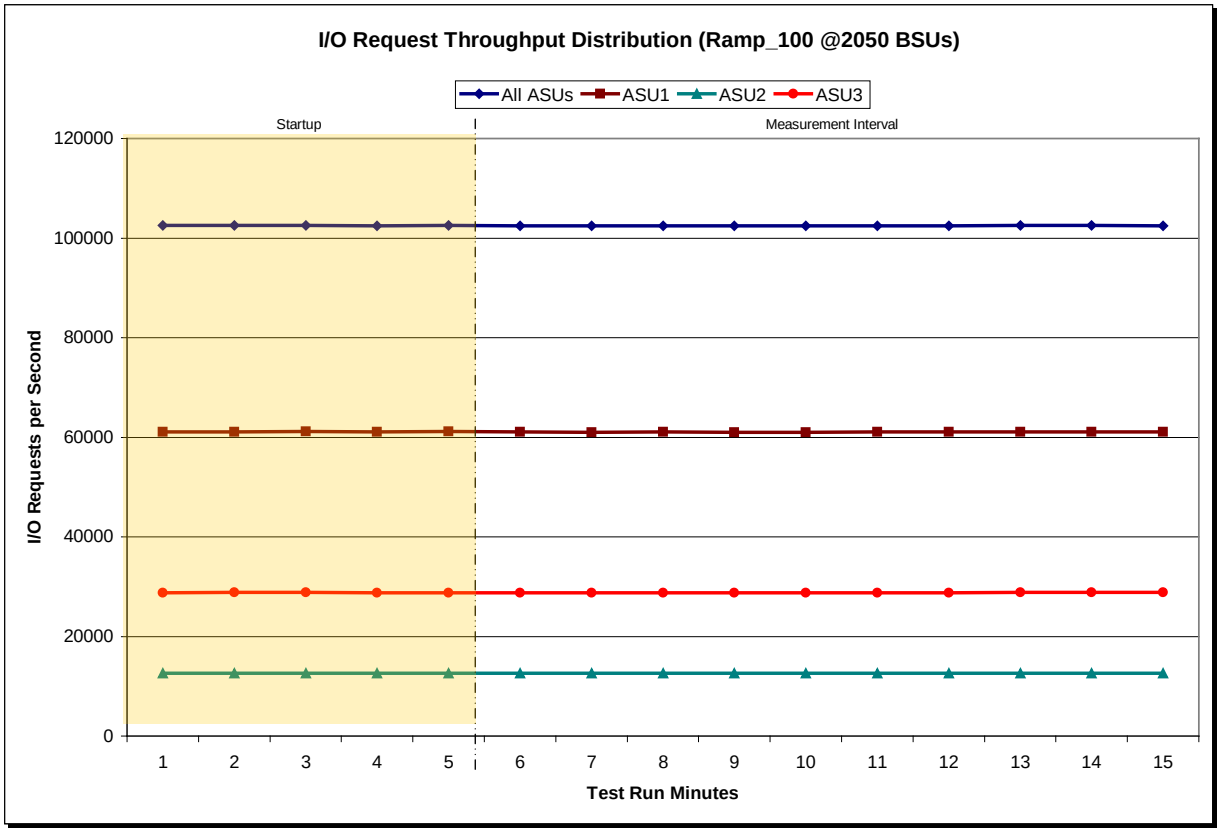
IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:28:51	22:33:52	0-4	0:05:01
Measurement Interval	22:33:52	22:43:52	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	102,514.80	61,097.20	12,619.53	28,798.07
1	102,561.07	61,095.08	12,619.08	28,846.90
2	102,572.77	61,134.12	12,601.83	28,836.82
3	102,456.58	61,068.25	12,596.93	28,791.40
4	102,550.15	61,129.80	12,619.90	28,800.45
5	102,480.92	61,068.12	12,606.28	28,806.52
6	102,447.92	61,031.88	12,613.50	28,802.53
7	102,444.08	61,060.47	12,592.67	28,790.95
8	102,433.75	61,021.37	12,603.42	28,808.97
9	102,444.97	61,017.52	12,619.93	28,807.52
10	102,433.22	61,050.05	12,599.42	28,783.75
11	102,499.60	61,076.12	12,634.82	28,788.67
12	102,514.17	61,098.32	12,599.58	28,816.27
13	102,519.62	61,100.50	12,600.22	28,818.90
14	102,498.32	61,073.15	12,607.22	28,817.95
Average	***102,471.66***	***61,059.75***	***12,607.71***	***28,804.20***

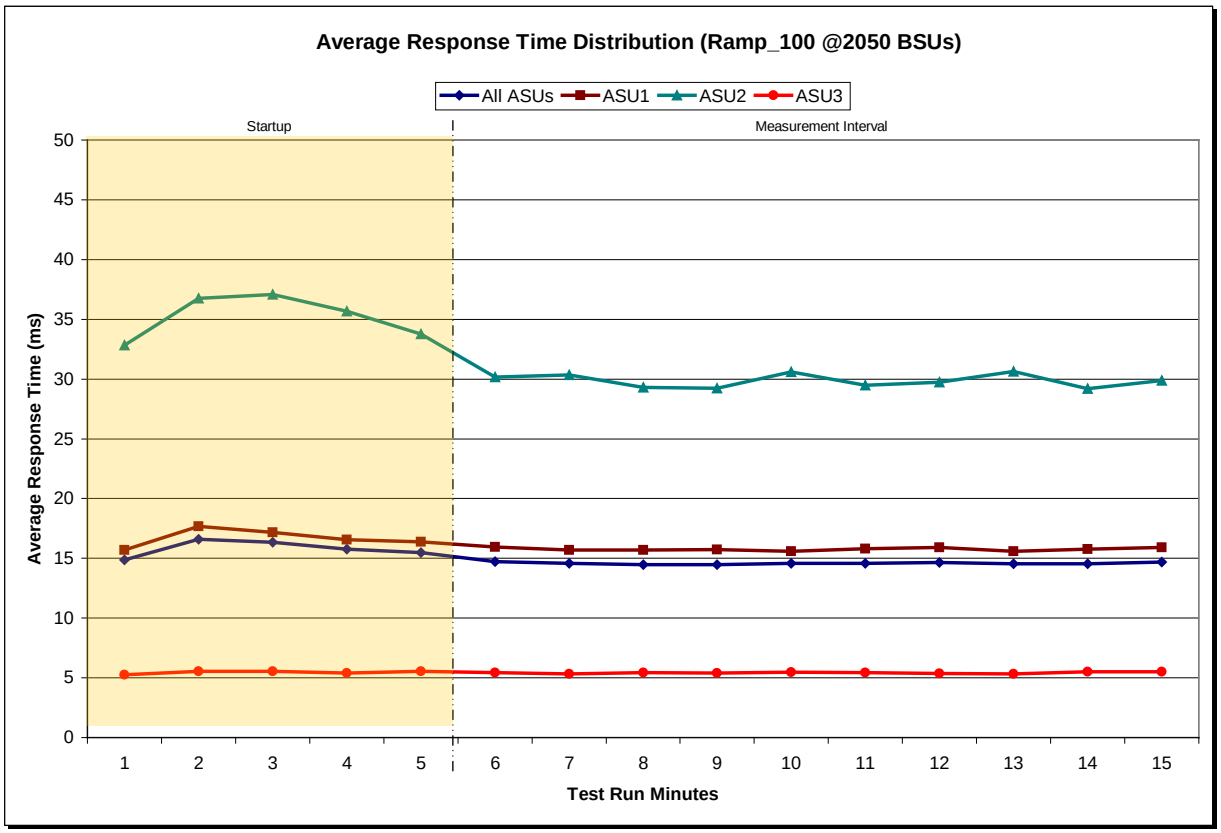
IOPS Test Run – I/O Request Throughput Distribution Graph



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

2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:28:51	22:33:52	0-4	0:05:01
Measurement Interval	22:33:52	22:43:52	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.87	15.70	32.82	5.25
1	16.61	17.67	36.75	5.54
2	16.35	17.18	37.08	5.55
3	15.78	16.56	35.67	5.41
4	15.47	16.37	33.78	5.53
5	14.74	15.94	30.15	5.44
6	14.58	15.69	30.33	5.32
7	14.48	15.70	29.30	5.42
8	14.48	15.72	29.24	5.38
9	14.59	15.57	30.59	5.49
10	14.58	15.80	29.48	5.45
11	14.65	15.90	29.75	5.38
12	14.55	15.58	30.65	5.33
13	14.53	15.77	29.20	5.49
14	14.69	15.91	29.86	5.49
Average	***14.59***	***15.76***	***29.86***	***5.42***

