



**SPC BENCHMARK 1™
FULL DISCLOSURE REPORT**

**INFORTREND TECHNOLOGY, INC.
INFORTREND ESVA F60**

SPC-1 V1.12

**Submitted for Review: February 8, 2010
Submission Identifier: A00088**

First Edition – February 2010

THE INFORMATION CONTAINED IN THIS DOCUMENT IS DISTRIBUTED ON AN AS IS BASIS WITHOUT ANY WARRANTY EITHER EXPRESS OR IMPLIED. The use of this information or the implementation of any of these techniques is the customer's responsibility and depends on the customer's ability to evaluate and integrate them into the customer's operational environment. While each item has been reviewed by Infortrend Technology, Inc. for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environment do so at their own risk.

This publication was produced in the United States. Infortrend Technology, Inc. may not offer the products, services, or features discussed in this document in other countries, and the information is subject to change with notice. Consult your local Infortrend Technology, Inc. representative for information on products and services available in your area.

© Copyright Infortrend Technology, Inc. 2010. All rights reserved.

Permission is hereby granted to reproduce this document in whole or in part, provided the copyright notice as printed above is set forth in full text on the title page of each item reproduced.

Trademarks

SPC Benchmark-1, SPC-1, SPC-1 IOPS, and SPC-1 LRT are trademarks of the Storage Performance Council. Infortrend, the Infortrend logo, SANWatch and ESVA are trademarks of Infortrend Technology, Inc. in the United States and other countries. All other brands, trademarks, and product names are the property of their respective owners.

Table of Contents

Audit Certification	vii
Audit Certification (cont.)	viii
Letter of Good Faith	ix
Executive Summary	10
Test Sponsor and Contact Information	10
Revision Information and Key Dates	10
Tested Storage Product (TSP) Description	10
Summary of Results	11
Storage Capacities, Relationships, and Utilization	11
Response Time - Throughput Curve	13
Response Time - Throughput Data	13
Priced Storage Configuration Pricing	14
Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration	15
Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Diagram	16
Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Components	17
Configuration Information	18
Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram	18
Storage Network Configuration	18
Host System and Tested Storage Configuration (TSC) Table of Components	18
Customer Tunable Parameters and Options	19
Tested Storage Configuration (TSC) Description	19
SPC-1 Workload Generator Storage Configuration	19
SPC-1 Data Repository	20
Storage Capacities and Relationships	20
SPC-1 Storage Capacities	20
SPC-1 Storage Hierarchy Ratios	20
SPC-1 Storage Capacities and Relationships Illustration	21
Logical Volume Capacity and ASU Mapping	21
Storage Capacity Utilization	22
SPC-1 Benchmark Execution Results	23
SPC-1 Tests, Test Phases, and Test Runs	23
Primary Metrics Test - Sustainability Test Phase	24
SPC-1 Workload Generator Input Parameters	24

Sustainability Test Results File	24
Sustainability – Data Rate Distribution Data (<i>MB/second</i>).....	25
Sustainability – Data Rate Distribution Graph	26
Sustainability – I/O Request Throughput Distribution Data.....	27
Sustainability – I/O Request Throughput Distribution Graph	28
Sustainability – Average Response Time (ms) Distribution Data	29
Sustainability – Average Response Time (ms) Distribution Graph	30
Sustainability – Response Time Frequency Distribution Data	31
Sustainability – Response Time Frequency Distribution Graph	31
Sustainability – Measured Intensity Multiplier and Coefficient of Variation.....	32
Primary Metrics Test – IOPS Test Phase.....	33
SPC-1 Workload Generator Input Parameters	33
IOPS Test Results File.....	33
IOPS Test Run – I/O Request Throughput Distribution Data	34
IOPS Test Run – I/O Request Throughput Distribution Graph.....	34
IOPS Test Run – Average Response Time (ms) Distribution Data	35
IOPS Test Run – Average Response Time (ms) Distribution Graph	35
IOPS Test Run – Response Time Frequency Distribution Data	36
IOPS Test Run –Response Time Frequency Distribution Graph.....	36
IOPS Test Run – I/O Request Information.....	37
IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation.....	37
Primary Metrics Test – Response Time Ramp Test Phase	38
SPC-1 Workload Generator Input Parameters	38
Response Time Ramp Test Results File.....	38
Response Time Ramp Distribution (IOPS) Data.....	39
Response Time Ramp Distribution (IOPS) Graph	40
SPC-1 LRT™ Average Response Time (ms) Distribution Data.....	41
SPC-1 LRT™ Average Response Time (ms) Distribution Graph	41
SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation	42
Repeatability Test	43
SPC-1 Workload Generator Input Parameters	43
Repeatability Test Results File	44
Repeatability 1 LRT – I/O Request Throughput Distribution Data.....	45
Repeatability 1 LRT – I/O Request Throughput Distribution Graph	45
Repeatability 1 LRT –Average Response Time (ms) Distribution Data	46
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph.....	46
Repeatability 1 IOPS – I/O Request Throughput Distribution Data	47
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph.....	47
Repeatability 1 IOPS –Average Response Time (ms) Distribution Data.....	48

Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph	48
Repeatability 2 LRT – I/O Request Throughput Distribution Data.....	49
Repeatability 2 LRT – I/O Request Throughput Distribution Graph	49
Repeatability 2 LRT –Average Response Time (ms) Distribution Data	50
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph.....	50
Repeatability 2 IOPS – I/O Request Throughput Distribution Data	51
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph.....	51
Repeatability 2 IOPS –Average Response Time (ms) Distribution Data.....	52
Repeatability 2 IOPS –Average Response Time (ms) Distribution Graph	52
Repeatability 1 (LRT) Measured Intensity Multiplier and Coefficient of Variation	53
Repeatability 1 (IOPS) Measured Intensity Multiplier and Coefficient of Variation	53
Repeatability 2 (LRT) Measured Intensity Multiplier and Coefficient of Variation	53
Repeatability 2 (IOPS) Measured Intensity Multiplier and Coefficient of Variation	54
Data Persistence Test.....	55
SPC-1 Workload Generator Input Parameters	55
Data Persistence Test Results File	55
Data Persistence Test Results.....	56
Priced Storage Configuration Availability Date.....	57
Pricing Information.....	57
Tested Storage Configuration (TSC) and Priced Storage Configuration Differences.....	57
Anomalies or Irregularities	57
Appendix A: SPC-1 Glossary	58
“Decimal” (<i>powers of ten</i>) Measurement Units.....	58
“Binary” (<i>powers of two</i>) Measurement Units.....	58
SPC-1 Data Repository Definitions.....	58
SPC-1 Data Protection Levels	59
SPC-1 Test Execution Definitions	59
I/O Completion Types	61
SPC-1 Test Run Components	61
Appendix B: Customer Tunable Parameters and Options.....	62
Windows 2003 Server.....	62
Appendix C: Tested Storage Configuration (TSC) Creation	63
Host Systems.....	63
Qlogic SANbox 5800 Switches	63
Management Station.....	63
ESVA Storage	63

1. Launch Virtualization Manager	64
2. Create a virtual pool.	65
3. Create virtual volumes.	65
4. Map virtual volumes.	68
5. Verify virtual volume mapping	70
Appendix D: SPC-1 Workload Generator Storage Commands and Parameters	71
Persistence Test 1 (write phase).....	71
Persistence Test 2 (read phase).....	71
Appendix E: SPC-1 Workload Generator Input Parameters	72
Primary Metrics and Repeatability Tests	72
Persistence Test.....	72
Persistence Test Run 1 (write phase).....	72
Persistence Test Run 2 (read phase).....	72
Appendix F: Third-Party Quotations.....	73

AUDIT CERTIFICATION



Galvin Chang
 Infortrend Technology, Inc.
 8F, No. 102 Sec 3, Jhonshan Rd
 Jhonhe City, Taipei County 235, Taiwan

February 8, 2010

The SPC Benchmark 1™ results listed below for the Infortrend ESVA F60 were produced in compliance with the SPC Benchmark 1™ 1.12 Onsite Audit requirements.

SPC Benchmark 1™ 1.12 Results	
Tested Storage Configuration (TSC) Name: Infortrend ESVA F60	
Metric	Reported Result
SPC-1 IOPS™	180,488.53
SPC-1 Price-Performance	\$5.12/SPC-1 IOPS™
Total ASU Capacity	49,177.376 GB
Data Protection Level	Protected (<i>Mirroring</i>)
Total TSC Price (including three-year maintenance)	\$924,231.6

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

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items, based on information supplied by Infortrend Technology, Inc.:
 - ✓ 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.)

Infortrend ESVA F60
SPC-1 Audit Certification

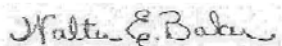
Page 2

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

Audit Notes:

The SPC-2 Persistence Test was approved for use to meet the SPC-1 persistence requirements.

Respectfully,



Walter E. Baker
SPC Auditor

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

LETTER OF GOOD FAITH

Infotrend Technology, Inc.



02 January, 2010

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

To: Walter Baker
Subject: SPC-1 Letter of Good Faith for the Infotrend ESVA F60

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

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

Sincerely,

Thomas Kao
Director
Product Planning Department

8F, No.102, Sec. 3, Jhongshan Rd., Jhonghe City, Taipei County 235, Taiwan
Tel: 886 2 2226-0126; Fax: 886 2 2226-0020

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Infotrend Technology, Inc. – http://www.infotrend.com Galvin Chang – galvin.chang@infotrend.com 8F, No. 102 Sec 3, Jhonshan Rd. Jhonhe City, Taiei County 235, Taiwan Phone: +866 02 2226 0126 x8512 FAX: +866 2 2226-0020
Test Sponsor Alternate Contact	Infotrend Technology, Inc. – http://www.infotrend.com Jeff Chuang – jeff.chuang@infotrend.com 8F, No. 102 Sec 3, Jhonshan Rd. Jhonhe City, Taiei County 235, Taiwan Phone: +866 02 2226 0126 x5231 FAX: +866 2 2226-0020
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	February 8, 2010
Date the FDR was submitted to the SPC	February 8, 2010
Date the priced storage configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	February 8, 2010

Tested Storage Product (TSP) Description

The Infotrend ESVA Fiber Series is designed to support a powerful, reliable and flexible Fiber Channel (FC) SAN. It offers wide configuration choices to meet diverse application requirements of performance, capacity, space and costs. Based on Enterprise Scalable Virtualized Architecture, the ESVA FC SAN can help mid-range enterprises optimize returns on investment, simplify storage infrastructure and maximize application productivity.

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Infortrend ESVA F60	
Metric	Reported Result
SPC-1 IOPS™	180,488.53
SPC-1 Price-Performance	\$5.12/SPC-1 IOPS™
Total ASU Capacity	49,177.376 GB
Data Protection Level	Protected (<i>Mirroring</i>)
Total TSC Price (including three-year maintenance)	\$924,231.65

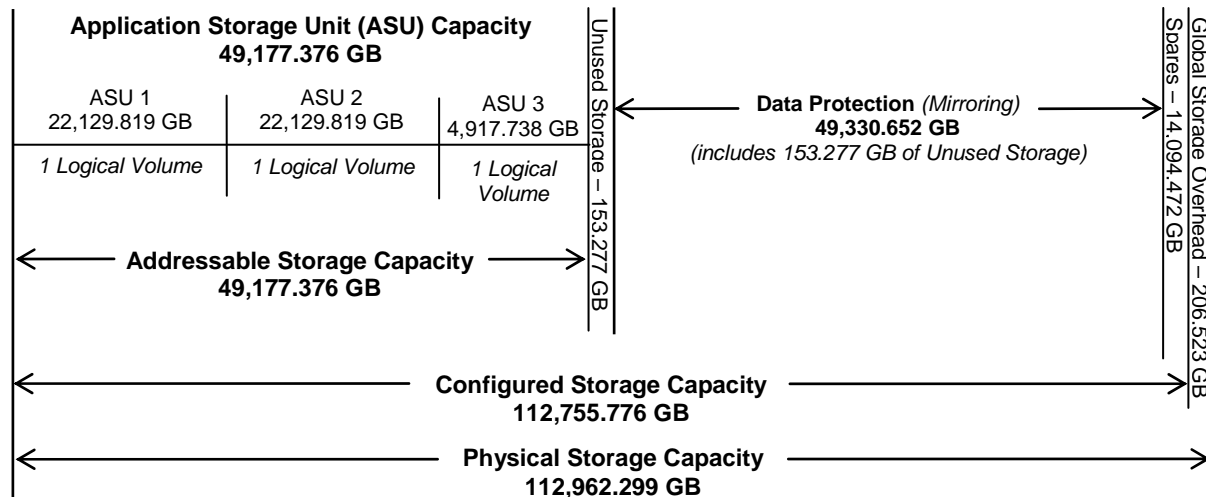
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

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

Storage Capacities, Relationships, and Utilization

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



SPC-1 Storage Capacity Utilization	
Application Utilization	43.53%
Protected Application Utilization	87.07%
Unused Storage Ratio	0.27%

Application Utilization: Total ASU Capacity (49,177.376 GB) divided by Physical Storage Capacity (112,963.299 GB)

Protected Application Utilization: (Total ASU Capacity (49,177.376 GB) plus total Data Protection Capacity (GB) minus unused Data Protection Capacity (GB) divided by Physical Storage Capacity (112,963.299 GB)

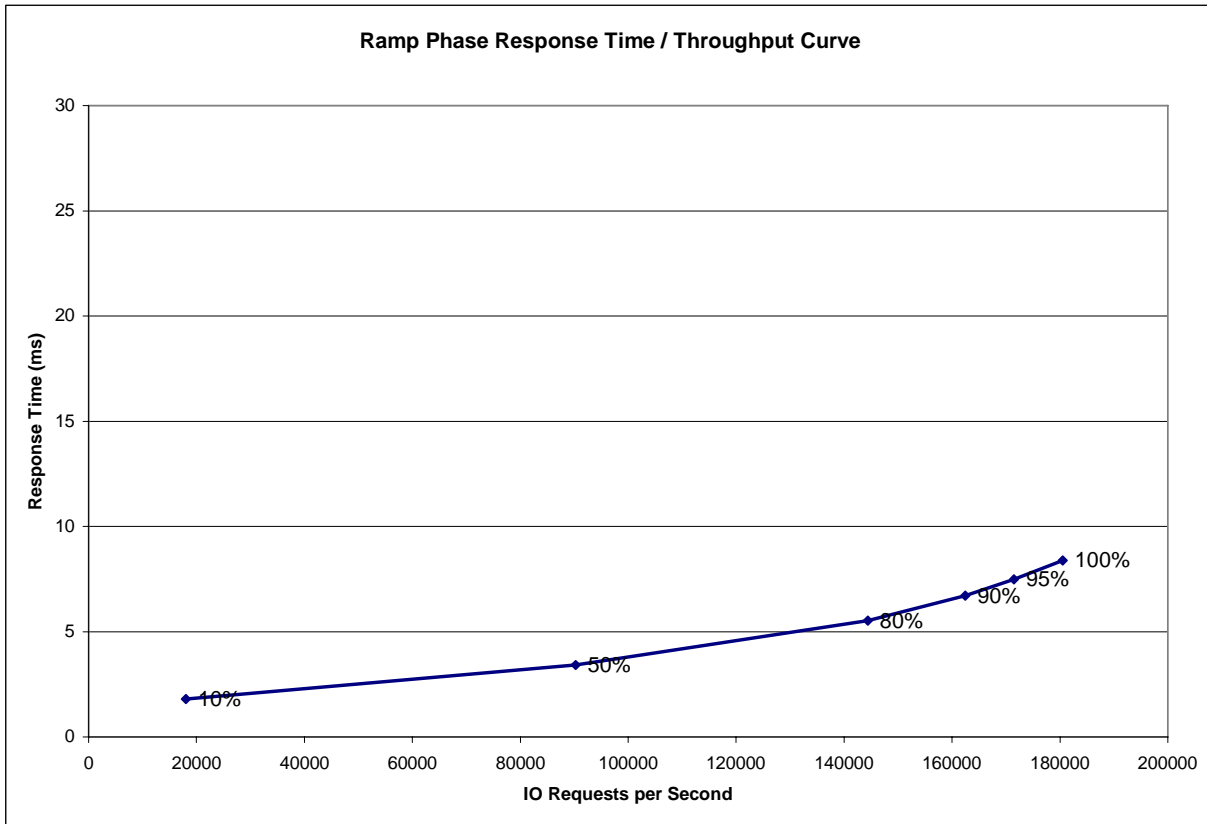
Unused Storage Ratio: Total Unused Capacity (GB) divided by Physical Storage Capacity (112,963.299 GB) and may not exceed 45%.