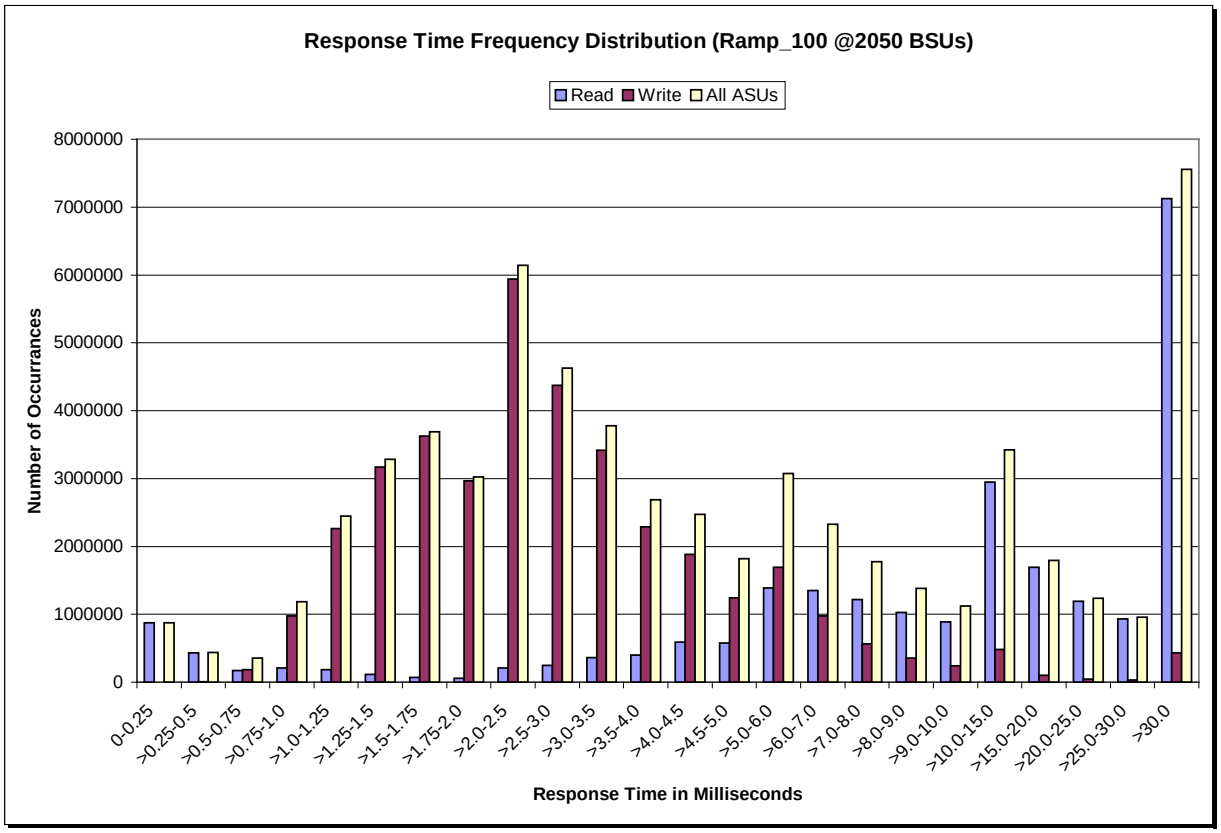
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	877,493	432,432	169,048	207,835	182,870	111,463	67,867	59,525
Write	6	5,718	183,373	974,530	2,265,691	3,171,101	3,624,324	2,964,624
All ASUs	877,499	438,150	352,421	1,182,365	2,448,561	3,282,564	3,692,191	3,024,149
ASU1	778,784	382,911	229,236	639,170	1,213,093	1,548,518	1,692,789	1,372,830
ASU2	98,714	53,037	52,022	153,607	288,253	364,399	394,979	317,529
ASU3	1	2,202	71,163	389,588	947,215	1,369,647	1,604,423	1,333,790
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	207,358	249,607	362,332	396,786	587,946	578,112	1,387,179	1,352,349
Write	5,938,265	4,375,754	3,415,953	2,288,702	1,882,407	1,243,553	1,689,441	973,632
All ASUs	6,145,623	4,625,361	3,778,285	2,685,488	2,470,353	1,821,665	3,076,620	2,325,981
ASU1	2,799,540	2,130,331	1,806,879	1,349,533	1,352,769	1,064,143	1,983,406	1,618,839
ASU2	624,429	456,584	360,902	247,351	217,080	159,639	276,536	232,478
ASU3	2,721,654	2,038,446	1,610,504	1,088,604	900,504	597,883	816,678	474,664
Response Time (ms)	**>7.0-8.0**	**>8.0-9.0**	**>9.0-10.0**	**>10.0-15.0**	**>15.0-20.0**	**>20.0-25.0**	**>25.0-30.0**	**>30.0**
Read	1,216,786	1,026,845	884,653	2,945,841	1,692,622	1,193,643	930,399	7,123,066
Write	561,331	353,260	240,099	480,443	101,530	43,748	28,938	431,118
All ASUs	1,778,117	1,380,105	1,124,752	3,426,284	1,794,152	1,237,391	959,337	7,554,184
ASU1	1,304,022	1,031,436	866,478	2,755,584	1,505,104	1,043,387	802,831	5,363,261
ASU2	197,408	173,623	138,484	423,793	229,663	164,217	134,193	1,805,451
ASU3	276,687	175,046	119,790	246,907	59,385	29,787	22,313	385,472

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
61,481,598	53,927,414	7,554,184

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.13.2

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

Clause 5.3.13.3

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2808	0.0700	0.2101	0.0180	0.0700	0.0350	0.2811
COV	0.002	0.001	0.002	0.001	0.003	0.001	0.003	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 14.

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

Clause 9.4.3.7.3

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

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 77.

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 - 2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:28:51	22:33:52	0-4	0:05:01
Measurement Interval	22:33:52	22:43:52	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	102,514.80	61,097.20	12,619.53	28,798.07
1	102,561.07	61,095.08	12,619.08	28,846.90
2	102,572.77	61,134.12	12,601.83	28,836.82
3	102,456.58	61,068.25	12,596.93	28,791.40
4	102,550.15	61,129.80	12,619.90	28,800.45
5	102,480.92	61,068.12	12,606.28	28,806.52
6	102,447.92	61,031.88	12,613.50	28,802.53
7	102,444.08	61,060.47	12,592.67	28,790.95
8	102,433.75	61,021.37	12,603.42	28,808.97
9	102,444.97	61,017.52	12,619.93	28,807.52
10	102,433.22	61,050.05	12,599.42	28,783.75
11	102,499.60	61,076.12	12,634.82	28,788.67
12	102,514.17	61,098.32	12,599.58	28,816.27
13	102,519.62	61,100.50	12,600.22	28,818.90
14	102,498.32	61,073.15	12,607.22	28,817.95
Average	*102,471.66*	*61,059.75*	*12,607.71*	*28,804.20*

95% Load Level - 1947 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:44:18	22:49:19	0-4	0:05:01
Measurement Interval	22:49:19	22:59:19	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	97,280.77	57,967.50	11,974.62	27,338.65
1	97,362.07	58,026.57	11,953.85	27,381.65
2	97,272.77	57,975.15	11,973.90	27,323.72
3	97,389.82	58,081.27	11,966.78	27,341.77
4	97,302.30	57,976.13	11,976.23	27,349.93
5	97,366.40	58,054.90	11,965.43	27,346.07
6	97,324.13	57,974.12	11,989.00	27,361.02
7	97,298.97	58,000.25	11,936.17	27,362.55
8	97,259.85	57,987.22	11,943.35	27,329.28
9	97,339.87	58,038.82	11,973.83	27,327.22
10	97,365.23	57,994.27	11,980.53	27,390.43
11	97,354.18	58,000.28	11,970.90	27,383.00
12	97,408.40	58,042.37	11,978.47	27,387.57
13	97,340.93	58,016.35	11,956.87	27,367.72
14	97,358.95	58,025.95	11,975.67	27,357.33
Average	*97,341.69*	*58,013.45*	*11,967.02*	*27,361.22*

90% Load Level - 1845 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:59:45	23:04:46	0-4	0:05:01
Measurement Interval	23:04:46	23:14:46	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	92,265.53	54,992.58	11,325.65	25,947.30
1	92,205.85	54,961.08	11,345.40	25,899.37
2	92,238.95	54,960.45	11,359.55	25,918.95
3	92,244.78	54,979.70	11,338.30	25,926.78
4	92,294.98	55,019.18	11,348.25	25,927.55
5	92,289.35	54,992.22	11,349.60	25,947.53
6	92,315.78	55,033.87	11,319.92	25,962.00
7	92,243.72	54,996.38	11,335.37	25,911.97
8	92,310.47	55,017.87	11,342.38	25,950.22
9	92,209.27	54,951.25	11,366.53	25,891.48
10	92,250.33	54,989.53	11,342.75	25,918.05
11	92,268.18	54,998.32	11,381.37	25,888.50
12	92,209.60	54,966.23	11,314.87	25,928.50
13	92,284.33	55,027.93	11,356.53	25,899.87
14	92,265.08	54,970.07	11,362.05	25,932.97
Average	*92,264.61*	*54,994.37*	*11,347.14*	*25,923.11*

80% Load Level - 1640 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:15:09	23:20:10	0-4	0:05:01
Measurement Interval	23:20:10	23:30:10	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	81,987.27	48,866.72	10,109.63	23,010.92
1	81,970.45	48,860.45	10,093.50	23,016.50
2	82,020.50	48,887.38	10,077.93	23,055.18
3	82,083.55	48,944.97	10,103.50	23,035.08
4	81,972.77	48,859.70	10,069.88	23,043.18
5	81,973.65	48,858.65	10,078.48	23,036.52
6	81,950.02	48,828.15	10,084.43	23,037.43
7	82,039.20	48,900.88	10,094.95	23,043.37
8	81,983.77	48,863.05	10,096.00	23,024.72
9	81,966.15	48,858.28	10,088.63	23,019.23
10	82,034.83	48,898.40	10,093.53	23,042.90
11	82,023.53	48,878.05	10,081.08	23,064.40
12	81,999.08	48,869.50	10,081.95	23,047.63
13	81,977.58	48,858.97	10,085.68	23,032.93
14	82,042.28	48,899.63	10,086.68	23,055.97
Average	*81,999.01*	*48,871.36*	*10,087.14*	*23,040.51*

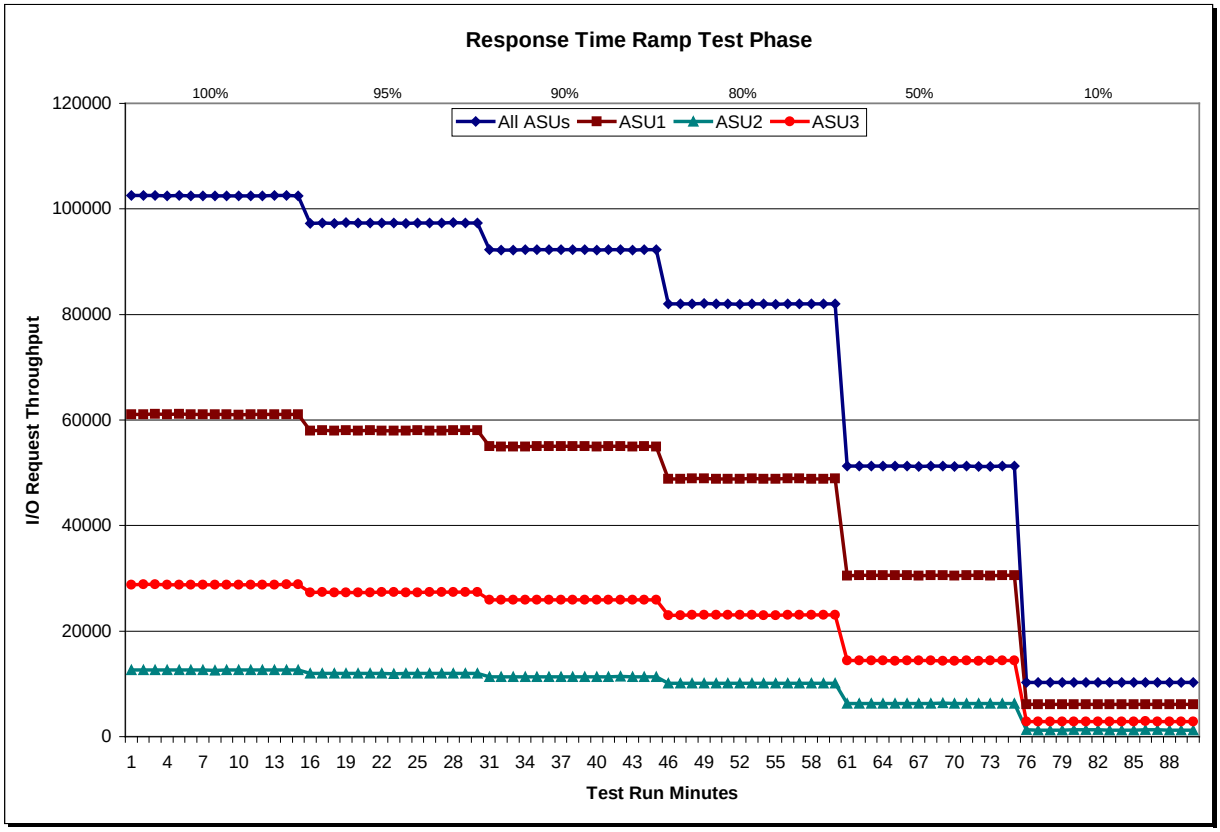
50% Load Level - 1025 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:30:33	23:35:34	0-4	0:05:01
Measurement Interval	23:35:34	23:45:34	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	51,238.10	30,525.72	6,271.05	14,441.33
1	51,273.17	30,568.78	6,302.60	14,401.78
2	51,298.22	30,566.43	6,308.60	14,423.18
3	51,250.65	30,546.58	6,295.30	14,408.77
4	51,276.30	30,591.60	6,301.37	14,383.33
5	51,276.20	30,572.22	6,312.85	14,391.13
6	51,212.88	30,509.55	6,288.23	14,415.10
7	51,246.07	30,546.05	6,298.07	14,401.95
8	51,268.35	30,570.55	6,321.13	14,376.67
9	51,181.03	30,505.02	6,290.83	14,385.18
10	51,257.37	30,532.57	6,304.85	14,419.95
11	51,217.07	30,531.78	6,303.25	14,382.03
12	51,200.05	30,518.65	6,282.18	14,399.22
13	51,256.97	30,545.90	6,298.42	14,412.65
14	51,298.88	30,562.75	6,315.47	14,420.67
Average	*51,241.49*	*30,539.50*	*6,301.53*	*14,400.46*

10% Load Level - 205 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:45:56	23:50:57	0-4	0:05:01
Measurement Interval	23:50:57	0:00:57	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	10,242.03	6,101.92	1,263.70	2,876.42
1	10,272.07	6,125.42	1,261.32	2,885.33
2	10,242.23	6,091.52	1,262.90	2,887.82
3	10,251.87	6,109.52	1,263.55	2,878.80
4	10,246.82	6,098.73	1,264.00	2,884.08
5	10,244.88	6,109.52	1,265.57	2,869.80
6	10,259.03	6,103.48	1,268.60	2,886.95
7	10,280.87	6,136.80	1,263.57	2,880.50
8	10,243.95	6,108.75	1,251.75	2,883.45
9	10,255.17	6,110.02	1,261.82	2,883.33
10	10,275.62	6,113.82	1,267.22	2,894.58
11	10,247.93	6,099.87	1,264.42	2,883.65
12	10,257.92	6,116.78	1,258.68	2,882.45
13	10,245.23	6,118.23	1,255.40	2,871.60
14	10,267.88	6,121.00	1,261.77	2,885.12
Average	*10,257.85*	*6,113.83*	*1,261.88*	*2,882.14*

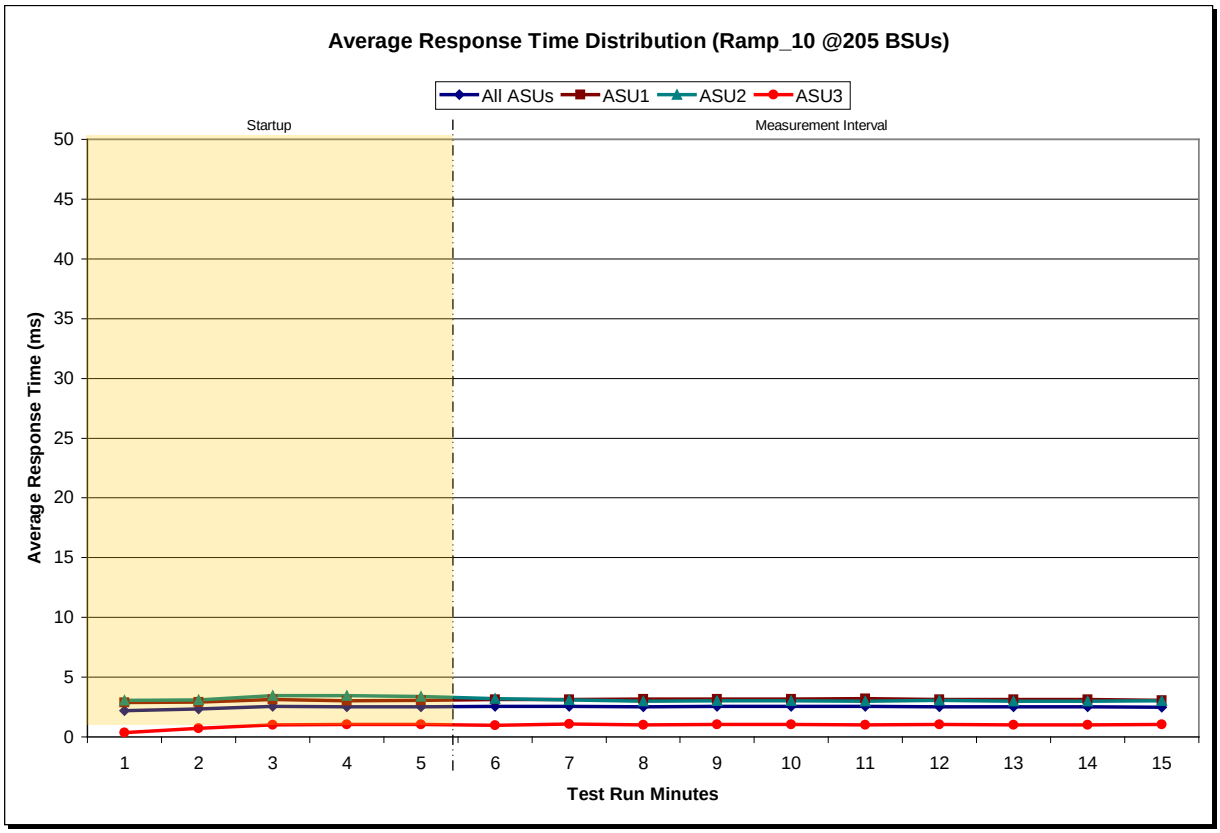
Response Time Ramp Distribution (IOPS) Graph



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

205 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:45:56	23:50:57	0-2	0:05:01
Measurement Interval	23:50:57	0:00:57	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.19	2.88	3.05	0.36
1	2.32	2.92	3.10	0.71
2	2.56	3.11	3.46	1.02
3	2.51	3.01	3.44	1.04
4	2.53	3.06	3.40	1.03
5	2.55	3.15	3.22	0.97
6	2.55	3.13	3.11	1.07
7	2.53	3.16	2.99	0.99
8	2.54	3.15	3.03	1.04
9	2.55	3.16	3.04	1.04
10	2.57	3.22	2.98	1.02
11	2.53	3.13	3.05	1.04
12	2.50	3.12	3.00	0.99
13	2.52	3.14	2.98	1.01
14	2.49	3.07	3.01	1.03
Average	***2.53***	***3.14***	***3.04***	***1.02***

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



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

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.13.2

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

Clause 5.3.13.3

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0352	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.007	0.002	0.003	0.002	0.010	0.004	0.008	0;002

Repeatability Test

Clause 5.4.5

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

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

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

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

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

Clause 9.4.3.7.4

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

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 77.

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	***102,471.66***
Repeatability Test Phase 1	102,511.38
Repeatability Test Phase 2	102,505.00

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

	SPC-1 LRT™
Primary Metrics	***2.53 ms***
Repeatability Test Phase 1	2.44 ms
Repeatability Test Phase 2	2.46 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.

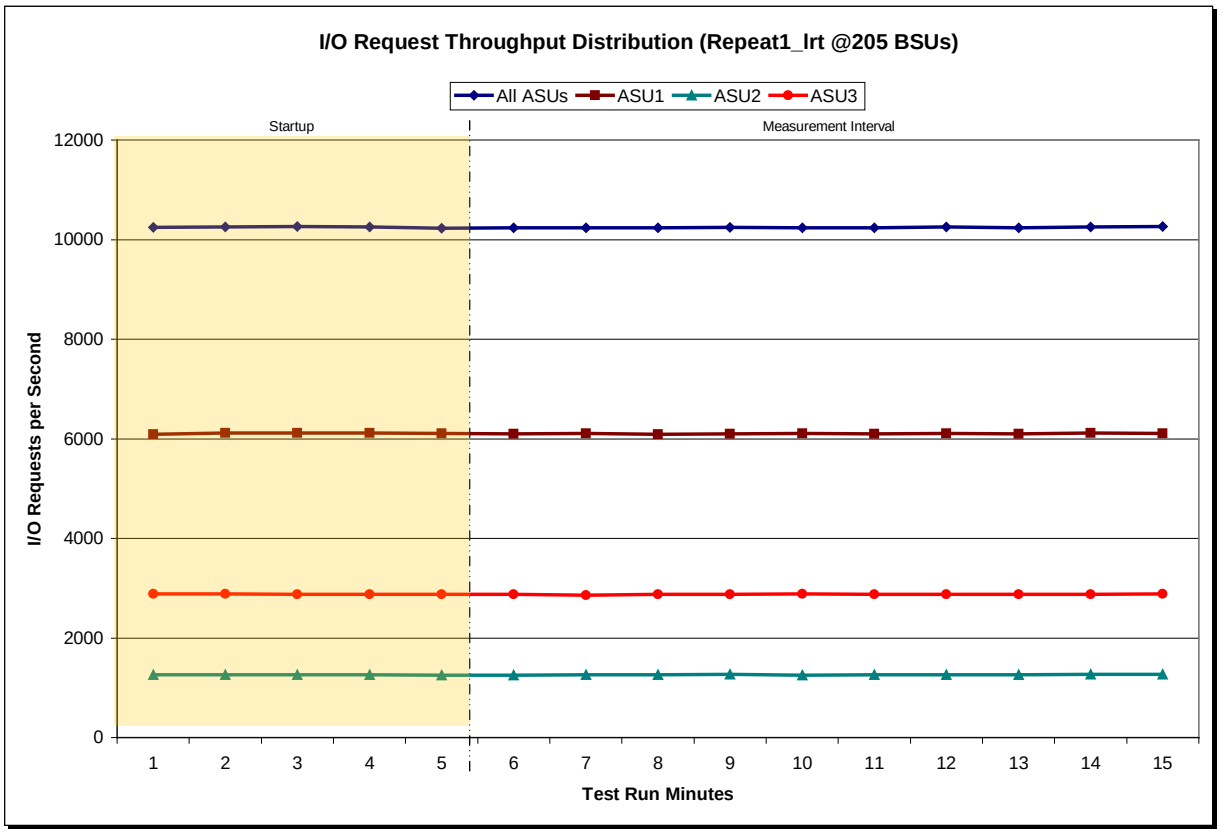
Repeatability Test Phase 1, Test Run 1 (LRT)
Repeatability Test Phase 1, Test Run 2 (IOPS)
Repeatability Test Phase 2, Test Run 1 (LRT)
Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