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

Response Time – Throughput Curve

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

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



Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	18,049.45	90,251.51	144,385.34	162,457.18	171,475.69	180,488.53
Average Response Time (ms):						
All ASUs	1.79	3.41	5.51	6.71	7.48	8.38
ASU-1	2.42	4.57	7.17	8.59	9.45	10.41
ASU-2	1.86	3.34	5.43	6.72	7.61	8.75
ASU-3	0.44	0.99	2.03	2.72	3.24	3.92
Reads	3.90	7.17	10.91	12.88	14.04	15.27
Writes	0.42	0.97	2.00	2.69	3.21	3.89

Priced Storage Configuration Pricing

Description	Quantity	Price	subtotal
Storage System			
ESVA F60-1830 package include	12	\$ 23,920.00	\$ 287,040.00
Control Module			
Cooling Module			
Battery Module			
Power Supply Unit			
16x 147GB magazine with MUX board plus 15k RPMSAS disk drive			
4x 5m cable lc-lc 1.8 mm x 2 mm-62.5/125 DUPLEX LSZH			
4x Finnisar 8 GB SFP			
ESVA J60-130 package	36	\$ 9,880.00	\$ 355,680.00
Controller Module			
Battery Module			
Power Supply Unit			
16x 147GB magazine with MUX board plus 15k RPMSAS disk drive			
6x SAS Cable			
Storage Software & Warranty			
Infotrend MPIO v1.23.2.40	1		
Load Balance driver v1.0.1.1 1045	1		
Infotrend SANWatch 2.0	1		
Premium Service Upgrade - 3 years Standard Service + 4hr Onsite (RAID)	12	\$ 6,571.00	\$ 78,852.00
Premium Service Upgrade - 3 years Standard Service + 4hr Onsite (JBOD)	36	\$ 4,571.00	\$ 164,556.00
Storage Subtotal			\$ 886,128.00
Third-Party Components			
SuperMicro X7DBE Xeon Quad-Core E5405 2.0GHz 16GM DDR memory	1	\$ 2,221.15	\$ 2,221.15
Qlogic SanBox 5800 Fibre Switch	4	\$ 3,548.00	\$ 14,192.00
Qlogic port Expansion license	12	\$ 737.00	\$ 8,844.00
XPAK Connector Cable	2	\$ 227.00	\$ 454.00
Qlogic HBA QLE2562 8GB	3	\$ 890.00	\$ 2,670.00
42U AMS2000 Rackmount	7	\$ 437.50	\$ 3,062.50
5m cable lc-lc 1.8 mm x 2 mm-62.5/125 DUPLEX LSZH	6	\$ 30.00	\$ 180.00
Finnisar 8 GB SFP	54	\$ 120.00	\$ 6,480.00
Host Subtotal			\$ 38,103.65
Total			\$ 924,231.65

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.

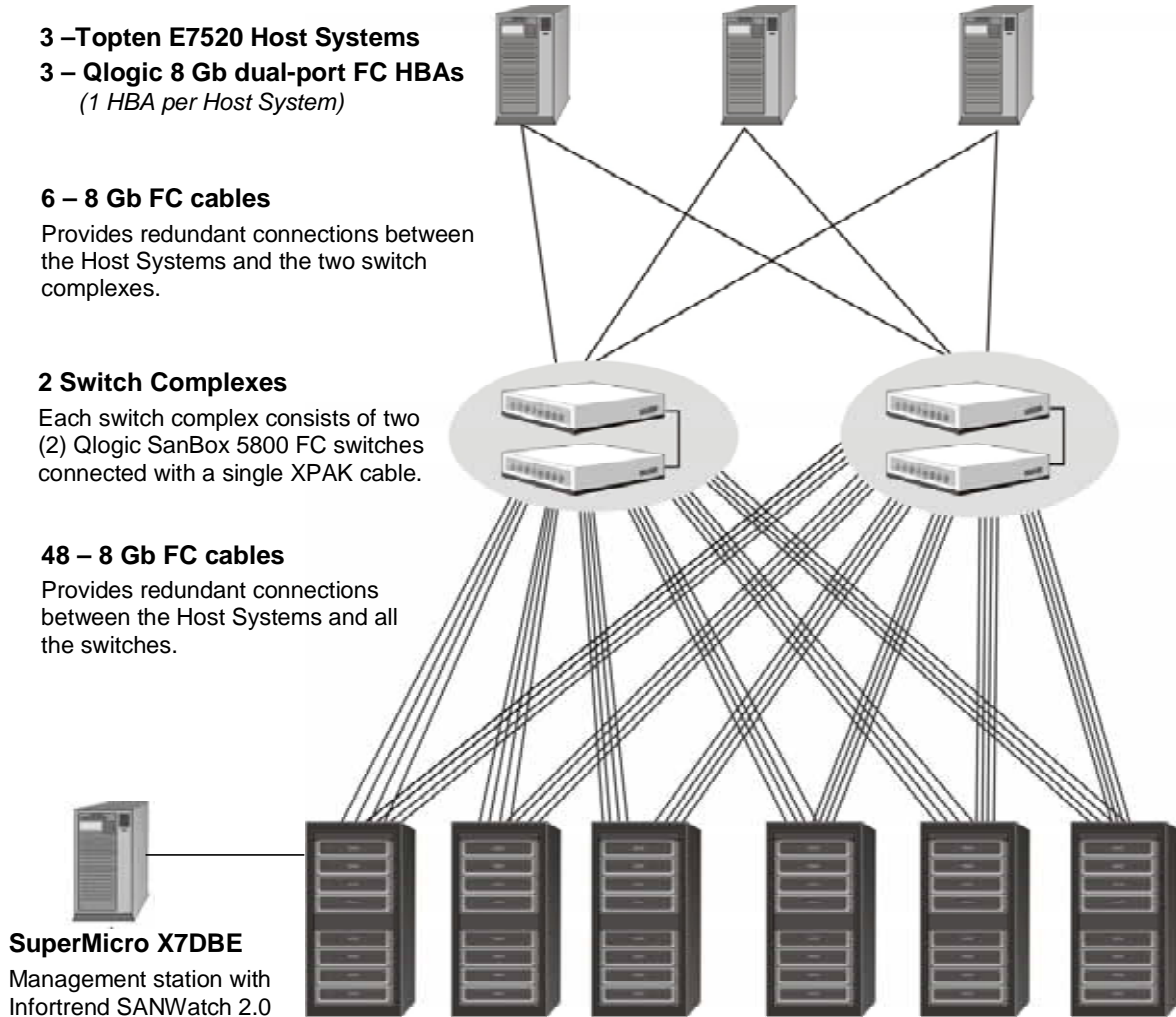
- Onsite present of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Price Storage Configuration that can be remedied by the repair or replacement of a Priced Storage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

Infortrend Corporation (*U.S. office*) 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 73 (*Appendix F: Third-Party Quotations*) for a copy of the third-party quotation.

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

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

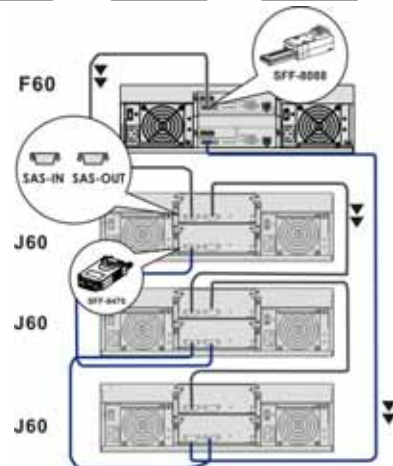
Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Diagram



12 – Infortrend ESVA F60 sets

Each set consists of:

- 1 – Infortrend ESVA F60**
 dual controller (4 GB cache/controller)
 with 16 146GB 15K RPM SAS disks drives
- 3 – Infortrend ESVA J60**
 Expansion units, each with
 16 146GB 15K RPM SAS disks drives
- 64 – 146GB 15K RPM SAS disks drives**
 per F60 set



Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Components

Host System:	Tested Storage Configuration (TSC)/ Priced Storage Configuration:
3 – Topten E7520 Host Systems	Infortrend MPIO v1.23.2.40 Load Balance driver v1.0.11 1045
Each Host System with:	<i>(both included with Host Systems)</i>
Dual Intel Xeon 2.0 GHz Quad Core processors with 12 MB L2 cache per CPU	3 – dual port Qlogic 8 Gb PCI-X HBAs (<i>QLE 2562</i>) <i>(one HBA per Host System)</i>
16 GB main memory	12 – Infortrend ESVA F60 Each F60 includes: 4 GB cache/memory 16 – 146 GB 15K RPM SAS disk drives 4 – 8 Gb Fibre Channel front-end connections 4 – 8 Gb Finnisar SFPs 4 – SAS backend connections (<i>2 used</i>) 4 – 5m cables lc-lc 1.8mm x2 mm /125 DUPLEX LSZH 36 – Infortrend ESVA J60 (3 J60s per F60) Each J60 includes: 16 – 146 GB 15K RPM SAS disk drives 6 – SAS cables
Windows Server 2003 Enterprise Edition 64-bit with SP2	
PCI-X	
	1 – SuperMicro X7DBE server (<i>management station</i>) with Infortrend SANWatch 2.0
	4 – Qlogic SanBox 5800 FC switches with 2 XPAK connector cables
	54 -8 Gb Finnisar SFPs
	6 – 5m cables lc-lc 1.8mm x2 mm /125 DUPLEX LSZH
	7 – 42U AMS Rackmounts

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 16 (*Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/Priced 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 Host System and TSC table of components may be found on page 16 (*Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/Priced 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 17 (*Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/Priced Storage Configuration Components*).

Customer Tunable Parameters and Options

Clause 9.4.3.5.1

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

“Appendix B: Customer Tunable Parameters and Options” on page 62 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

Tested Storage Configuration (TSC) Description

Clause 9.4.3.5.2

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

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

“Appendix C: Tested Storage Configuration (TSC) Creation” on page 63 contains the detailed information that describes how to create and configure the logical TSC.

SPC-1 Workload Generator Storage Configuration

Clause 9.4.3.5.3

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

The SPC-1 Workload Generator storage configuration commands and parameters for this measurement appear in “Appendix D: SPC-1 Workload Generator Storage Commands and Parameters” on page 71.

SPC-1 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1 storage capacities and mappings used in the Tested Storage Configuration. “SPC-1 Data Repository Definitions” on page 58 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.4.3.6.1

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

SPC-1 Storage Capacities

SPC-1 Storage Capacities		
Storage Hierarchy Component	Units	Capacity
Total ASU Capacity	Gigabytes (GB)	49,177.376
Addressable Storage Capacity	Gigabytes (GB)	49,177.376
Configured Storage Capacity	Gigabytes (GB)	112,755.776
Physical Storage Capacity	Gigabytes (GB)	112,962.299
Data Protection (<i>Mirroring</i>)	Gigabytes (GB)	49,330.652
Required Storage (<i>including spares</i>)	Gigabytes (GB)	14,094.472
Global Storage Overhead	Gigabytes (GB)	206.523
Total Unused Storage	Gigabytes (GB)	306.553

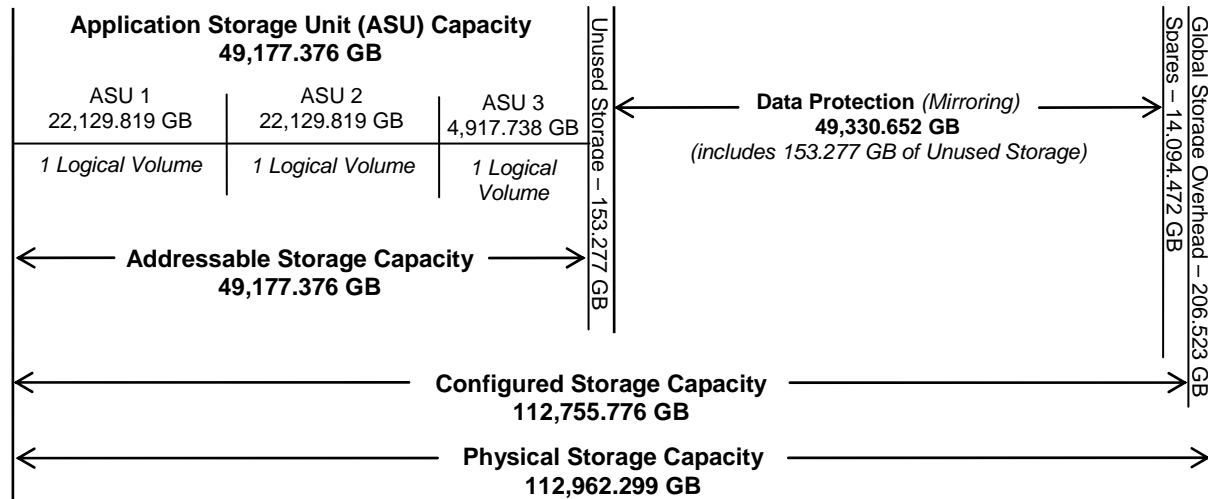
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	43.61%	43.53%
Required for Data Protection (<i>Mirrored</i>)		43.75%	43.67%
Addressable Storage Capacity		43.61%	43.53%
Required Storage (<i>including spares</i>)		12.50%	12.48%
Configured Storage Capacity			99.82%
Global Storage Overhead			0.18%
Unused Storage:			
Addressable	0.00%		
Configured		0.27%	
Physical			0.00%

The Physical Storage Capacity consisted of 112,962.299 GB distributed over 768 disk drives each with a formatted capacity of 147.086 GB. There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 206.523 GB (0.18%) of Physical Storage Capacity. There was 306.553 GB (0.18%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100.00% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) of Unused Storage within the Addressable Storage Capacity. The Data Protection (*mirroring*) capacity was 49,330.652 GB of which 49,177.376 GB was utilized. The total Unused Storage capacity was 306.553 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 (22,129.819 GB)	ASU-2 (22,129.819 GB)	ASU-3 (4,917.738 GB)
1 Logical Volume 22,129.819 GB per Logical Volume (22,129.819 GB used per Logical Volume)	1 Logical Volume 22,129.819 GB per Logical Volume (22,129.819 GB used per Logical Volume)	1 Logical Volume 4,917.738 GB per Logical Volume (4,917.738 GB used per Logical Volume)

The Data Protection Level used for all Logical Volumes was “Mirrored” as described on page 11. See “ASU Configuration” in the [IOPS Test Results File](#) for more detailed configuration information.

Storage Capacity Utilization

Clause 9.4.3.6.2

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

Clause 2.8.1

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

Clause 2.8.2

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

Clause 2.8.3

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

SPC-1 Storage Capacity Utilization	
Application Utilization	43.53%
Protected Application Utilization	87.07%
Unused Storage Ratio	0.27%

SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. “SPC-1 Test Execution Definitions” on page 59 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

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

SPC-1 Tests, Test Phases, and Test Runs

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

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

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

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

Primary Metrics Test – Sustainability Test Phase

Clause 5.4.4.1.1

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

Clause 5.4.4.1.2

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

Clause 5.4.4.1.4

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

Clause 9.4.3.7.1

For the Sustainability Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

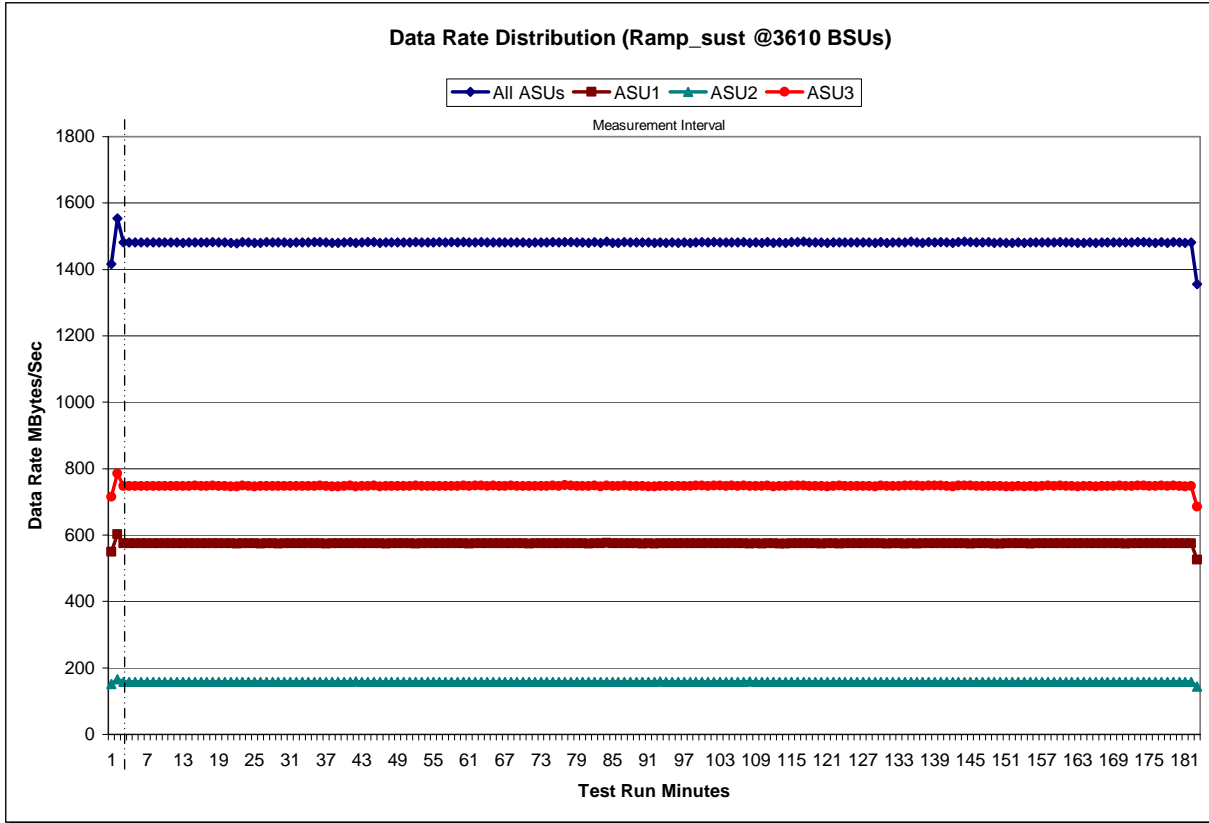
The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in “Appendix E: SPC-1 Workload Generator Input Parameters” on Page 72.

Sustainability Test Results File

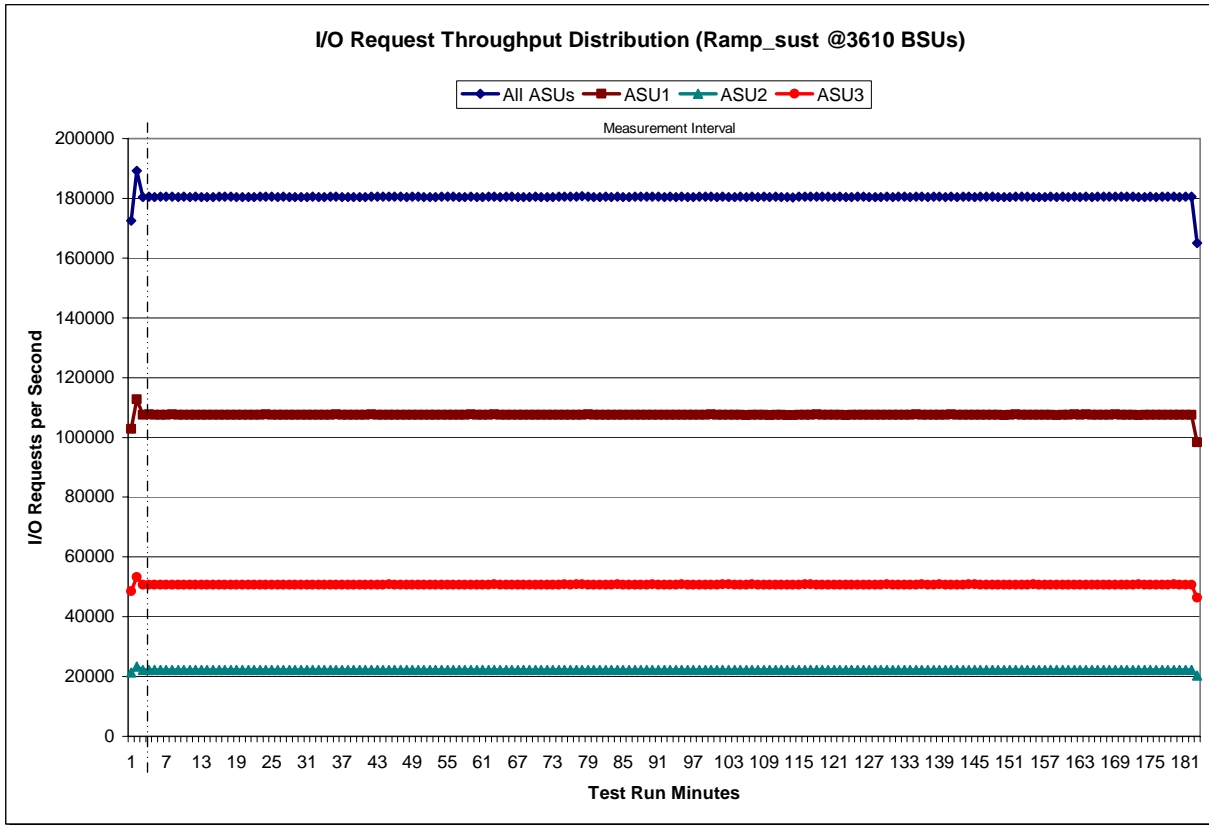
A link to the test results file generated from the Sustainability Test Run is listed below.

[Sustainability Test Results File](#)

Sustainability – Data Rate Distribution Graph



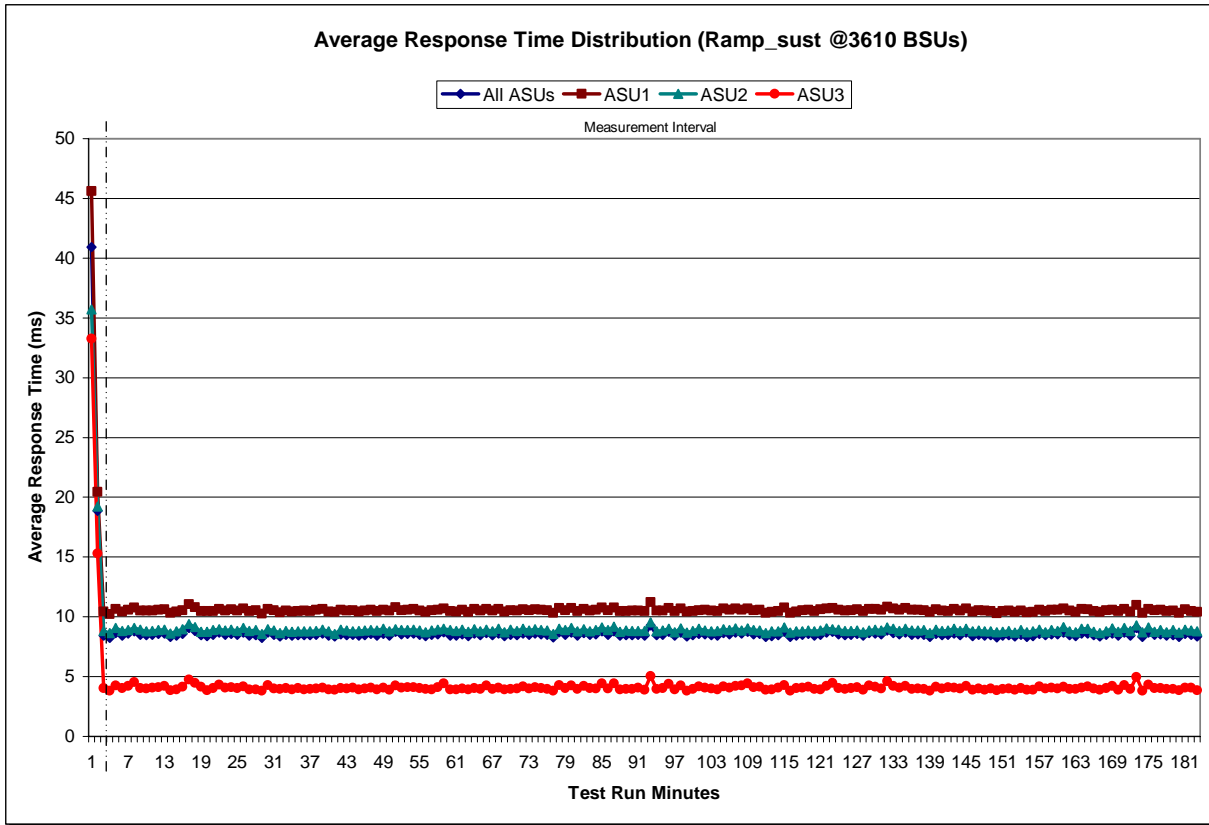
Sustainability – I/O Request Throughput Distribution Graph



Sustainability – Average Response Time (ms) Distribution Data

Ramp-Up/Start-Up Measurement Interval		Start 18:30:04	Stop 18:33:04	Interval 0-2	Duration 0:03:00															
Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3						
0	40.92	45.60	35.70	33.27	63	8.59	10.66	8.95	4.02	126	8.58	10.62	8.86	4.11						
1	18.84	20.44	19.21	15.31	64	8.45	10.51	8.77	3.94	127	8.41	10.47	8.72	3.90						
2	8.43	10.42	8.83	4.03	65	8.64	10.66	8.92	4.24	128	8.62	10.65	8.86	4.23						
3	8.24	10.23	8.64	3.83	66	8.46	10.51	8.79	3.95	129	8.61	10.65	8.94	4.12						
4	8.65	10.65	9.07	4.25	67	8.61	10.66	8.99	4.09	130	8.52	10.58	8.85	4.00						
5	8.43	10.43	8.83	4.03	68	8.40	10.44	8.72	3.94	131	8.87	10.83	9.10	4.61						
6	8.59	10.59	8.89	4.23	69	8.50	10.55	8.94	3.98	132	8.65	10.67	8.99	4.23						
7	8.80	10.75	9.05	4.54	70	8.46	10.50	8.83	3.98	133	8.53	10.58	8.83	4.06						
8	8.51	10.52	8.93	4.05	71	8.62	10.64	8.99	4.18	134	8.67	10.71	8.98	4.20						
9	8.47	10.52	8.77	3.98	72	8.49	10.53	8.84	4.01	135	8.51	10.59	8.85	3.95						
10	8.49	10.52	8.81	4.05	73	8.59	10.63	8.96	4.10	136	8.52	10.60	8.85	3.98						
11	8.57	10.60	8.91	4.11	74	8.53	10.59	8.87	4.02	137	8.48	10.53	8.88	3.96						
12	8.62	10.63	8.93	4.21	75	8.48	10.54	8.87	3.95	138	8.33	10.40	8.65	3.81						
13	8.31	10.35	8.62	3.87	76	8.29	10.34	8.57	3.82	139	8.58	10.61	8.94	4.13						
14	8.42	10.46	8.80	3.93	77	8.69	10.71	9.00	4.28	140	8.47	10.50	8.82	4.01						
15	8.55	10.55	8.95	4.14	78	8.51	10.53	8.89	4.04	141	8.49	10.48	8.84	4.10						
16	9.08	11.06	9.39	4.74	79	8.69	10.72	9.06	4.24	142	8.60	10.65	8.99	4.08						
17	8.81	10.78	9.13	4.48	80	8.43	10.46	8.77	3.95	143	8.46	10.50	8.83	3.98						
18	8.47	10.47	8.75	4.13	81	8.63	10.65	8.95	4.20	144	8.66	10.69	9.01	4.22						
19	8.40	10.46	8.75	3.87	82	8.48	10.51	8.77	4.03	145	8.40	10.45	8.79	3.87						
20	8.48	10.49	8.89	4.03	83	8.52	10.58	8.90	4.00	146	8.51	10.56	8.86	4.00						
21	8.67	10.66	8.97	4.31	84	8.78	10.77	9.11	4.42	147	8.44	10.51	8.80	3.88						
22	8.50	10.51	8.85	4.08	85	8.50	10.55	8.89	3.98	148	8.45	10.48	8.79	4.01						
23	8.58	10.62	8.91	4.10	86	8.78	10.75	9.16	4.43	149	8.29	10.31	8.71	3.84						
24	8.49	10.53	8.82	4.03	87	8.43	10.48	8.73	3.94	150	8.44	10.49	8.74	3.95						
25	8.66	10.70	9.06	4.16	88	8.45	10.48	8.87	3.96	151	8.48	10.52	8.81	4.00						
26	8.43	10.48	8.84	3.92	89	8.46	10.51	8.82	3.97	152	8.36	10.40	8.67	3.90						
27	8.47	10.53	8.87	3.93	90	8.49	10.52	8.81	4.05	153	8.49	10.50	8.89	4.04						
28	8.26	10.28	8.58	3.83	91	8.43	10.47	8.83	3.90	154	8.33	10.35	8.70	3.89						
29	8.66	10.65	8.96	4.29	92	9.27	11.22	9.53	5.04	155	8.38	10.41	8.78	3.87						
30	8.50	10.55	8.86	3.99	93	8.46	10.52	8.80	3.94	156	8.58	10.59	8.92	4.17						
31	8.36	10.38	8.63	3.97	94	8.48	10.50	8.86	4.03	157	8.44	10.49	8.73	3.98						
32	8.48	10.51	8.83	4.04	95	8.74	10.74	8.99	4.39	158	8.54	10.58	8.88	4.06						
33	8.41	10.45	8.74	3.94	96	8.41	10.47	8.70	3.94	159	8.52	10.59	8.83	3.98						
34	8.46	10.48	8.79	4.03	97	8.68	10.70	9.02	4.24	160	8.66	10.70	9.16	4.14						
35	8.45	10.51	8.79	3.93	98	8.35	10.42	8.66	3.82	161	8.46	10.51	8.78	3.95						
36	8.44	10.49	8.78	3.97	99	8.45	10.49	8.83	3.96	162	8.39	10.41	8.73	3.95						
37	8.51	10.58	8.84	3.99	100	8.57	10.56	8.98	4.17	163	8.60	10.64	9.00	4.07						
38	8.59	10.65	8.91	4.05	101	8.54	10.59	8.84	4.05	164	8.61	10.61	9.01	4.18						
39	8.41	10.43	8.80	3.93	102	8.46	10.51	8.78	3.98	165	8.45	10.48	8.76	4.00						
40	8.34	10.40	8.59	3.87	103	8.43	10.48	8.81	3.93	166	8.36	10.41	8.65	3.87						
41	8.54	10.58	8.91	4.03	104	8.64	10.68	8.97	4.16	167	8.51	10.56	8.79	4.03						
42	8.47	10.51	8.87	3.99	105	8.54	10.58	8.87	4.09	168	8.61	10.60	9.05	4.21						
43	8.51	10.54	8.77	4.08	106	8.67	10.69	9.03	4.22	169	8.42	10.48	8.76	3.90						
44	8.42	10.45	8.82	3.93	107	8.60	10.60	8.87	4.24	170	8.66	10.64	9.06	4.29						
45	8.47	10.51	8.86	3.99	108	8.73	10.70	9.04	4.43	171	8.43	10.45	8.80	3.98						
46	8.55	10.59	8.91	4.07	109	8.54	10.55	8.91	4.12	172	9.08	10.98	9.28	4.96						
47	8.43	10.46	8.84	3.94	110	8.56	10.59	8.84	4.12	173	8.30	10.33	8.71	3.82						
48	8.57	10.59	9.01	4.08	111	8.33	10.34	8.65	3.90	174	8.68	10.66	9.10	4.32						
49	8.43	10.50	8.78	3.90	112	8.37	10.39	8.77	3.94	175	8.50	10.56	8.75	4.02						
50	8.73	10.80	8.97	4.24	113	8.48	10.49	8.78	4.07	176	8.53	10.58	8.89	4.03						
51	8.54	10.56	8.88	4.08	114	8.75	10.77	9.12	4.28	177	8.42	10.46	8.70	3.97						
52	8.55	10.58	8.88	4.10	115	8.30	10.34	8.67	3.82	178	8.48	10.52	8.90	3.97						
53	8.59	10.64	8.92	4.10	116	8.44	10.45	8.77	4.03	179	8.30	10.32	8.69	3.86						
54	8.48	10.51	8.84	4.02	117	8.51	10.55	8.79	4.06	180	8.57	10.61	8.94	4.08						
55	8.39	10.41	8.72	3.94	118	8.57	10.60	8.85	4.13	181	8.48	10.49	8.84	4.07						
56	8.48	10.55	8.84	3.94	119	8.43	10.47	8.79	3.94	182	8.36	10.40	8.78	3.84						
57	8.54	10.57	8.91	4.09	120	8.51	10.61	8.84	3.92	Average	8.52	10.55	8.87	4.06						
58	8.72	10.69	8.99	4.42	121	8.67	10.70	9.03	4.21											
59	8.43	10.46	8.87	3.93	122	8.75	10.73	8.96	4.45											
60	8.42	10.46	8.81	3.94	123	8.54	10.58	8.93	4.05											
61	8.53	10.59	8.91	3.99	124	8.47	10.51	8.83	3.96											
62	8.38	10.41	8.76	3.92	125	8.49	10.53	8.82	4.03											