205 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:01:47	0:06:47	0-4	0:05:00
Measurement Interval	0:06:47	0:16:47	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	10,243.02	6,089.50	1,264.48	2,889.03
1	10,256.98	6,112.95	1,261.28	2,882.75
2	10,260.15	6,119.45	1,261.17	2,879.53
3	10,252.52	6,118.03	1,257.83	2,876.65
4	10,233.10	6,104.77	1,255.70	2,872.63
5	10,235.32	6,100.28	1,256.07	2,878.97
6	10,233.68	6,107.75	1,262.23	2,863.70
7	10,234.57	6,093.52	1,261.27	2,879.78
8	10,243.13	6,098.37	1,266.83	2,877.93
9	10,238.98	6,103.68	1,249.05	2,886.25
10	10,241.12	6,098.77	1,261.20	2,881.15
11	10,252.25	6,109.30	1,262.13	2,880.82
12	10,239.10	6,102.37	1,262.98	2,873.75
13	10,253.93	6,114.22	1,267.00	2,872.72
14	10,262.98	6,110.67	1,270.60	2,881.72
Average	***10,243.51***	***6,103.89***	***1,261.94***	***2,877.68***

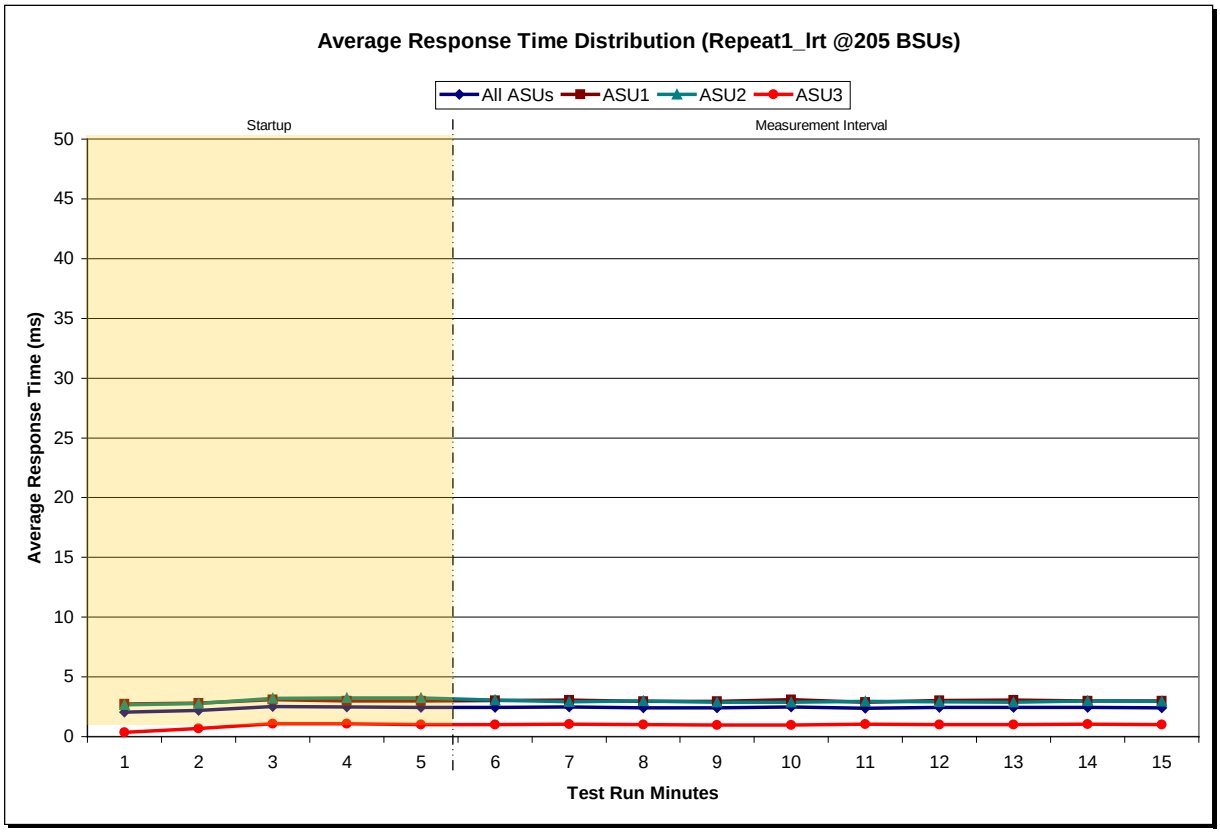
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

205 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:01:47	0:06:47	0-4	0:05:00
Measurement Interval	0:06:47	0:16:47	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.07	2.75	2.67	0.37
1	2.21	2.82	2.79	0.67
2	2.54	3.08	3.20	1.09
3	2.48	2.98	3.23	1.07
4	2.46	2.99	3.23	0.99
5	2.46	3.02	3.06	1.02
6	2.48	3.06	2.93	1.04
7	2.42	2.97	3.00	1.02
8	2.40	2.97	2.89	0.98
9	2.47	3.09	2.88	0.98
10	2.37	2.88	2.94	1.04
11	2.44	3.01	2.92	1.02
12	2.46	3.05	2.88	1.01
13	2.44	2.97	2.99	1.05
14	2.42	2.97	2.95	1.00
Average	***2.44***	***3.00***	***2.94***	***1.02***

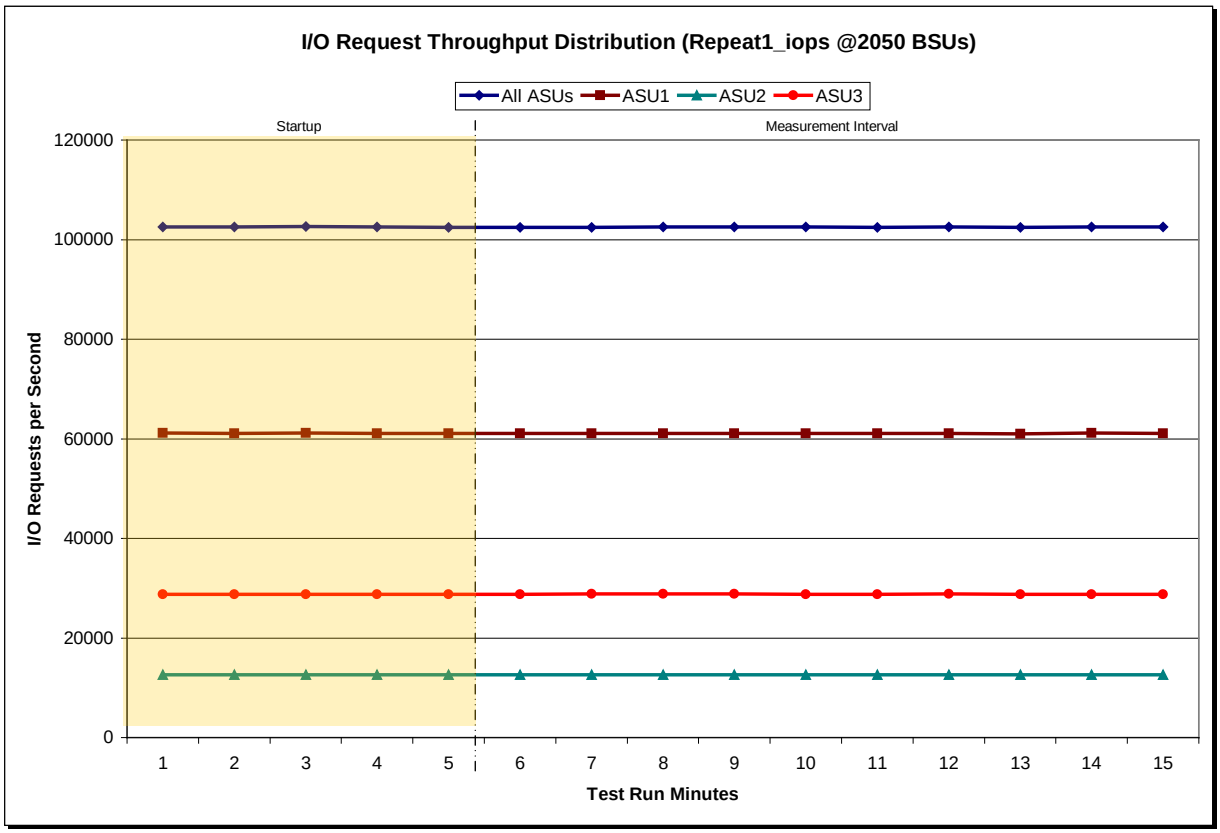
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:17:13	0:22:14	0-4	0:05:01
Measurement Interval	0:22:14	0:32:14	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	102,555.97	61,135.45	12,627.22	28,793.30
1	102,514.73	61,122.45	12,600.45	28,791.83
2	102,604.48	61,194.45	12,614.68	28,795.35
3	102,518.90	61,104.25	12,624.23	28,790.42
4	102,487.10	61,067.17	12,613.78	28,806.15
5	102,466.83	61,080.63	12,596.57	28,789.63
6	102,502.98	61,096.12	12,593.17	28,813.70
7	102,568.25	61,110.73	12,643.27	28,814.25
8	102,505.97	61,081.98	12,605.10	28,818.88
9	102,517.83	61,105.33	12,614.12	28,798.38
10	102,474.65	61,064.57	12,600.07	28,810.02
11	102,589.10	61,102.93	12,637.83	28,848.33
12	102,434.43	61,021.47	12,612.72	28,800.25
13	102,532.52	61,124.63	12,604.58	28,803.30
14	102,521.20	61,115.58	12,607.53	28,798.08
Average	***102,511.38***	***61,090.40***	***12,611.50***	***28,809.48***