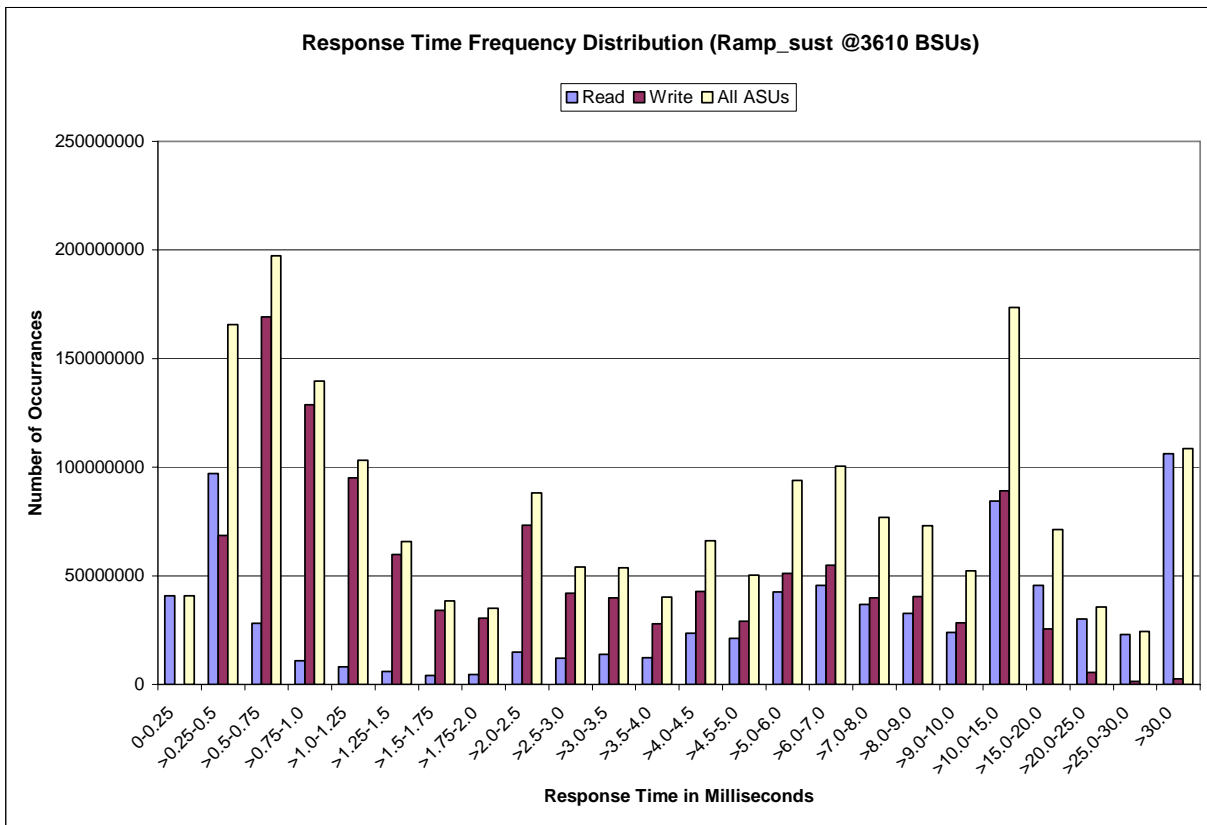
Sustainability – Average Response Time (ms) Distribution Graph



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	40,836,601	97,066,183	28,112,279	10,826,680	8,037,551	5,903,500	4,201,811	4,510,236
Write	22	68,493,299	169,195,521	128,855,015	95,159,807	59,899,510	34,139,206	30,557,192
All ASUs	40,836,623	165,559,482	197,307,800	139,681,695	103,197,358	65,803,010	38,341,017	35,067,428
ASU1	29,514,520	103,290,001	97,779,849	62,310,605	44,333,812	28,758,124	17,372,222	16,324,642
ASU2	11,322,098	36,024,071	26,382,001	15,864,293	11,300,388	7,347,462	4,342,171	3,953,678
ASU3	5	26,245,410	73,145,950	61,506,797	47,563,158	29,697,424	16,626,624	14,789,108
Response Time (ms)	>2.0-2.5	>2.5-3.0	>3.0-3.5	>3.5-4.0	>4.0-4.5	>4.5-5.0	>5.0-6.0	>6.0-7.0
Read	14,880,407	12,181,639	13,866,873	12,332,219	23,540,665	21,131,195	42,630,419	45,582,894
Write	73,261,298	41,931,152	39,838,509	27,943,890	42,698,928	29,210,218	51,189,190	54,884,626
All ASUs	88,141,705	54,112,791	53,705,382	40,276,109	66,239,593	50,341,413	93,819,609	100,467,520
ASU1	43,412,218	28,634,629	29,605,460	23,331,004	40,389,672	32,310,497	61,468,787	64,577,697
ASU2	9,674,523	5,719,275	5,487,251	3,925,060	5,968,775	4,425,988	8,529,495	10,369,145
ASU3	35,054,964	19,758,887	18,612,671	13,020,045	19,881,146	13,604,928	23,821,327	25,520,678
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	36,927,793	32,639,862	24,040,128	84,348,961	45,650,843	30,103,114	22,914,221	106,167,110
Write	39,860,360	40,367,869	28,271,057	89,199,766	25,611,897	5,488,137	1,443,834	2,484,875
All ASUs	76,788,153	73,007,731	52,311,185	173,548,727	71,262,740	35,591,251	24,358,055	108,651,985
ASU1	49,995,851	45,584,889	33,024,110	112,860,686	51,658,592	29,366,117	21,323,555	94,001,494
ASU2	8,254,573	8,624,534	6,119,373	19,013,533	7,576,086	3,628,079	2,348,313	13,462,335
ASU3	18,537,729	18,798,308	13,167,702	41,674,508	12,028,062	2,597,055	686,187	1,188,156

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	0.000	0.001	0.001	0.002	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 to the Workload Generator.*
- 6. The total number of I/O Requests completed in the Measurement Interval as well as the number of I/O Requests with a Response Time less than or equal to 30 milliseconds and the number of I/O Requests with a Response Time greater than 30 milliseconds.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in “Appendix E: SPC-1 Workload Generator Input Parameters” on Page 72.

IOPS Test Results File

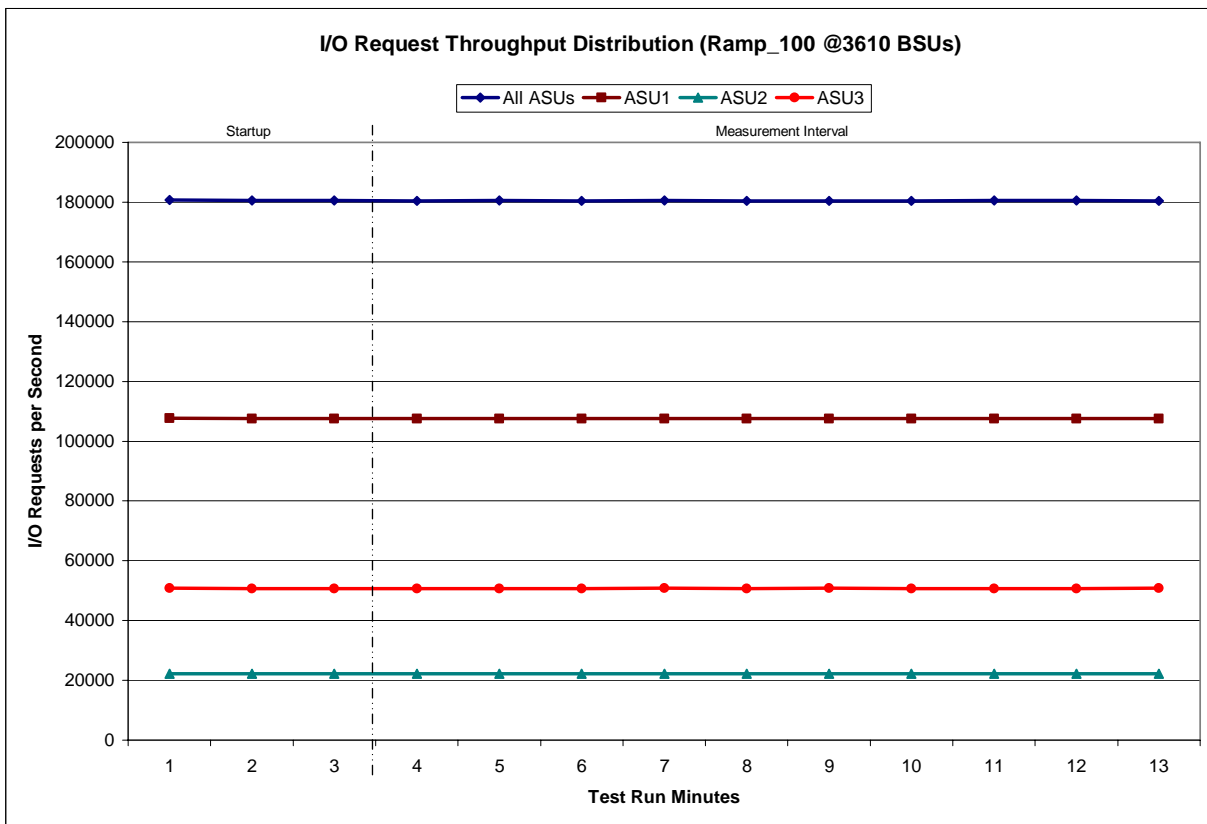
A link to the test results file generated from the IOPS Test Run is listed below.

[IOPS Test Results File](#)

IOPS Test Run – I/O Request Throughput Distribution Data

3610 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	21:34:50	21:37:51	0-2	0:03:01
<i>Measurement Interval</i>	21:37:51	21:47:51	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	180,646.33	107,661.22	22,225.77	50,759.35
1	180,506.97	107,556.35	22,209.02	50,741.60
2	180,503.10	107,600.08	22,199.95	50,703.07
3	180,369.52	107,534.98	22,200.85	50,633.68
4	180,561.80	107,614.62	22,202.08	50,745.10
5	180,470.30	107,548.88	22,193.08	50,728.33
6	180,560.85	107,586.08	22,208.17	50,766.60
7	180,456.02	107,560.68	22,196.05	50,699.28
8	180,481.08	107,569.58	22,147.77	50,763.73
9	180,423.43	107,558.08	22,206.83	50,658.52
10	180,582.55	107,606.18	22,220.75	50,755.62
11	180,510.42	107,611.58	22,196.42	50,702.42
12	180,469.33	107,535.62	22,173.20	50,760.52
Average	180,488.53	107,572.63	22,194.52	50,721.38

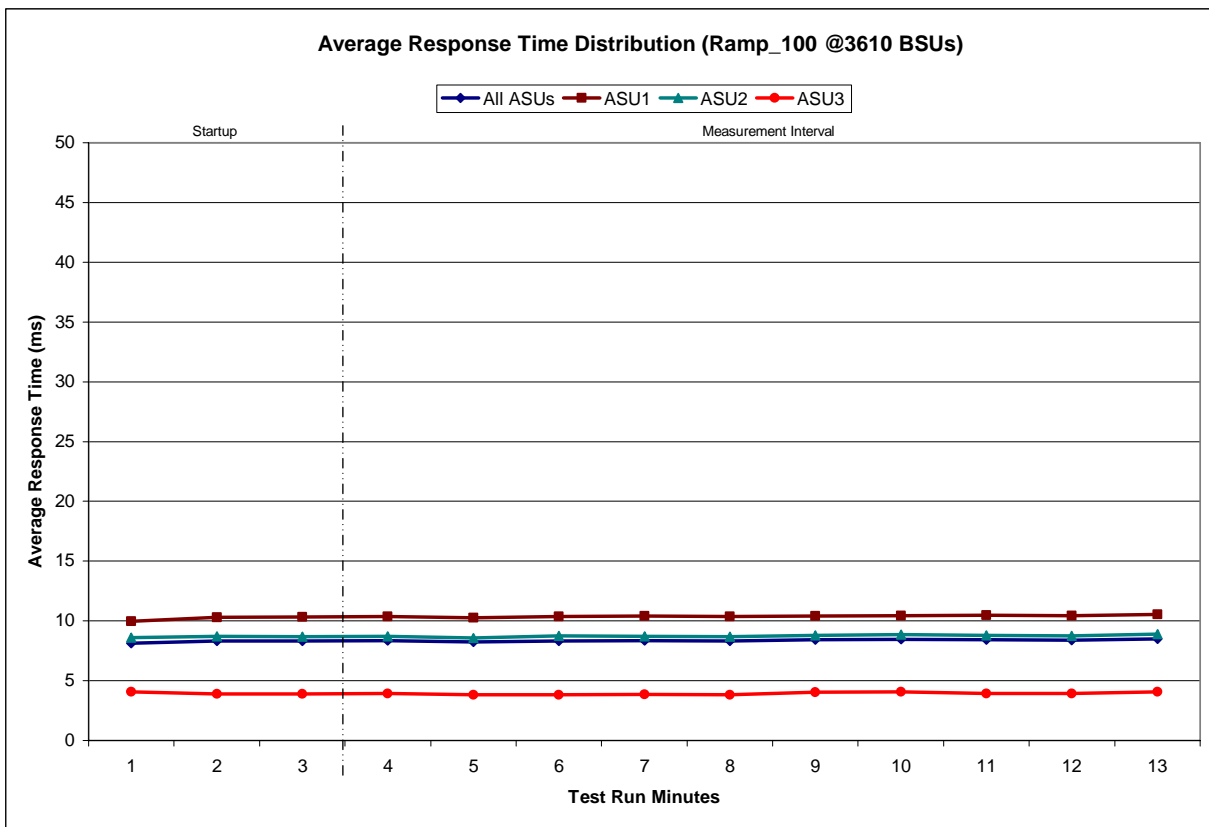
IOPS Test Run – I/O Request Throughput Distribution Graph



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

3610 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	21:34:50	21:37:51	0-2	0:03:01
<i>Measurement Interval</i>	21:37:51	21:47:51	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	8.15	9.98	8.62	4.06
1	8.30	10.30	8.70	3.89
2	8.31	10.32	8.66	3.87
3	8.35	10.36	8.70	3.92
4	8.25	10.27	8.56	3.82
5	8.33	10.37	8.74	3.83
6	8.36	10.41	8.72	3.86
7	8.32	10.36	8.68	3.83
8	8.41	10.41	8.77	4.02
9	8.45	10.44	8.85	4.05
10	8.43	10.47	8.79	3.93
11	8.40	10.43	8.75	3.93
12	8.51	10.54	8.89	4.05
<i>Average</i>	8.38	10.41	8.75	3.92

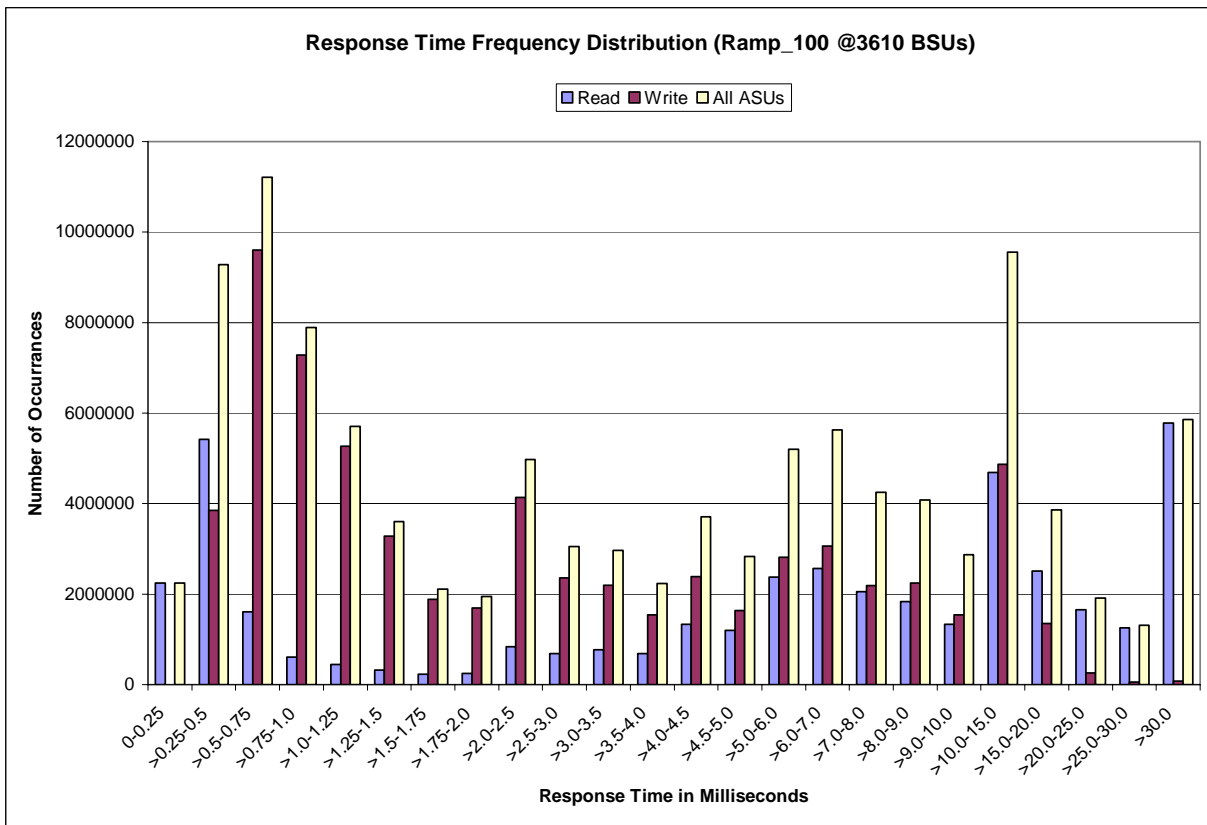
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	2,248,187	5,422,646	1,610,030	612,572	443,938	323,244	230,027	249,282
Write	1	3,855,579	9,604,990	7,280,257	5,265,362	3,285,180	1,880,709	1,696,689
All ASUs	2,248,188	9,278,225	11,215,020	7,892,829	5,709,300	3,608,424	2,110,736	1,945,971
ASU1	1,626,296	5,782,573	5,557,651	3,515,744	2,448,079	1,575,963	955,968	906,709
ASU2	621,891	2,014,734	1,497,787	894,830	623,842	401,776	239,165	218,542
ASU3	1	1,480,918	4,159,582	3,482,255	2,637,379	1,630,685	915,603	820,720
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	834,895	688,752	770,397	687,172	1,328,399	1,196,960	2,379,974	2,570,481
Write	4,134,288	2,360,628	2,198,591	1,543,940	2,384,650	1,633,343	2,817,965	3,061,556
All ASUs	4,969,183	3,049,380	2,968,988	2,231,112	3,713,049	2,830,303	5,197,939	5,632,037
ASU1	2,447,068	1,615,423	1,639,390	1,295,890	2,270,528	1,823,375	3,415,334	3,628,018
ASU2	544,043	321,376	302,956	216,770	333,437	247,381	472,298	580,518
ASU3	1,978,072	1,112,581	1,026,642	718,452	1,109,084	759,547	1,310,307	1,423,501
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	2,056,966	1,834,720	1,331,953	4,686,648	2,513,253	1,650,978	1,257,602	5,780,966
Write	2,190,163	2,239,909	1,536,844	4,866,420	1,350,874	260,662	55,016	78,105
All ASUs	4,247,129	4,074,629	2,868,797	9,553,068	3,864,127	1,911,640	1,312,618	5,859,071
ASU1	2,774,825	2,549,574	1,817,259	6,228,761	2,818,793	1,593,572	1,160,703	5,095,098
ASU2	456,236	481,791	336,153	1,050,316	412,257	195,476	125,902	727,069
ASU3	1,016,068	1,043,264	715,385	2,273,991	633,077	122,592	26,013	36,904

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
108,291,763	102,432,692	5,859,071

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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

Clauses 5.1.10 and 5.3.13.2

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

Clause 5.3.13.3

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

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

Primary Metrics Test – Response Time Ramp Test Phase

Clause 5.4.4.3

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

The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 13.