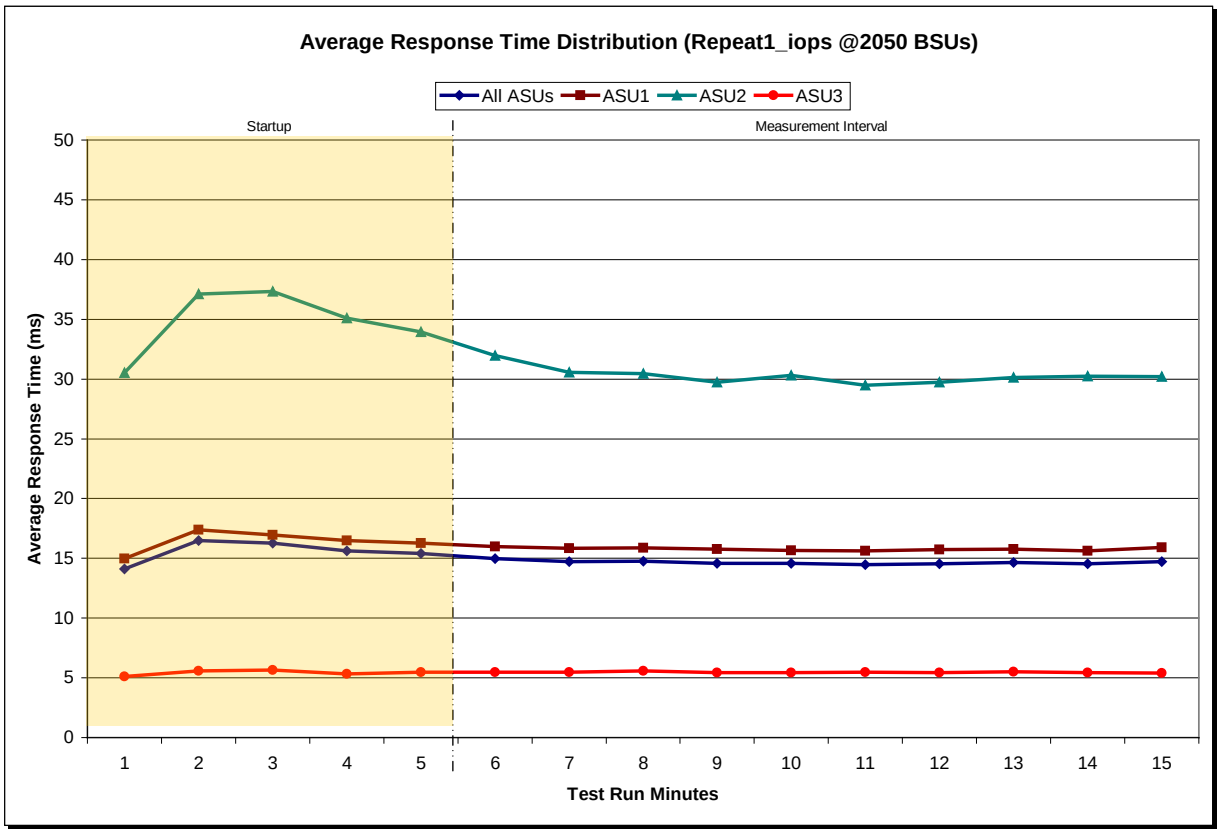
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:17:13	0:22:14	0-4	0:05:01
Measurement Interval	0:22:14	0:32:14	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.11	14.96	30.54	5.11
1	16.49	17.37	37.11	5.59
2	16.27	16.94	37.32	5.63
3	15.64	16.48	35.08	5.34
4	15.41	16.26	33.94	5.48
5	14.99	15.98	31.96	5.46
6	14.72	15.83	30.55	5.46
7	14.78	15.88	30.45	5.56
8	14.57	15.76	29.72	5.44
9	14.58	15.65	30.30	5.45
10	14.46	15.62	29.48	5.45
11	14.55	15.71	29.75	5.43
12	14.66	15.78	30.14	5.51
13	14.55	15.62	30.24	5.43
14	14.71	15.91	30.21	5.38
Average	***14.66***	***15.77***	***30.28***	***5.46***

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

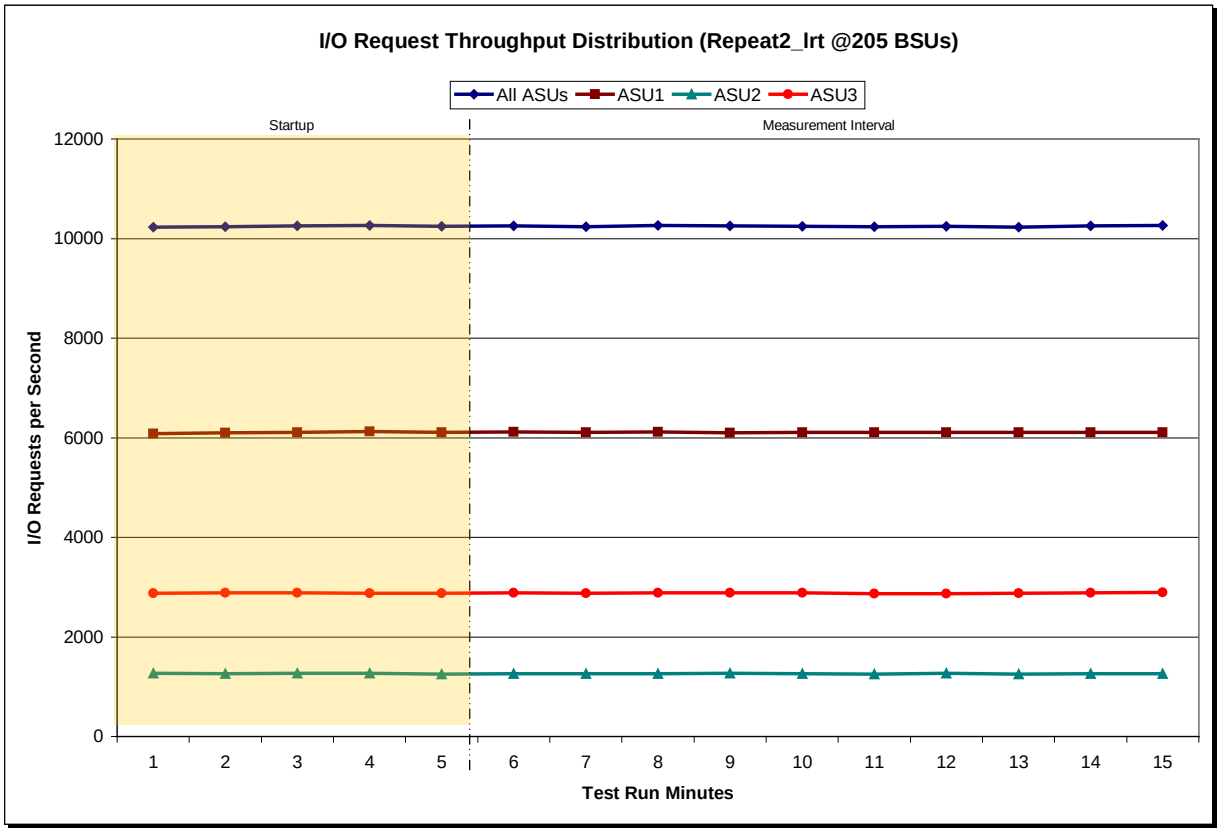


Repeatability 2 LRT – I/O Request Throughput Distribution Data

205 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:33:05	0:38:05	0-4	0:05:00
Measurement Interval	0:38:05	0:48:05	4-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	10,228.03	6,082.93	1,266.07	2,879.03
1	10,239.90	6,099.93	1,258.27	2,881.70
2	10,259.13	6,104.73	1,266.10	2,888.30
3	10,266.42	6,123.15	1,267.15	2,876.12
4	10,243.70	6,110.73	1,253.85	2,879.12
5	10,254.15	6,113.50	1,259.03	2,881.62
6	10,238.92	6,103.77	1,257.23	2,877.92
7	10,261.52	6,113.07	1,261.68	2,886.77
8	10,252.30	6,101.27	1,269.32	2,881.72
9	10,246.48	6,106.15	1,258.85	2,881.48
10	10,233.52	6,105.83	1,256.97	2,870.72
11	10,243.12	6,106.65	1,268.28	2,868.18
12	10,230.35	6,104.27	1,250.95	2,875.13
13	10,256.90	6,110.67	1,260.70	2,885.53
14	10,262.15	6,107.83	1,264.45	2,889.87
Average	***10,247.94***	***6,107.30***	***1,260.75***	***2,879.89***

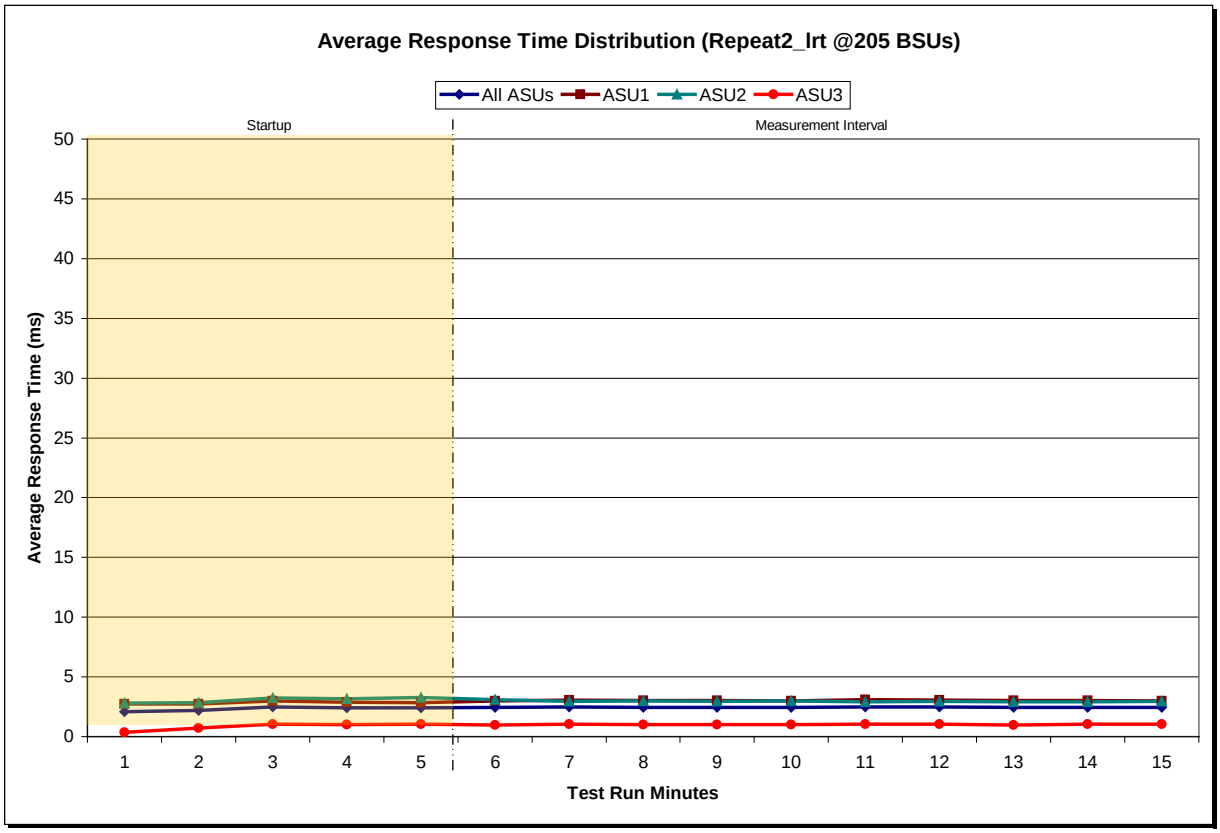
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

205 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:33:05	0:38:05	0-4	0:05:00
Measurement Interval	0:38:05	0:48:05	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.08	2.75	2.79	0.35
1	2.19	2.75	2.84	0.72
2	2.47	2.99	3.24	1.06
3	2.40	2.89	3.19	1.01
4	2.40	2.86	3.27	1.03
5	2.45	3.00	3.10	0.99
6	2.47	3.05	2.96	1.03
7	2.44	3.01	2.97	1.00
8	2.45	3.02	2.94	1.02
9	2.44	3.00	2.99	1.00
10	2.50	3.08	2.92	1.06
11	2.47	3.05	2.95	1.05
12	2.43	3.01	2.91	0.98
13	2.46	3.03	2.92	1.04
14	2.45	3.00	2.96	1.06
Average	***2.46***	***3.03***	***2.96***	***1.02***

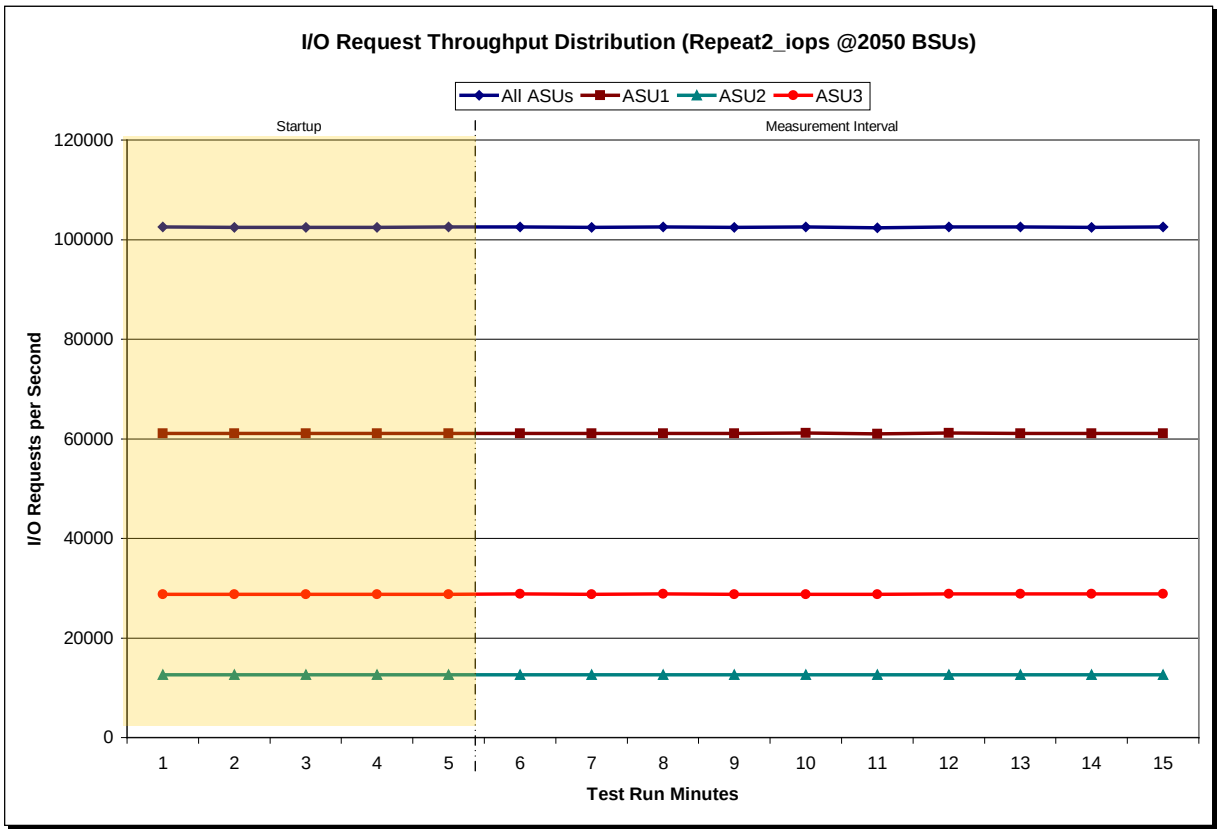
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:48:31	0:53:32	0-4	0:05:01
Measurement Interval	0:53:32	1:03:32	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	102,537.23	61,091.22	12,636.93	28,809.08
1	102,429.95	61,044.60	12,605.10	28,780.25
2	102,458.23	61,114.45	12,590.28	28,753.50
3	102,501.53	61,095.57	12,596.80	28,809.17
4	102,506.20	61,094.05	12,617.67	28,794.48
5	102,534.92	61,087.22	12,607.90	28,839.80
6	102,453.33	61,041.37	12,609.72	28,802.25
7	102,546.25	61,118.27	12,615.75	28,812.23
8	102,438.78	61,081.33	12,614.35	28,743.10
9	102,563.37	61,139.05	12,619.92	28,804.40
10	102,412.00	60,975.87	12,631.47	28,804.67
11	102,585.05	61,126.70	12,645.88	28,812.47
12	102,533.52	61,097.47	12,612.22	28,823.83
13	102,457.87	61,042.03	12,592.17	28,823.67
14	102,524.88	61,050.08	12,634.93	28,839.87
Average	***102,505.00***	***61,075.94***	***12,618.43***	***28,810.63***

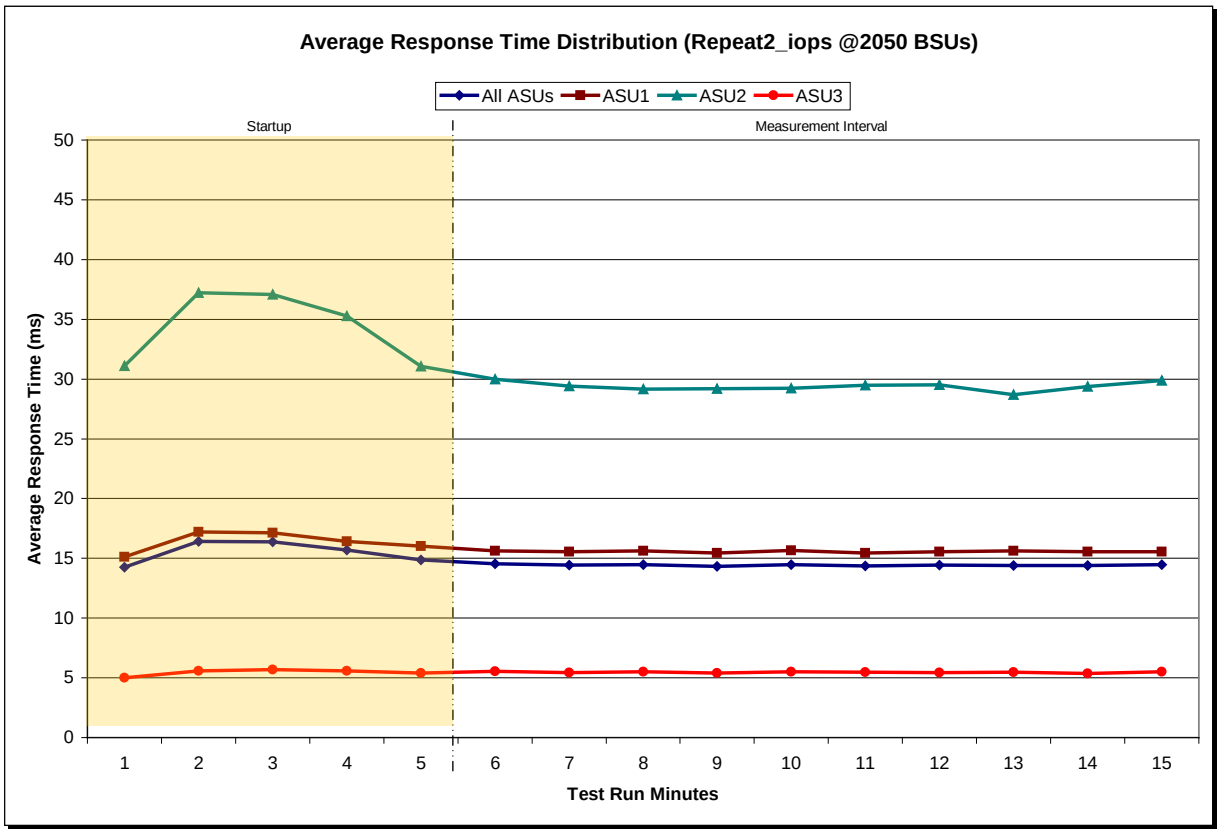
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

2050 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:48:31	0:53:32	0-4	0:05:01
Measurement Interval	0:53:32	1:03:32	4-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.25	15.13	31.11	5.00
1	16.41	17.22	37.21	5.58
2	16.37	17.14	37.07	5.68
3	15.69	16.42	35.29	5.57
4	14.88	16.00	31.07	5.41
5	14.55	15.62	29.99	5.53
6	14.42	15.56	29.42	5.44
7	14.46	15.64	29.15	5.52
8	14.32	15.45	29.18	5.39
9	14.48	15.67	29.24	5.49
10	14.37	15.45	29.47	5.46
11	14.42	15.54	29.52	5.42
12	14.38	15.64	28.68	5.46
13	14.39	15.56	29.39	5.36
14	14.48	15.54	29.89	5.50
Average	***14.43***	***15.57***	***29.39***	***5.46***

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



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

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.13.2

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

Clause 5.3.13.3

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0351	0.2809	0.0699	0.2100	0.0180	0.0701	0.0350	0.2809
COV	0.004	0.003	0.003	0.003	0.008	0.004	0.009	0.002

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

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

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2812	0.0700	0.2098	0.0180	0.0702	0.0349	0.2810
COV	0.006	0.001	0.005	0.001	0.007	0.005	0.009	0.002

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	0.2809	0.0700	0.2100	0.0180	0.0701	0.0350	0.2811
COV	0.002	0.001	0.001	0.001	0.003	0.002	0.002	0.001

Data Persistence Test

Clause 6

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

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

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

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

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

Clause 9.4.3.8

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

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 77.