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

Clause 9.4.3.7.3

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

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in “Appendix E: SPC-1 Workload Generator Input Parameters” on Page 72.

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](#)

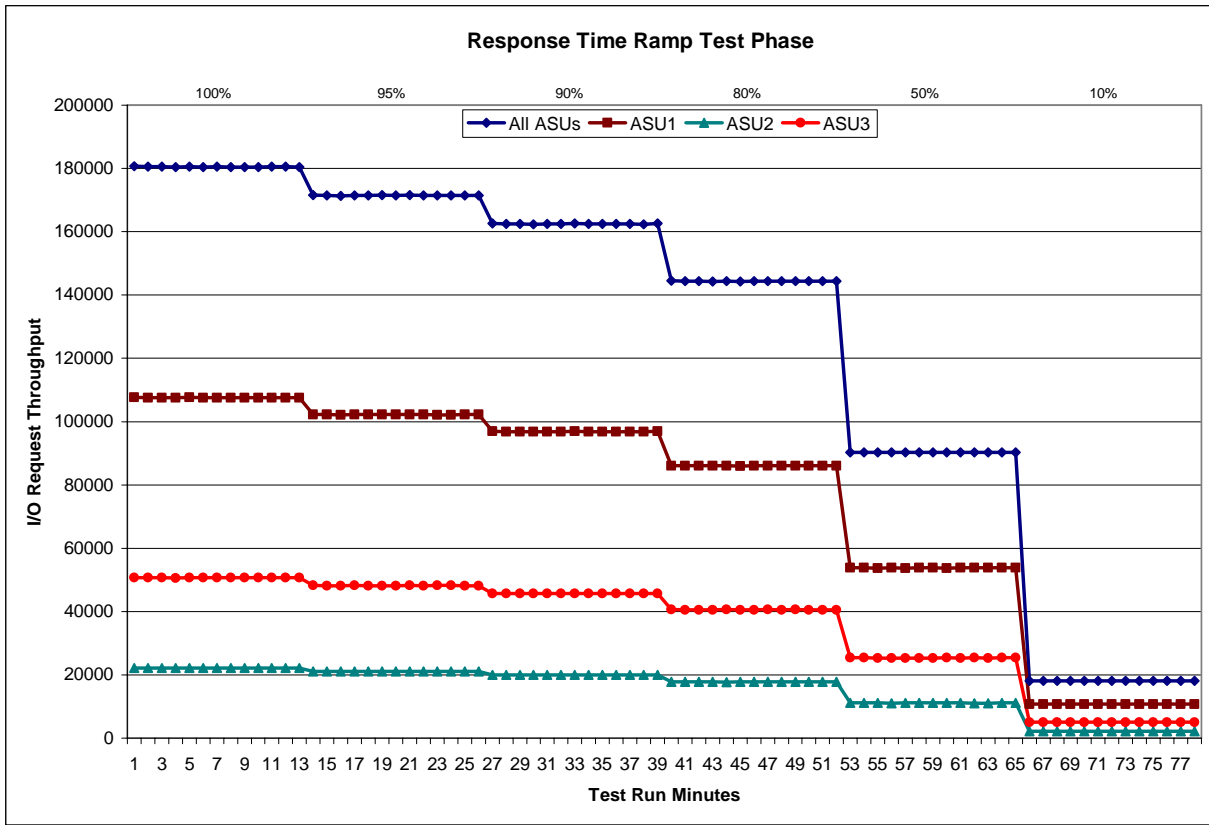
[10% Load Level](#)

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 - 3610 BSUs					95% Load Level - 3429 BSUs				
Start-Up/Ramp-Up	Start	Stop	Interval	Duration	Start-Up/Ramp-Up	Start	Stop	Interval	Duration
Measurement Interval	21:34:50	21:37:51	0-2	0:03:01	Measurement Interval	21:49:31	21:52:32	0-2	0:03:01
(60 second intervals)	21:37:51	21:47:51	3-12	0:10:00	Measurement Interval	21:52:32	22:02:32	3-12	0:10:00
	All ASUs	ASU-1	ASU-2	ASU-3		All ASUs	ASU-1	ASU-2	ASU-3
0	180,646.33	107,661.22	22,225.77	50,759.35	0	171,589.78	102,296.82	21,089.35	48,203.62
1	180,506.97	107,556.35	22,209.02	50,741.60	1	171,493.90	102,223.77	21,078.98	48,191.15
2	180,503.10	107,600.08	22,199.95	50,703.07	2	171,361.40	102,107.27	21,092.13	48,162.00
3	180,369.52	107,534.98	22,200.85	50,633.68	3	171,487.72	102,198.55	21,082.17	48,207.00
4	180,561.80	107,614.62	22,202.08	50,745.10	4	171,469.05	102,206.43	21,074.52	48,188.10
5	180,470.30	107,548.88	22,193.08	50,728.33	5	171,526.88	102,225.53	21,110.67	48,190.68
6	180,560.85	107,586.08	22,208.17	50,766.60	6	171,425.53	102,196.23	21,080.23	48,149.07
7	180,456.02	107,560.68	22,196.05	50,699.28	7	171,530.52	102,230.10	21,094.82	48,205.60
8	180,481.08	107,569.58	22,147.77	50,763.73	8	171,440.95	102,212.88	21,066.50	48,161.57
9	180,423.43	107,558.08	22,206.83	50,658.52	9	171,462.50	102,161.00	21,089.52	48,211.98
10	180,582.55	107,606.18	22,220.75	50,755.62	10	171,509.00	102,159.60	21,130.47	48,218.93
11	180,510.42	107,611.58	22,196.42	50,702.42	11	171,444.45	102,178.80	21,083.53	48,182.12
12	180,469.33	107,535.62	22,173.20	50,760.52	12	171,460.30	102,225.17	21,060.20	48,174.93
Average	180,488.53	107,572.63	22,194.52	50,721.38	Average	171,475.69	102,199.43	21,087.26	48,189.00
90% Load Level - 3249 BSUs					80% Load Level - 2888 BSUs				
Start-Up/Ramp-Up	Start	Stop	Interval	Duration	Start-Up/Ramp-Up	Start	Stop	Interval	Duration
Measurement Interval	22:04:10	22:07:11	0-2	0:03:01	Measurement Interval	22:18:50	22:21:51	0-2	0:03:01
(60 second intervals)	22:07:11	22:17:11	3-12	0:10:00	Measurement Interval	22:21:51	22:31:51	3-12	0:10:00
	All ASUs	ASU-1	ASU-2	ASU-3		All ASUs	ASU-1	ASU-2	ASU-3
0	162,618.77	96,908.02	20,009.53	45,701.22	0	144,498.15	86,123.77	17,776.60	40,597.78
1	162,485.55	96,795.47	20,000.72	45,689.37	1	144,362.90	86,040.62	17,773.40	40,548.88
2	162,450.83	96,843.98	19,970.57	45,636.28	2	144,412.83	86,072.33	17,779.83	40,560.67
3	162,405.08	96,761.85	19,990.48	45,652.75	3	144,312.87	86,027.75	17,746.45	40,538.67
4	162,414.53	96,793.30	19,991.60	45,629.63	4	144,392.95	86,058.90	17,738.07	40,595.98
5	162,432.15	96,827.12	19,977.20	45,627.83	5	144,318.63	85,982.17	17,754.52	40,581.95
6	162,565.13	96,894.00	19,989.83	45,681.30	6	144,380.83	86,053.25	17,749.30	40,578.28
7	162,442.65	96,816.50	19,978.53	45,647.62	7	144,433.43	86,040.00	17,799.88	40,593.55
8	162,472.27	96,832.25	19,977.70	45,662.32	8	144,418.73	86,066.28	17,780.83	40,571.62
9	162,462.18	96,835.95	19,982.65	45,643.58	9	144,442.28	86,097.58	17,758.82	40,585.88
10	162,447.22	96,823.95	19,978.02	45,645.25	10	144,412.17	86,043.77	17,808.77	40,559.63
11	162,386.95	96,806.60	19,954.60	45,625.75	11	144,341.03	86,053.43	17,745.88	40,541.72
12	162,543.60	96,882.37	20,016.78	45,644.45	12	144,400.43	86,085.78	17,759.37	40,555.28
Average	162,457.18	96,827.39	19,983.74	45,646.05	Average	144,385.34	86,050.89	17,764.19	40,570.26
50% Load Level - 1805 BSUs					10% Load Level - 361 BSUs				
Start-Up/Ramp-Up	Start	Stop	Interval	Duration	Start-Up/Ramp-Up	Start	Stop	Interval	Duration
Measurement Interval	22:33:26	22:36:27	0-2	0:03:01	Measurement Interval	22:48:00	22:51:01	0-2	0:03:01
(60 second intervals)	22:36:27	22:46:27	3-12	0:10:00	Measurement Interval	22:51:01	23:01:01	3-12	0:10:00
	All ASUs	ASU-1	ASU-2	ASU-3		All ASUs	ASU-1	ASU-2	ASU-3
0	90,323.70	53,826.10	11,114.73	25,382.87	0	18,047.47	10,751.78	2,219.73	5,075.95
1	90,262.12	53,790.27	11,088.08	25,383.77	1	18,055.95	10,749.25	2,212.72	5,093.98
2	90,217.62	53,748.88	11,117.83	25,350.90	2	18,063.03	10,760.00	2,230.05	5,072.98
3	90,214.38	53,780.58	11,079.85	25,353.95	3	18,040.50	10,739.32	2,226.15	5,075.03
4	90,216.55	53,764.77	11,130.42	25,321.37	4	18,042.68	10,749.18	2,217.88	5,075.62
5	90,245.00	53,792.35	11,097.17	25,355.48	5	18,057.13	10,766.08	2,219.02	5,072.03
6	90,257.05	53,787.22	11,117.72	25,352.12	6	18,028.78	10,754.52	2,214.65	5,059.62
7	90,263.37	53,766.52	11,109.22	25,387.63	7	18,038.02	10,767.63	2,216.08	5,054.30
8	90,231.32	53,817.80	11,085.38	25,328.13	8	18,039.47	10,753.12	2,221.45	5,064.90
9	90,253.60	53,811.78	11,080.25	25,361.57	9	18,069.52	10,773.38	2,219.72	5,076.42
10	90,222.58	53,794.87	11,080.27	25,347.45	10	18,035.82	10,754.93	2,229.32	5,051.57
11	90,320.85	53,828.23	11,104.65	25,387.97	11	18,084.38	10,764.82	2,223.17	5,096.40
12	90,290.35	53,807.60	11,111.63	25,371.12	12	18,058.20	10,770.57	2,214.90	5,072.73
Average	90,251.51	53,795.17	11,099.66	25,356.68	Average	18,049.45	10,759.36	2,220.23	5,069.86

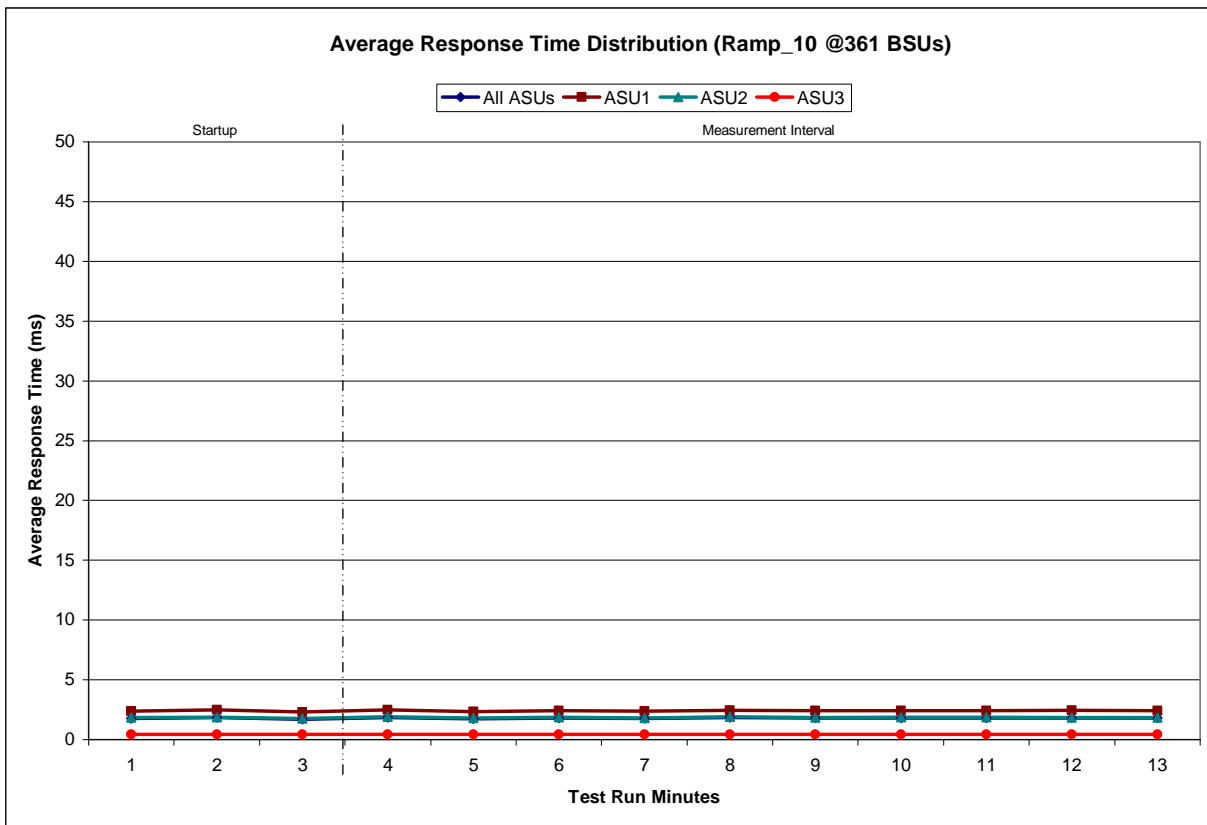
Response Time Ramp Distribution (IOPS) Graph



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

361 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	22:48:00	22:51:01	0-2	0:03:01
<i>Measurement Interval</i>	22:51:01	23:01:01	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.76	2.37	1.84	0.44
1	1.84	2.49	1.89	0.45
2	1.70	2.29	1.76	0.42
3	1.83	2.47	1.92	0.45
4	1.74	2.35	1.80	0.43
5	1.80	2.42	1.88	0.45
6	1.77	2.39	1.80	0.43
7	1.83	2.46	1.90	0.45
8	1.78	2.41	1.83	0.43
9	1.80	2.42	1.88	0.44
10	1.80	2.43	1.87	0.44
11	1.80	2.44	1.84	0.44
12	1.79	2.41	1.84	0.44
<i>Average</i>	<i>1.79</i>	<i>2.42</i>	<i>1.86</i>	<i>0.44</i>

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	0.0350	0.2810	0.0700	0.2101	0.0180	0.0701	0.0349	0.2809
COV	0.004	0.002	0.004	0.002	0.007	0.004	0.002	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 72.

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™
<i>Primary Metrics</i>	180,488.53
Repeatability Test Phase 1	180,485.19
Repeatability Test Phase 2	180,488.35

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 be greater than 95% of the reported SPC-1 IOPS™ Primary Metric.