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	363,063
Total Number of Logical Blocks Verified	361,176
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	10 minutes
Size in Bytes of each Logical Block	512
Number of Failed I/O Requests in the process of the Test	0

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

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

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

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 9.2.4.9

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

The Huawei OceanStor™ S5600T as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.4.3.3.6

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

Pricing information may found in the Priced Storage Configuration Pricing section on page 15.

TESTED STORAGE CONFIGURATION (TSC) AND PRICED STORAGE CONFIGURATION DIFFERENCES

Clause 9.4.3.3.7

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

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 15.

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™ S5600T .

APPENDIX A: SPC-1 GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SPC-1 Data Repository Definitions

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

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

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

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

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

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

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

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

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

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

SPC-1 Data Protection Levels

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

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

SPC-1 Test Execution Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

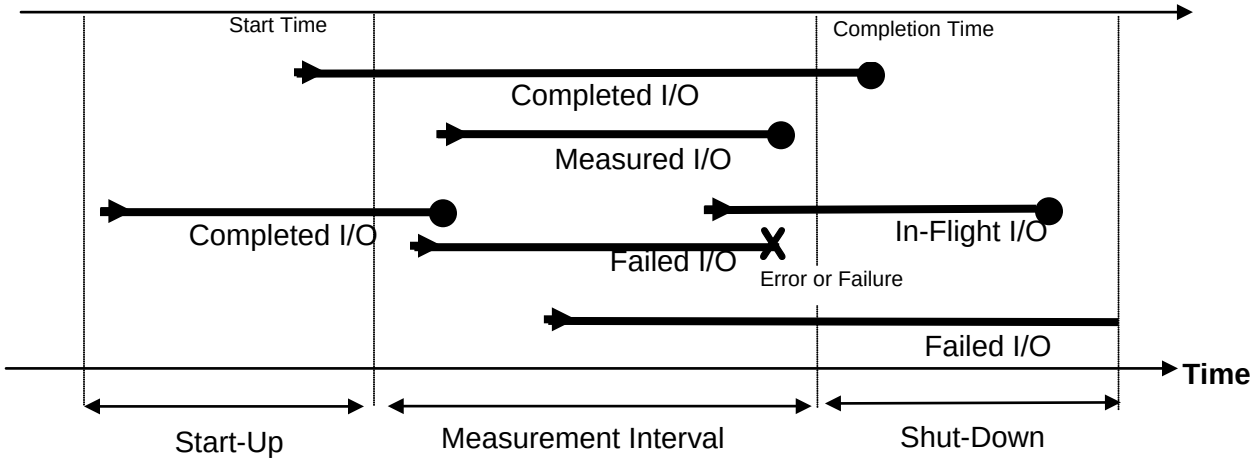
Test: A collection of Test Phases and or Test Runs sharing a common objective.

Test Run: The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up

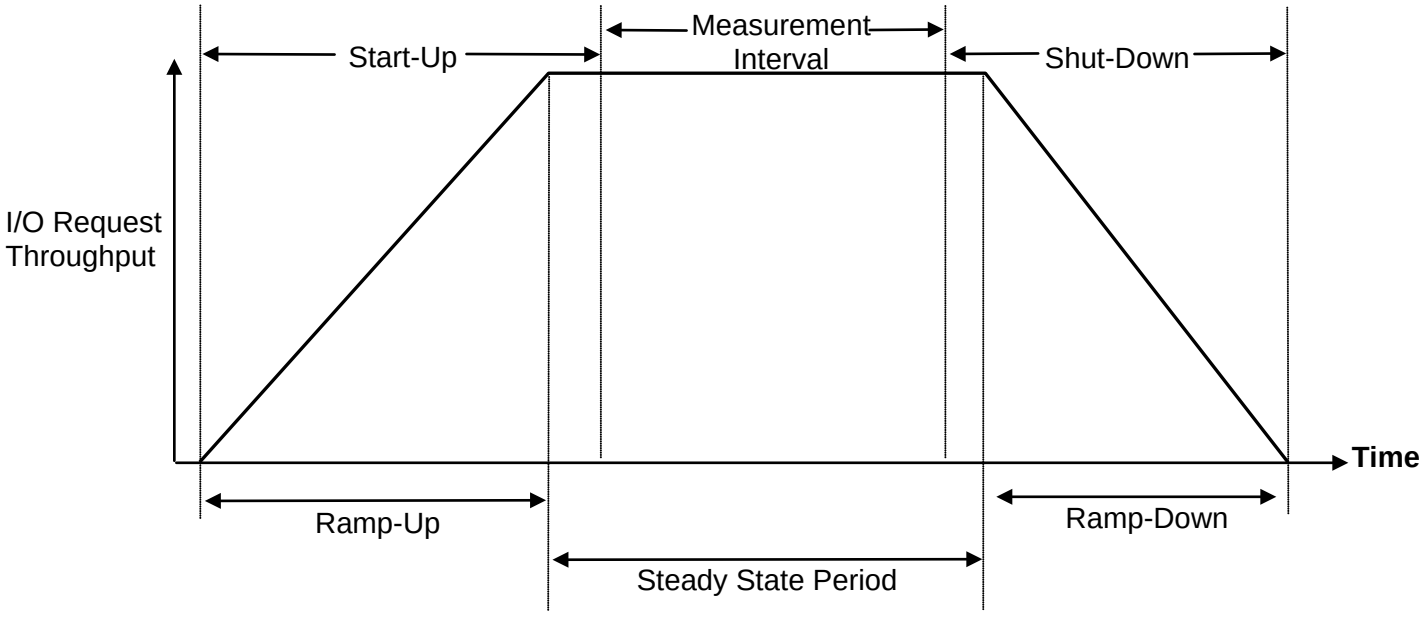
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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

I/O Completion Types



SPC-1 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

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

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

1. Create Host Group and Host

Execute the following commands in OceanStor™ S5600T's CLI to create one host group *HostGroup001*, and add one host *Host109* to the host group, then add twelve host FC ports WWNs to *Host109*. The **-t** parameter is used in the command **createhostgroup** to define the host operating system type, and type 1 means windows. The **-type** parameter of command **addhostport** means port type, and type 1 means FC host port.

```
createhostgroup -n HostGroup001 -t 1
addhost -group 1 -n Host109
addhostport -host 0 -type 1 -wwn 21000024ff2088dc -n FCInitiator001
addhostport -host 0 -type 1 -wwn 21000024ff2c95fc -n FCInitiator002
addhostport -host 0 -type 1 -wwn 21000024ff2c95fd -n FCInitiator003
addhostport -host 0 -type 1 -wwn 21000024ff2088dd -n FCInitiator004
addhostport -host 0 -type 1 -wwn 21000024ff2c9498 -n FCInitiator005
addhostport -host 0 -type 1 -wwn 21000024ff2c9499 -n FCInitiator006
addhostport -host 0 -type 1 -wwn 21000024ff2b9981 -n FCInitiator007
addhostport -host 0 -type 1 -wwn 21000024ff2c95df -n FCInitiator008
addhostport -host 0 -type 1 -wwn 21000024ff2b9980 -n FCInitiator009
addhostport -host 0 -type 1 -wwn 21000024ff2c95de -n FCInitiator010
addhostport -host 0 -type 1 -wwn 2101001b32317979 -n FCInitiator011
addhostport -host 0 -type 1 -wwn 2100001b32117979 -n FCInitiator012
```

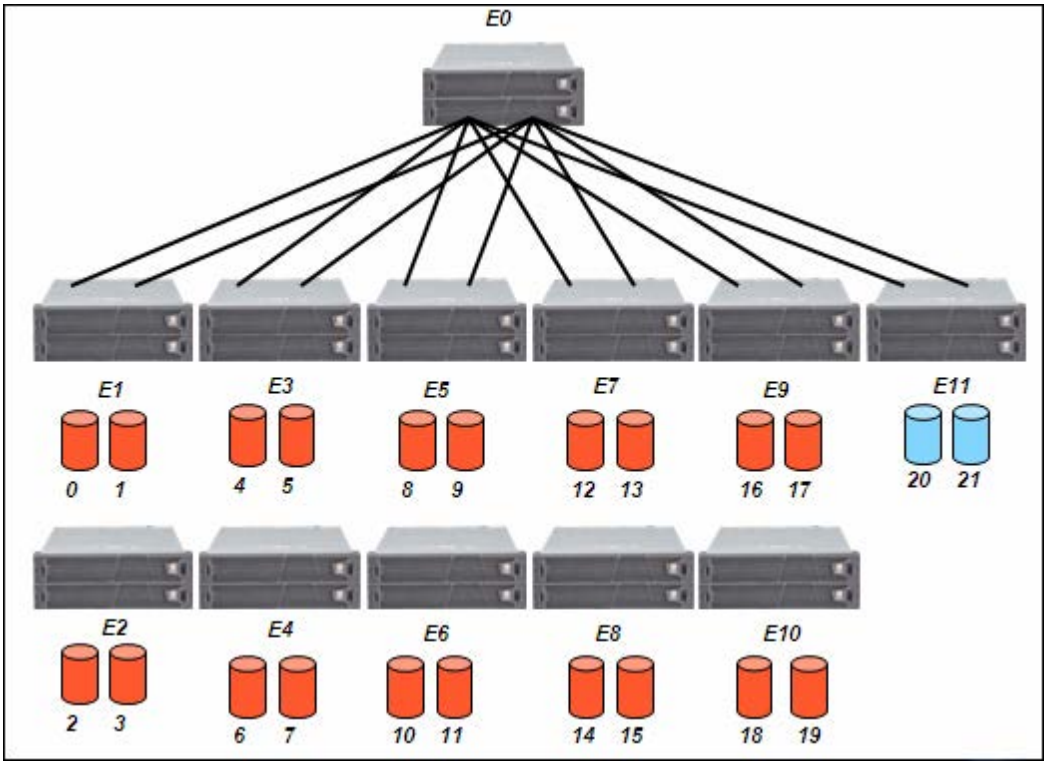
2. Create RAID Groups and LUNs

The TSC was configured with 24 - 300GB disk drives in enclosures E1-E10 and 12 - 600GB disk drives in enclosure E11. The disks at slot 0-3 of enclosure E1 are vault disk drives, which reserves 23 GiB per disk drive to retain uncommitted data in the case of unexpected power loss.

The **mklun.sh** script, listed below, is executed on the **Lenovo ThinkCentre M75e Tower** desktop which has **ubuntu 10.10 Linux** and **expect** installed, to create 22 RAID groups and 22 LUNs (one LUN per RAID group), and map those LUNs to the host group 1 created above in step #1.

As illustrated below:

- RAID Groups 0-19 each contains 12 disks and are assigned to enclosure E1 - E10, 2 RAID Groups per enclosure.
- RAID Groups 20-21 each contains 6 disks and are assigned to enclosure E11.



The **createlun** command in the **mklun.sh** script creates the 22 LUNs, one LUN per RAID group, using the maximum capacity available for the LUNs.

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

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

3. Create SPC-1 Logical Volumes

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

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

mklun.sh

```
#!/bin/bash

stor=129.22.241.10
stor_user=admin
stor_pswd=123456

export LANG=C

echo "creating LUN ..."

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

     set timeout 60

     set lunid 0
     set rgid 0

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

     for {set enclosure 1} { \$enclosure <= 10 } { incr enclosure } {
            foreach list {,0:,1:,2:,3:,4:,5:,6:,7:,8:,9:,10:,11:
,12:,13:,14:,15:,16:,17:,18:,19:,20:,21:,22:,23:} {
                   set disk_list [string map [list , \$enclosure,] \$list]
                   send "createrg -n ASU-\$rgid -l 10 -num 2 -list \$disk_list\r"
                   expect "(y/n)"
                   send "y\r"
                   expect ">"
                   #send "chgrgiospindown -sw on -rg \$rgid -idle 0\r"
                   #expect "(y/n)"
                   #send "y\r"
                   #expect ">"
                   send "showrg -rg \$rgid\r"
                   expect ">"
                   if { \$enclosure <= 5 } {
                          set ctrl a
                   } else {
                          set ctrl b
                   }
                   send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -c \$ctrl\r"
```

```
                  set sucsses 0
                  while { \$sucsses == 0 } {
                         expect {
                                "Error" {
                                       expect ">"
                                       sleep 1
                                       send "createlun -rg \$rgid -n ASU-\$lunid -
susize 512 -c \$ctrl\r"
                                }
                                ">" {
                                       set sucsses 1
                                }
                         }
                  }
                  send "showlun -lun \$lunid\r"
                  expect ">"
                  send "addhostmap -group 1 -devlun \$lunid\r"
                  set sucsses 0
                        while { \$sucsses == 0 } {
                                expect {
                                        "Error" {
                                                expect ">"
                                                sleep 1
                                                send "addhostmap -group 1 -devlun
\$lunid\r"
                                        }
                                        ">" {
                                                set sucsses 1
                                        }
                                }
                        }
                  send "showhostmap -map [expr \$lunid + 1048576]\r"
                  expect ">"
                  incr lunid
                  incr rgid
            }
      }
         for {set enclosure 11} { \$enclosure <= 11 } { incr enclosure } {
                foreach list {,0:,1:,2:,3:,4:,5: ,6:,7:,8:,9:,10:,11:} {
                        set disk_list [string map [list , \$enclosure,] \$list]
                  send "createrg -n ASU-\$rgid -l 10 -num 2 -list \$disk_list\r"
                        expect "(y/n)"
                        send "y\r"
                        expect ">"
                        #send "chgrgiospindown -sw on -rg \$rgid -idle 0\r"
                        #expect "(y/n)"
                        #send "y\r"
                        #expect ">"
                        send "showrg -rg \$rgid\r"
                        expect ">"
                        if [ expr \$lunid%2 ] {
                                set ctrl b
                        } else {
                                set ctrl a
                        }
                        send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -c
\$ctrl\r"
                        set sucsses 0
                        while { \$sucsses == 0 } {
                                expect {
                                        "Error" {
                                                expect ">"
                                                sleep 1
```

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

formatting=1

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

```
        formatting=`cat tmp.log | grep Formatting | wc -l`
done
```

mkvolume.sh

```
#!/bin/bash

master=129.22.241.109
slaves=""
username=administrator
password=Huawei123

diskcount=22
vgdiskcount=20
asu3diskcount=2

asu1disksize=771300
asu2disksize=771300
asu3disksize=1714000

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

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

export LANG=C

echo "Creating Volume... "

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

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

asu2disklists=$asu1disklists

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

asu3disklist="$asu3disklist$diskcount"

asu3disklists="$asu3disklist"

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

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

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

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

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

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

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

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

Master JVM

```
host=master
slaves=(H1_1,H1_2,H1_3,H1_4,H1_5,H1_6,H1_7,H1_8,H1_9,H1_10,H1_11,H1_12,H1_13,H1_14,H
1_15,H1_16,H1_17,H1_18,H1_19,H1_20,H1_21,H1_22)
sd=asu1_1,lun=\\.\D:,size=16175333376000
sd=asu2_1,lun=\\.\E:,size=16175333376000
sd=asu3_1,lun=\\.\G:,size=3594518528000
```

Slave JVM *(Slave JVM 1)*

```
master=129.22.241.109
host=H1_1
sd=asu1_1,lun=\\.\D:,size=16175333376000
sd=asu2_1,lun=\\.\E:,size=16175333376000
sd=asu3_1,lun=\\.\G:,size=3594518528000
```

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

Persistence Test

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

Persistence Test Run 1 (write phase)

```
host=localhost,jvms=1,maxstreams=200
sd=sd1,lun=\\.\D:,size=16175333376000
sd=sd2,lun=\\.\E:,size=16175333376000
sd=sd3,lun=\\.\G:,size=3594518528000
maxlatestart=1
reportinginterval=5
segmentlength=512m
rd=default,rampup=180,periods=90,measurement=300,runout=0,rampdown=0,buffers=1
rd=default,rdpct=0,xfersize=1024k
rd=TR1-69s_SPC-2-persist-w,streams=69
```

Persistence Test Run 2 (read phase)

```
host=localhost,jvms=1,maxstreams=200
sd=sd1,lun=\\.\D:,size=16175333376000
sd=sd2,lun=\\.\E:,size=16175333376000
sd=sd3,lun=\\.\G:,size=3594518528000
maxlatestart=1
reportinginterval=5
segmentlength=512m
maxpersistenceerrors=10
rd=default,buffers=1,rdpct=100,xfersize=1024k
rd=TR1-69s_SPC-2-persist-r
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

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

The following scripts was used to execute the Primary Metrics Test *(Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase)*, Repeatability Test *(Repeatability Test Phase 1 and Repeatability Test Phase 2)*, and Persistence Test Run 1 in an uninterrupted sequence.

```
bsu=2050

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

spc1.sh

```
#!/bin/bash

phase=$1
bsu=$2
startup=$3
master=129.22.241.109
slaves=""
username=administrator
password=Huawei123

slavecount=`echo $slaves | wc -w`

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

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

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

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

slaveline="slaves=("

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

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

killall expect
```

persist1.sh

```
#!/bin/bash

bsu=$1

master=129.22.241.109
slaves=""
username=administrator
password=Huawei123

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

echo "Starting persist1 ..."

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

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

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

Persistence Test Run 2

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

```
#!/bin/bash

bsu=$1

master=129.22.241.109
slaves=""
username=administrator
password=Huawei123

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

echo "Starting persist2 ..."

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

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

     send "type persist2.cfg\r"
     expect "spc1_test>"
     send "..\\\\spc2\\\\spc2.bat -f persist2.cfg -o persist2\r"
     expect "spc1_test>"
     send "exit\r"
        expect EOF
__END_SPC2_TEST
```

APPENDIX F: THIRD PARTY QUOTATION

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

www.RakanSystems.com

Quote

Date	Quote #
7/21/2011	2011-179

Quote Prepared for:

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

Prepared by:

Paul Foote
pfoote.RakanSystems.com
303.419.0746

Expiration Date:

10/31/2011

RFQ#

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

Item	Description	Qty	Rate	Total:
S5600TBB	S5600T, dual controllers, AC, 48GB cache,with UPS Cache Protected Module,without Front-End & Back-End Port	1	20,474.00	20,474.00T
SDE35U4BB	DAE12435U4-03 Disk Enclosure(4U,220V AC,SAS Expansion Module,24X3.5" HD Slots without Disk Unit,with HS SAS in Band Management Software),with 2 SAS 1M Cables	11	3,292.00	36,212.00T
STIO6GSAS	2*24Gbps SAS-wide I/O modules(2 ports each)	6	1,052.00	6,312.00T
STIO8GFC	4*8Gbps Fibre Channel I/O modules(4 ports each)	4	1,304.00	5,216.00T
SHD35SA300	3.5 inch 300GB 15K RPM SAS	240	473.00	113,520.00T
SHD35SA600	3.5 inch 600GB 15K RPM SAS	12	756.00	9,072.00T
S5000MP	S5000T Multi-Path Software	1	682.00	682.00T
S5600ISM	ISM Software License for S5600T (ESSENTIAL)	1	2,728.00	2,728.00T

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

Subtotal	
Sales Tax (4.1%) Colorado Only	
Total:	

Accepted by:

Signature: _____ **Date:** _____

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

Page 1

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

Quote

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

www.RakanSystems.com

Date	Quote #
7/21/2011	2011-179

Quote Prepared for:

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

Prepared by:

Paul Foote
pfoote.RakanSystems.com
303.419.0746

Expiration Date:

10/31/2011

RFQ#

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

Item	Description	Qty	Rate	Total:
S5000SSLC	Storage Array Control System Software License for S5000T (ESSENTIAL) 12 - Patch Cord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m - No Charge 1 - Purchased Cable,MiniSAS Cable,Key246,3m - No Charge	1	0.00	0.00T
CS-SAS2MU...	External Mini-SAS Cable - 26-pin 4x Mini-SAS (SFF-8088) to 26-pin 4x Mini-SAS (SFF-8088)	2	147.00	294.00T
TSGS5600AIO	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	1	7,578.00	7,578.00

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

Subtotal	
Sales Tax (4.1%) Colorado Only	
Total:	

Accepted by:

Signature: _____ **Date:** _____

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

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

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

www.RakanSystems.com

Quote

Date	Quote #
7/21/2011	2011-179

Quote Prepared for:

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Paul Foote
pfoote.RakanSystems.com
303.419.0746

Expiration Date:

10/31/2011

RFQ#

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

Item	Description	Qty	Rate	Total:
TSGSTJ4SA60	Upgrade from Standard to Gold service package in warranty period (3 years). Gold service package include:7*24 Remote Support. Access to all new software updates. 4 Hours Parts Delivery. 4 Hours Engineer Onsite.	11	4,823.00	53,053.00
QLE2562-CK	QLogic Dual Port 8Gb Fibre Channel to PCI Express Host Bus Adapter (QLE2562-CK)	6	2,598.00	15,588.00T
5042A6U	Lenovo ThinkCentre M75e 5042 Tower	1	549.00	549.00T

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

Subtotal	$271,278.00
Sales Tax (4.1%) Colorado Only	$8,636.53
Total:	$279,914.53

Accepted by:

Signature: _____ **Date:** _____

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

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