	SPC-1 LRT™
<i>Primary Metrics</i>	1.79 ms
Repeatability Test Phase 1	1.79 ms
Repeatability Test Phase 2	1.79 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)..

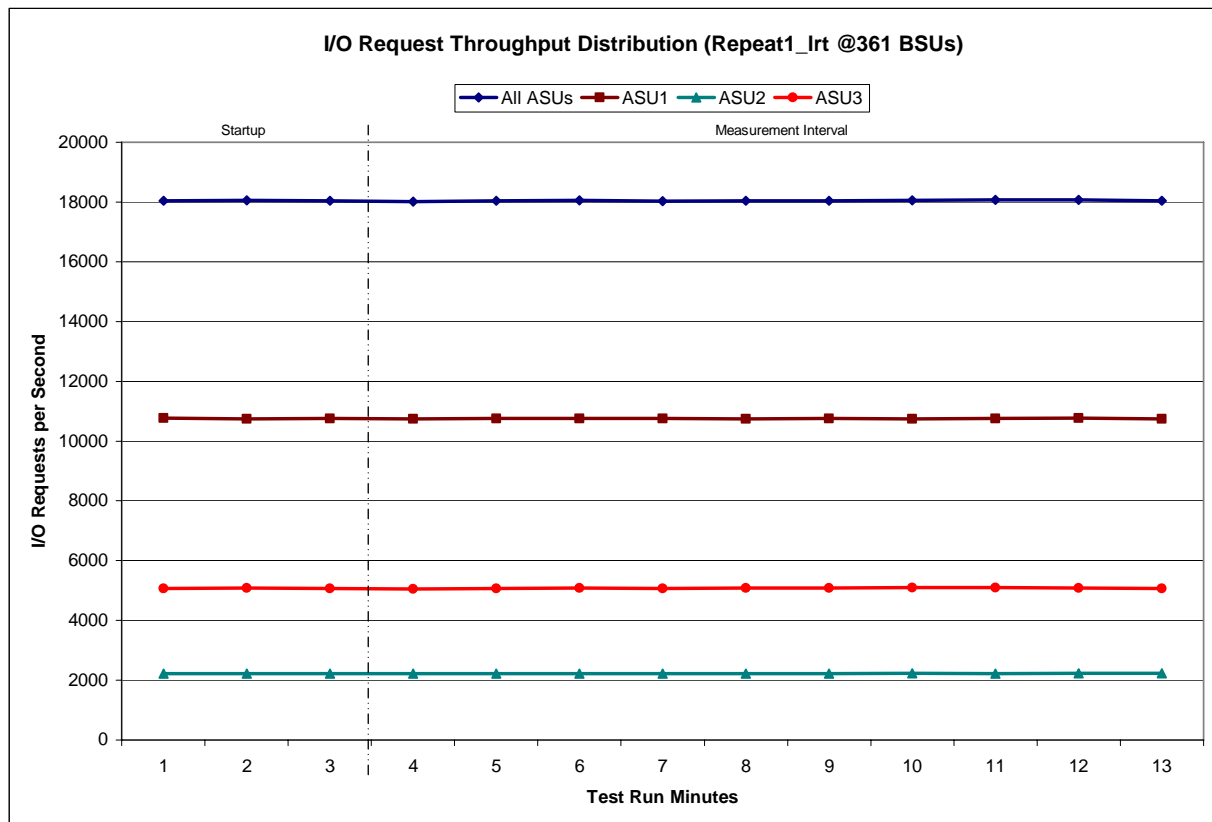
A link to the test result file generated from each Repeatability Test Run is listed below.

- [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

361 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	23:02:50	23:05:50	0-2	0:03:00
<i>Measurement Interval</i>	23:05:50	23:15:50	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	18,046.75	10,771.80	2,212.00	5,062.95
1	18,054.08	10,747.85	2,221.27	5,084.97
2	18,045.18	10,753.48	2,220.52	5,071.18
3	18,018.88	10,745.45	2,219.07	5,054.37
4	18,039.65	10,754.35	2,218.88	5,066.42
5	18,057.08	10,755.77	2,218.35	5,082.97
6	18,034.12	10,757.17	2,213.07	5,063.88
7	18,047.43	10,748.72	2,221.18	5,077.53
8	18,042.65	10,749.73	2,215.38	5,077.53
9	18,059.58	10,742.22	2,225.12	5,092.25
10	18,073.28	10,757.57	2,223.67	5,092.05
11	18,070.92	10,767.52	2,225.50	5,077.90
12	18,045.25	10,743.27	2,228.33	5,073.65
Average	18,048.89	10,752.18	2,220.86	5,075.86

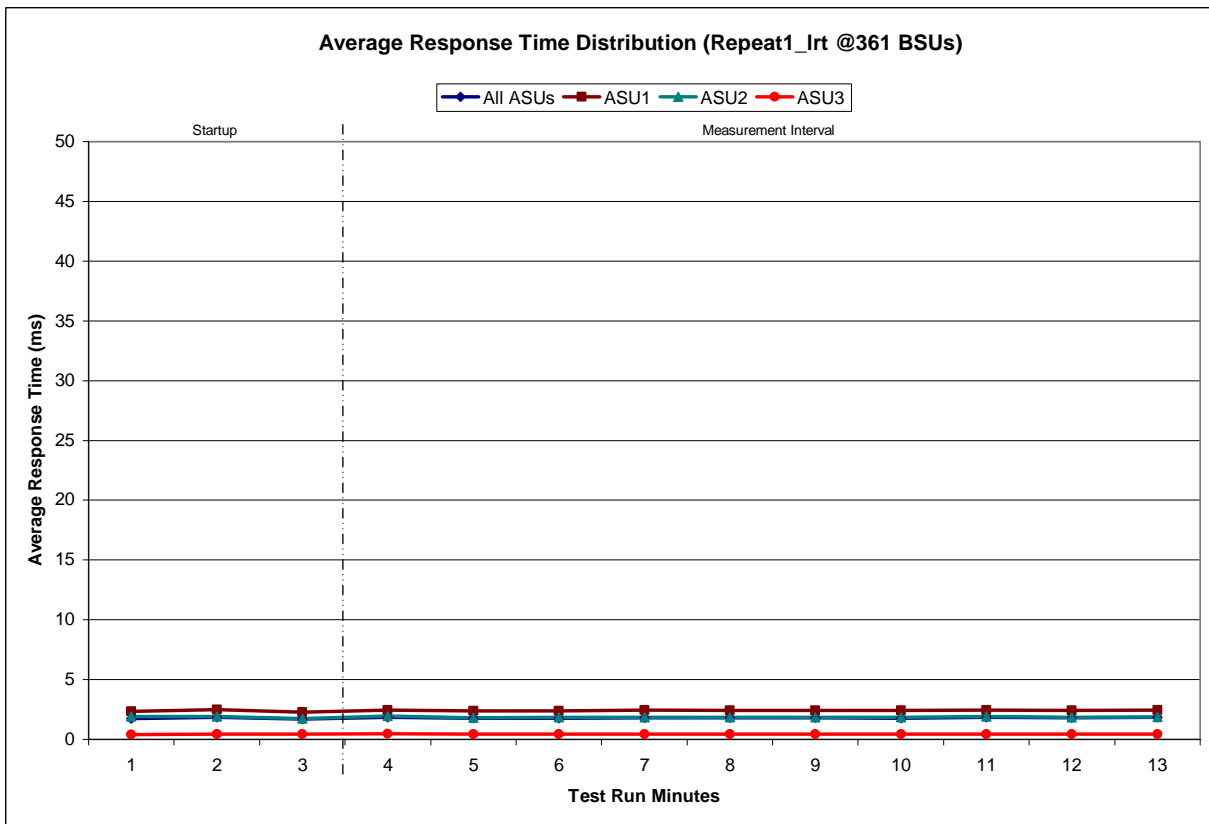
Repeatability 1 LRT - I/O Request Throughput Distribution Graph



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

361 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	23:02:50	23:05:50	0-2	0:03:00
<i>Measurement Interval</i>	23:05:50	23:15:50	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.74	2.33	1.89	0.41
1	1.84	2.48	1.92	0.45
2	1.69	2.28	1.73	0.42
3	1.84	2.46	1.95	0.45
4	1.75	2.36	1.81	0.43
5	1.76	2.36	1.85	0.44
6	1.80	2.44	1.82	0.44
7	1.79	2.41	1.85	0.44
8	1.80	2.43	1.84	0.44
9	1.78	2.40	1.83	0.44
10	1.82	2.46	1.91	0.44
11	1.78	2.41	1.84	0.44
12	1.82	2.46	1.88	0.44
<i>Average</i>	<i>1.79</i>	<i>2.42</i>	<i>1.86</i>	<i>0.44</i>

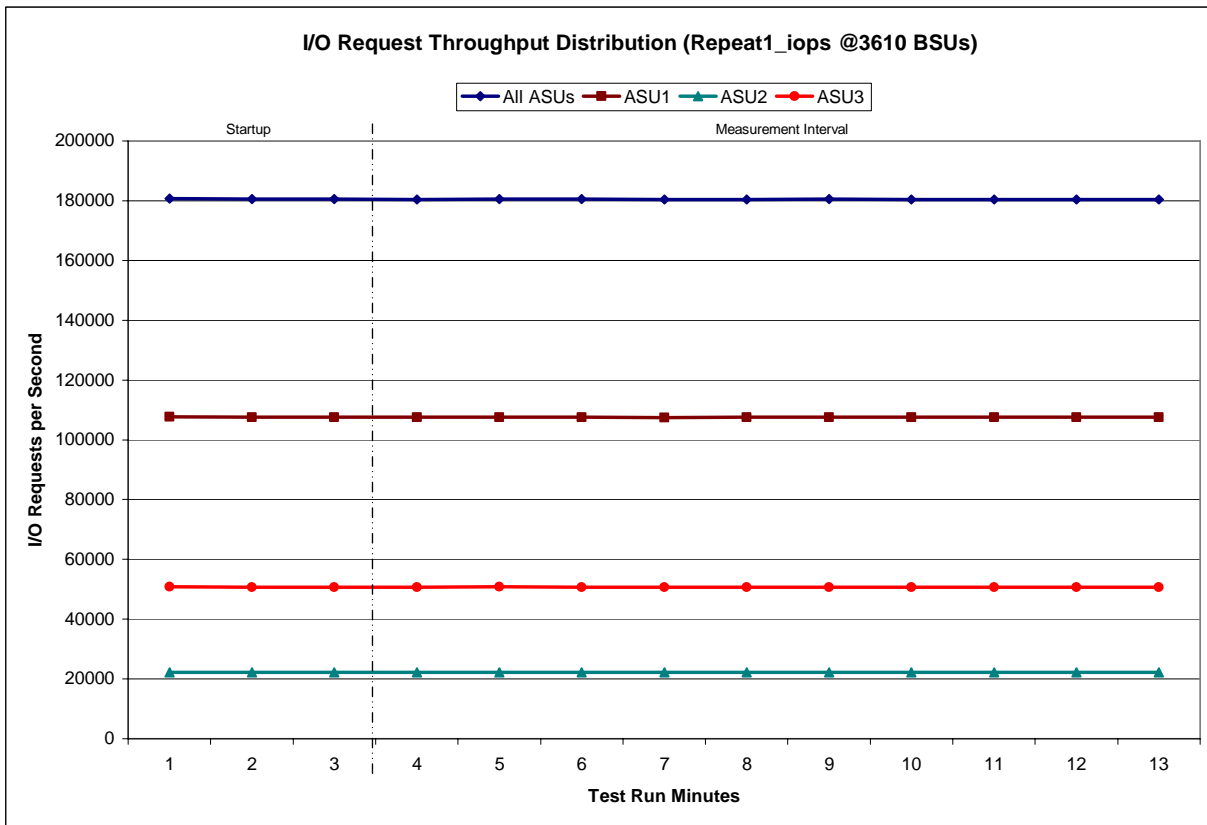
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS - I/O Request Throughput Distribution Data

3610 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	23:17:33	23:20:34	0-2	0:03:01
<i>Measurement Interval</i>	23:20:34	23:30:34	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	180,683.17	107,666.00	22,232.65	50,784.52
1	180,518.30	107,567.20	22,228.48	50,722.62
2	180,493.00	107,551.80	22,216.25	50,724.95
3	180,480.35	107,514.25	22,220.62	50,745.48
4	180,528.03	107,561.82	22,207.07	50,759.15
5	180,546.35	107,593.82	22,210.13	50,742.40
6	180,425.80	107,483.80	22,231.30	50,710.70
7	180,426.88	107,574.27	22,187.17	50,665.45
8	180,558.97	107,587.12	22,226.50	50,745.35
9	180,473.98	107,539.95	22,222.52	50,711.52
10	180,458.15	107,506.53	22,212.50	50,739.12
11	180,482.92	107,611.75	22,194.80	50,676.37
12	180,470.50	107,524.75	22,207.15	50,738.60
<i>Average</i>	<i>180,485.19</i>	<i>107,549.81</i>	<i>22,211.98</i>	<i>50,723.41</i>

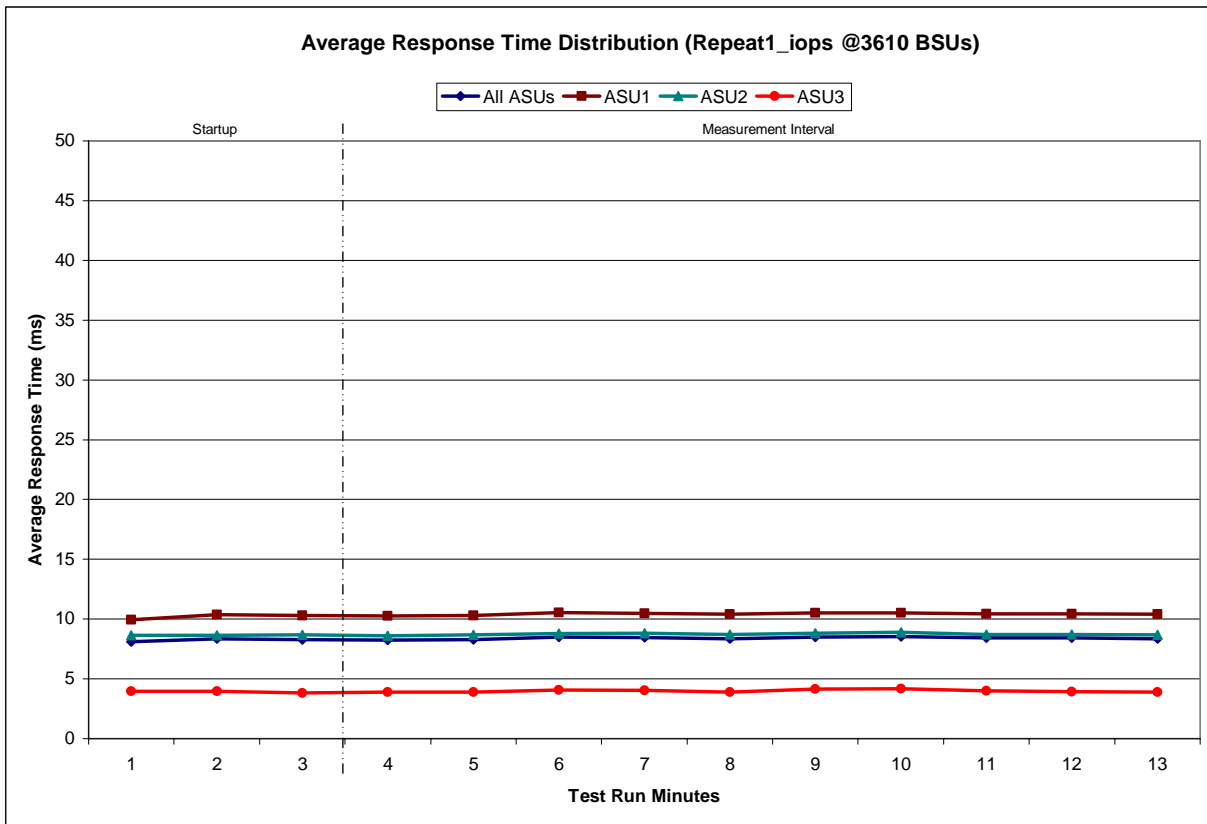
Repeatability 1 IOPS - I/O Request Throughput Distribution Graph



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

3610 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:17:33	23:20:34	0-2	0:03:01
Measurement Interval	23:20:34	23:30:34	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	8.10	9.93	8.65	3.97
1	8.37	10.38	8.64	3.98
2	8.28	10.30	8.69	3.82
3	8.25	10.25	8.60	3.87
4	8.29	10.29	8.67	3.87
5	8.50	10.53	8.80	4.07
6	8.46	10.48	8.82	4.03
7	8.37	10.40	8.73	3.88
8	8.51	10.51	8.83	4.13
9	8.53	10.51	8.88	4.16
10	8.42	10.45	8.70	3.98
11	8.41	10.45	8.73	3.92
12	8.36	10.41	8.68	3.87
Average	8.41	10.43	8.74	3.98

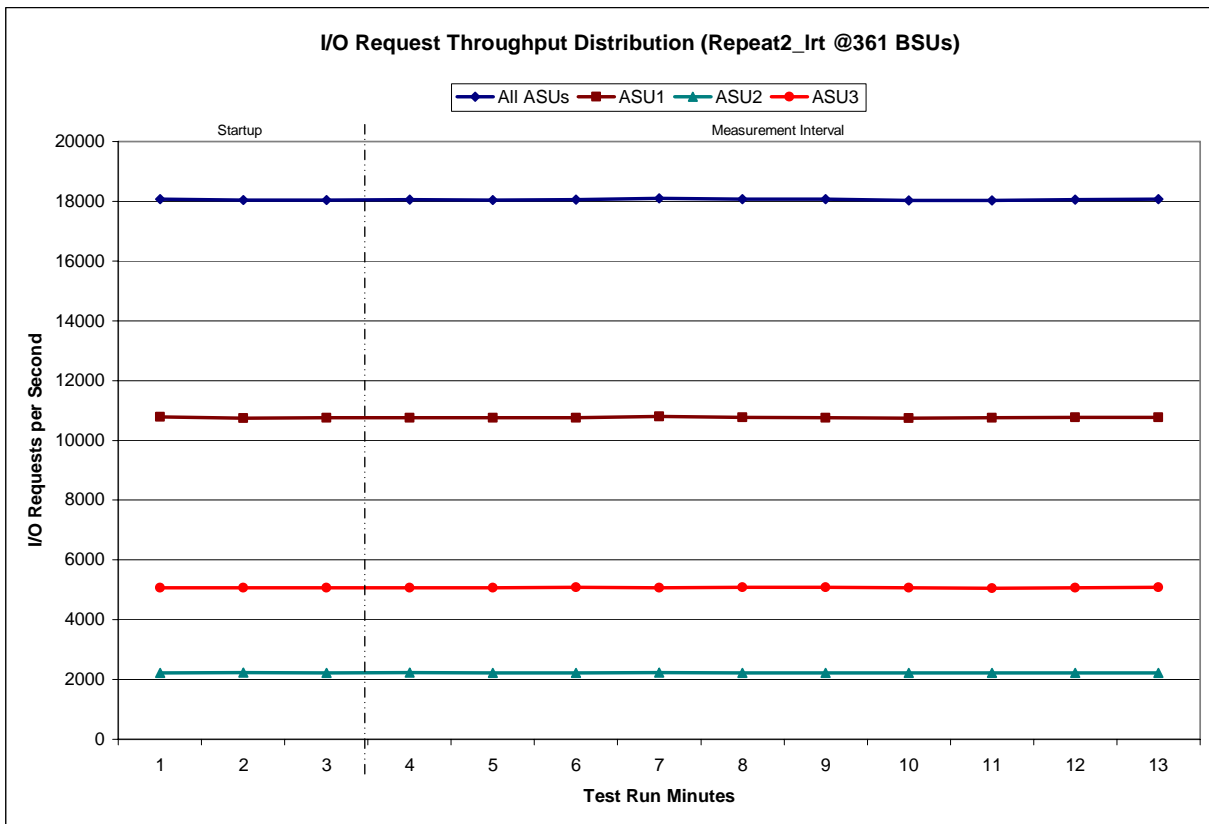
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

361 BSUs Start-Up/Ramp-Up Measurement Interval	Start	Stop	Interval	Duration
	23:32:20	23:35:20	0-2	0:03:00
	23:35:20	23:45:20	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	18,070.50	10,781.53	2,218.97	5,070.00
1	18,040.02	10,742.63	2,231.68	5,065.70
2	18,035.00	10,752.12	2,217.18	5,065.70
3	18,059.57	10,750.72	2,236.73	5,072.12
4	18,046.60	10,759.52	2,217.03	5,070.05
5	18,055.08	10,750.60	2,217.88	5,086.60
6	18,096.47	10,799.80	2,230.67	5,066.00
7	18,071.77	10,769.63	2,221.75	5,080.38
8	18,065.62	10,756.73	2,220.52	5,088.37
9	18,020.93	10,739.55	2,218.42	5,062.97
10	18,026.33	10,754.83	2,214.35	5,057.15
11	18,057.02	10,769.33	2,218.18	5,069.50
12	18,070.67	10,773.70	2,219.12	5,077.85
Average	18,057.01	10,762.44	2,221.47	5,073.10

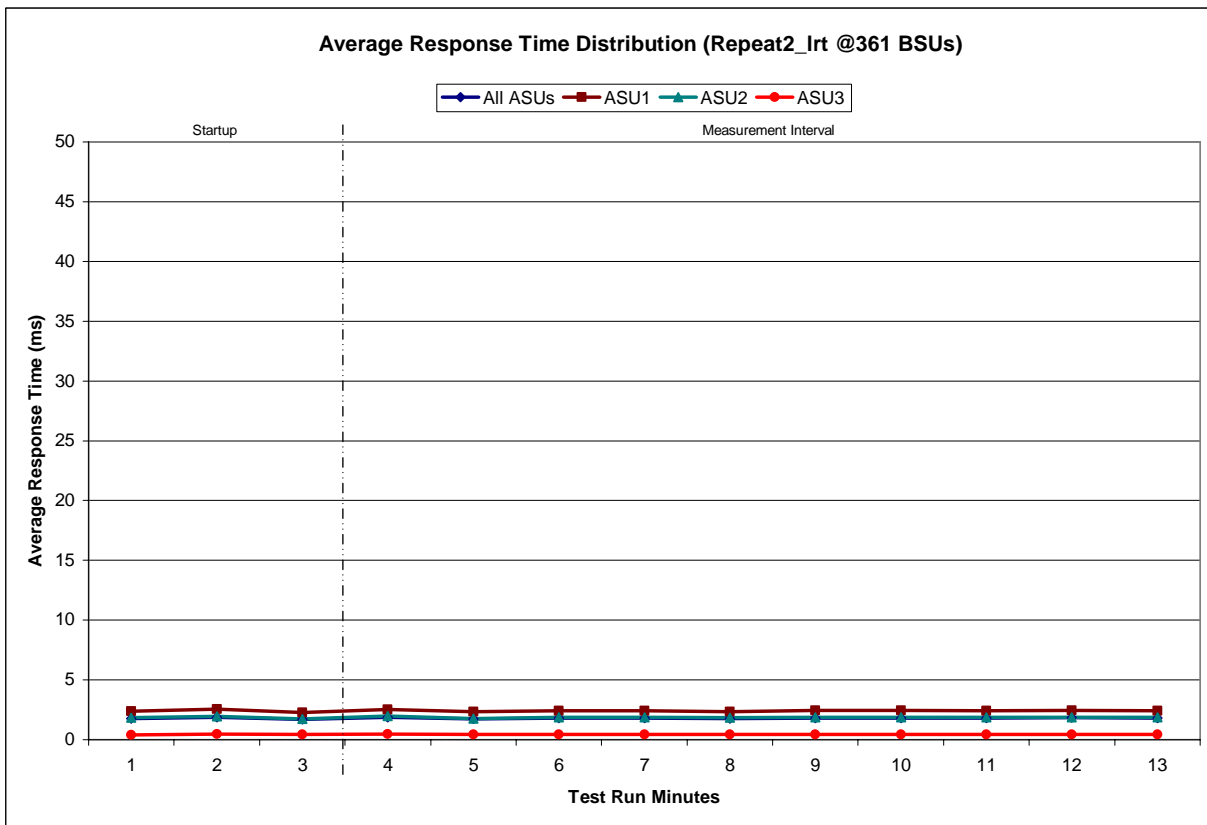
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

361 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	23:32:20	23:35:20	0-2	0:03:00
<i>Measurement Interval</i>	23:35:20	23:45:20	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.75	2.37	1.83	0.39
1	1.89	2.55	1.94	0.45
2	1.68	2.26	1.74	0.41
3	1.87	2.51	1.99	0.45
4	1.73	2.34	1.76	0.42
5	1.79	2.41	1.86	0.44
6	1.80	2.43	1.86	0.44
7	1.75	2.36	1.82	0.43
8	1.80	2.44	1.87	0.44
9	1.81	2.44	1.86	0.44
10	1.79	2.41	1.86	0.44
11	1.82	2.46	1.89	0.44
12	1.79	2.41	1.86	0.43
Average	1.79	2.42	1.86	0.44

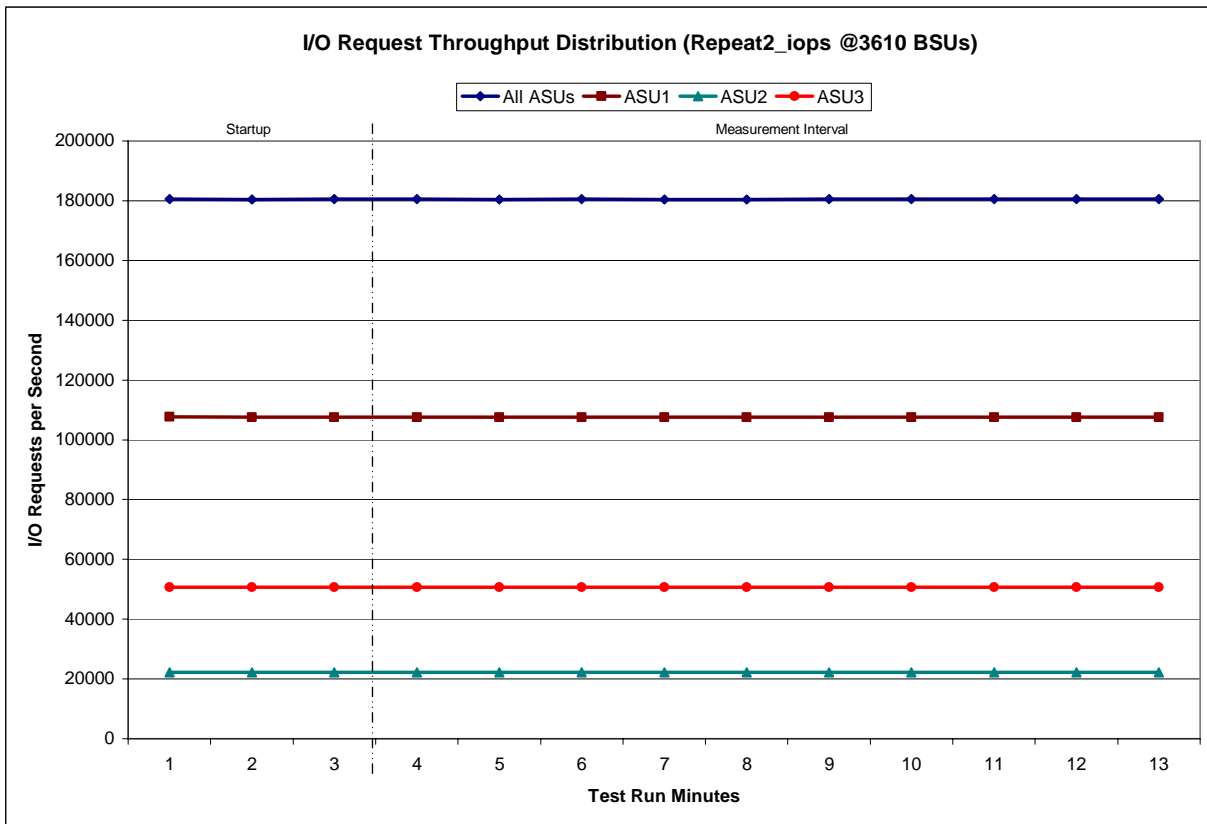
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS - I/O Request Throughput Distribution Data

3610 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:47:00	23:50:01	0-2	0:03:01
Measurement Interval	23:50:01	0:00:01	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	180,601.15	107,632.12	22,216.50	50,752.53
1	180,466.82	107,555.87	22,185.92	50,725.03
2	180,490.47	107,573.60	22,201.32	50,715.55
3	180,505.50	107,621.50	22,195.87	50,688.13
4	180,390.65	107,522.87	22,201.25	50,666.53
5	180,499.38	107,566.85	22,206.65	50,725.88
6	180,398.90	107,491.05	22,208.85	50,699.00
7	180,470.00	107,559.87	22,177.50	50,732.63
8	180,499.30	107,572.48	22,202.03	50,724.78
9	180,553.60	107,598.05	22,225.62	50,729.93
10	180,489.83	107,573.68	22,203.98	50,712.17
11	180,529.20	107,553.25	22,229.47	50,746.48
12	180,547.12	107,582.18	22,217.58	50,747.35
Average	180,488.35	107,564.18	22,206.88	50,717.29

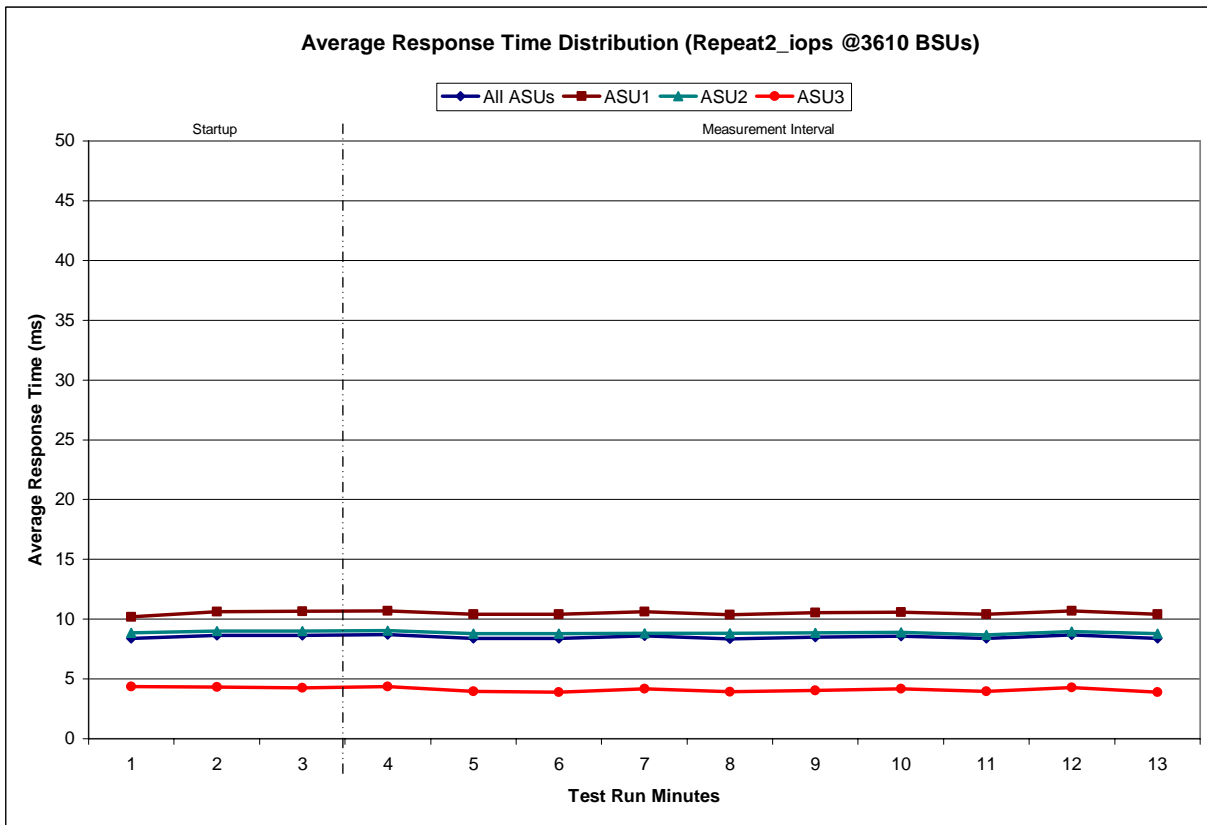
Repeatability 2 IOPS - I/O Request Throughput Distribution Graph



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

3610 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:47:00	23:50:01	0-2	0:03:01
Measurement Interval	23:50:01	0:00:01	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	8.38	10.18	8.85	4.36
1	8.65	10.61	9.00	4.32
2	8.64	10.64	9.00	4.26
3	8.71	10.70	9.05	4.36
4	8.39	10.39	8.80	3.96
5	8.37	10.40	8.78	3.89
6	8.59	10.63	8.82	4.17
7	8.36	10.36	8.82	3.91
8	8.50	10.53	8.86	4.03
9	8.57	10.57	8.91	4.18
10	8.37	10.40	8.68	3.95
11	8.67	10.68	8.97	4.28
12	8.38	10.41	8.78	3.90
Average	8.49	10.51	8.85	4.06

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	0.0349	0.2810	0.0700	0.2098	0.0180	0.0700	0.0350	0.2812
COV	0.005	0.002	0.004	0.002	0.007	0.002	0.005	0.002

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	0.0350	0.2809	0.0700	0.2100	0.0180	0.0701	0.0350	0.2810
COV	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	0.0351	0.2811	0.0700	0.2099	0.0180	0.0700	0.0350	0.2809
COV	0.005	0.001	0.003	0.002	0.006	0.003	0.004	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
<i>IM</i>	<i>0.0350</i>	<i>0.2810</i>	<i>0.0700</i>	<i>0.2100</i>	<i>0.0180</i>	<i>0.0700</i>	<i>0.0350</i>	<i>0.2810</i>
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0701	0.0350	0.2810
COV	0.001	0.001	0.001	0.001	0.003	0.001	0.002	0.000

Data Persistence Test

Clause 6

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

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

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

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

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

Clause 9.4.3.8

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

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

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 72.

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	316,242
Total Number of Logical Blocks Verified	315,174
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	5 minutes
Size in Bytes of each Logical Block	1024
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 Infortrend ESVA F60 as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.4.3.3.6

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

Pricing information may be found in the Priced Storage Configuration Pricing section on page 14.

TESTED STORAGE CONFIGURATION (TSC) AND PRICED STORAGE CONFIGURATION DIFFERENCES

Clause 9.4.3.3.7

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

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 14.

ANOMALIES OR IRREGULARITIES

Clause 9.4.3.10

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

There were no anomalies or irregularities encountered during the SPC-1 Onsite Audit of the Infortrend ESVA F60 .

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 gibibyte (GiB) is equal to 1,073,741,824 (2^{30}) bytes.
- A tebibyte (TiB) is equal to 1,099,511,627,776 (2^{40}) bytes.
- A pebibyte (PiB) is equal to 1,125,899,906,842,624 (2^{50}) bytes.
- An exbibyte (EiB) is equal to 1,152,921,504,606,846,967 (2^{60}) bytes.

SPC-1 Data Repository Definitions

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

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

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

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

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

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

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

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

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

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

SPC-1 Data Protection Levels

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

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

SPC-1 Test Execution Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

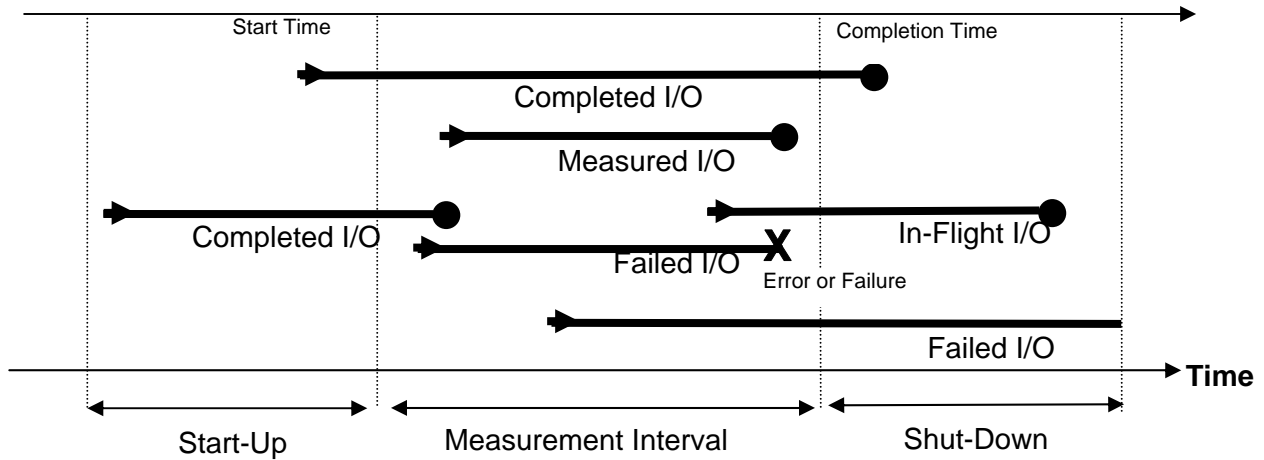
Test: A collection of Test Phases and or Test Runs sharing a common objective.

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

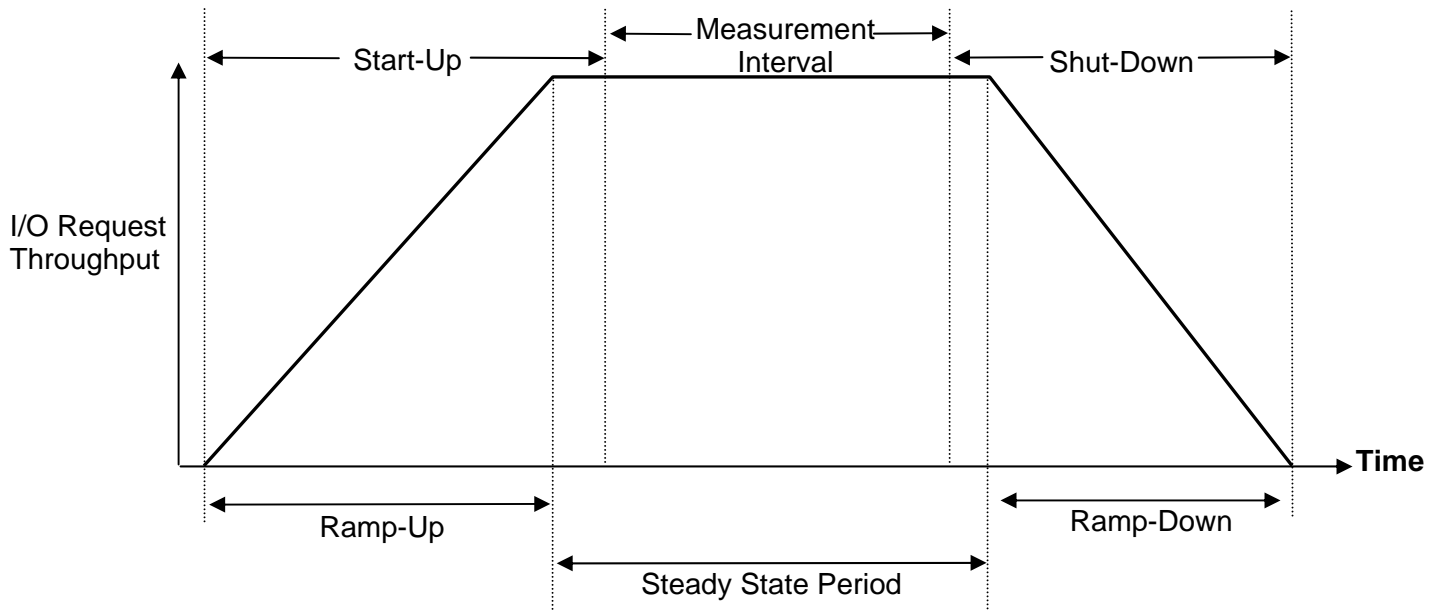
period, Shut-Down period, and Ramp-Down period as illustrated in the “SPC-1 Test Run Components” below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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

I/O Completion Types



SPC-1 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

Windows 2003 Server

Modify the Windows registry to add a new DWord name "CacheRange" with a value of "4000" to HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\iftdmr. That registry change defines the largest virtual volume size.

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

Host Systems

Configure each host system following the steps below.

1. Install Microsoft Windows Server 2003 64-bit Service Pack 2
2. Install and setup one Qlogic 2562 HBA using Infortrend certified Qlogic drivers
3. Install Infortrend ESVA load-balancing driver and EonPath multi-pathing driver.

Qlogic SANbox 5800 Switches

Connect the physical connections from the Host Systems to the ESVA F60 sets as illustrated on page 16 (*Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/*

Priced Storage Configuration Diagram).

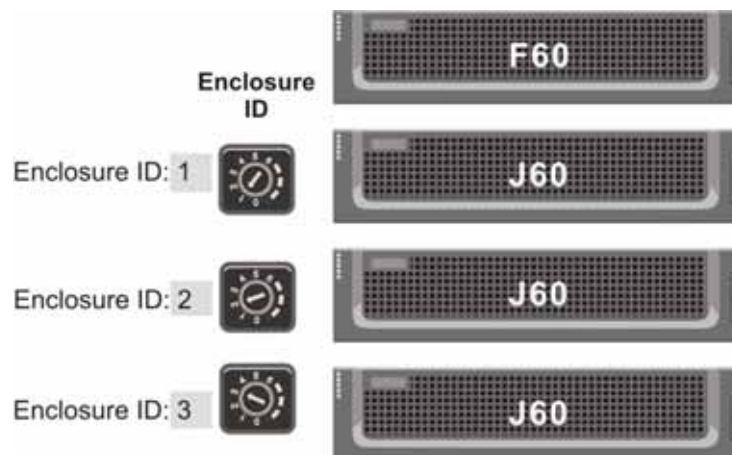
Management Station

Install SANWatch on a computer meeting the system requirements announced by Infortrend. Then the configuration on ESVA can be done through this computer as a management station.

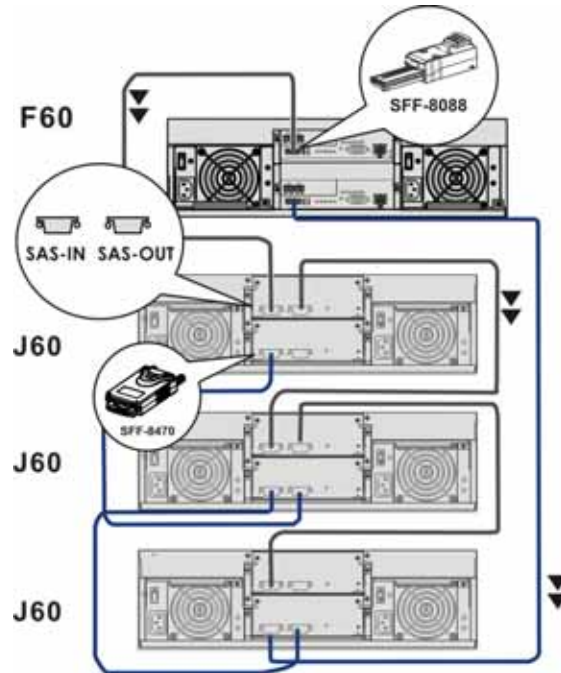
ESVA Storage

Each ESVA F60 set includes one ESVA F60 controller system and three ESVA J60 disk enclosures. Install sixteen drives into each F60 and J60, and then make physical connections between them following the steps below:

1. Using a flat blade screwdriver to configure the rotary ID switch on each J60 enclosure, making the first J60 with ID 1, the second with ID 2 and the third with ID 3.



2. Refer to the diagram below to connect the F60 system with the J60 enclosures with SAS cables.



After making the physical connections, refer to <http://g-support.infortrend.com/SOP.html> to activate licenses.

After license activation, configure the ESVA storage in SANWatch following the steps below:

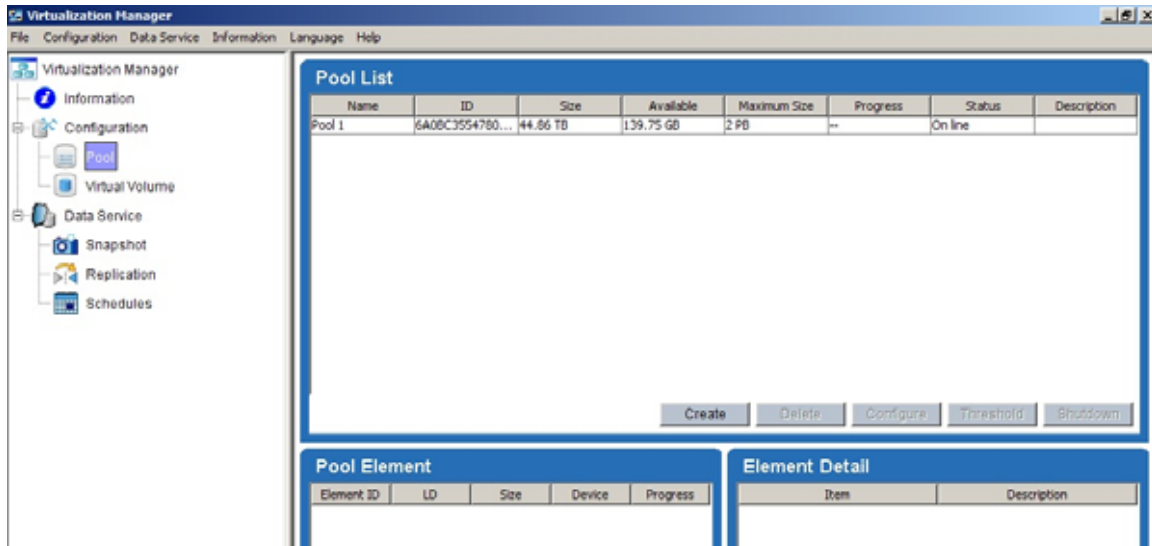
1. Launch Virtualization Manager

In SANWatch portal, click on the Virtualization Management icon on the tool bar. Then Virtualization Manager will be started.

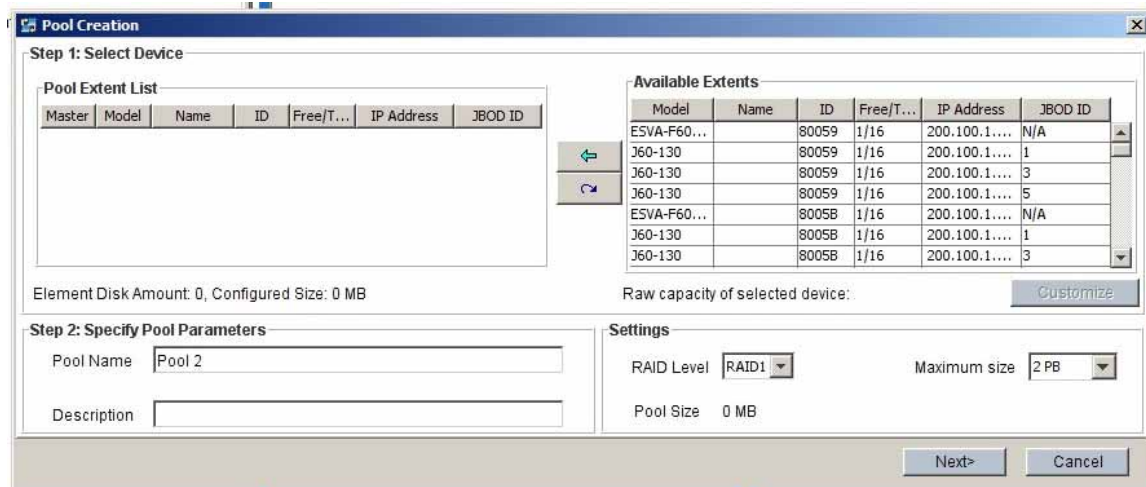


2. Create a virtual pool.

Select **Pool** icon by a left-click from the navigation panel. On the **Pool List** pane, use the **Create** button to open the configuration wizard.

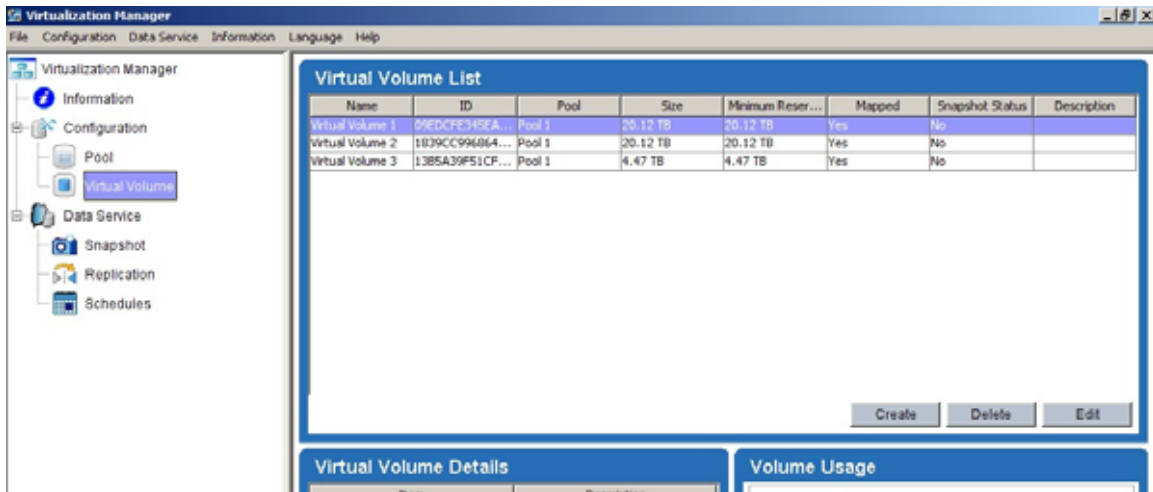


The **Pool Creation** window will prompt. Select all devices from the **Available Extents** list to add them into the **Pool Extent List**. Then name the pool and add descriptions if necessary, and select RAID1 as the RAID level.

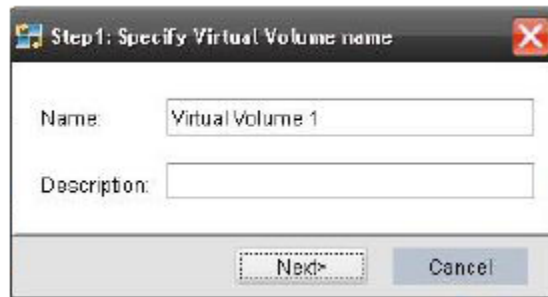


3. Create virtual volumes.

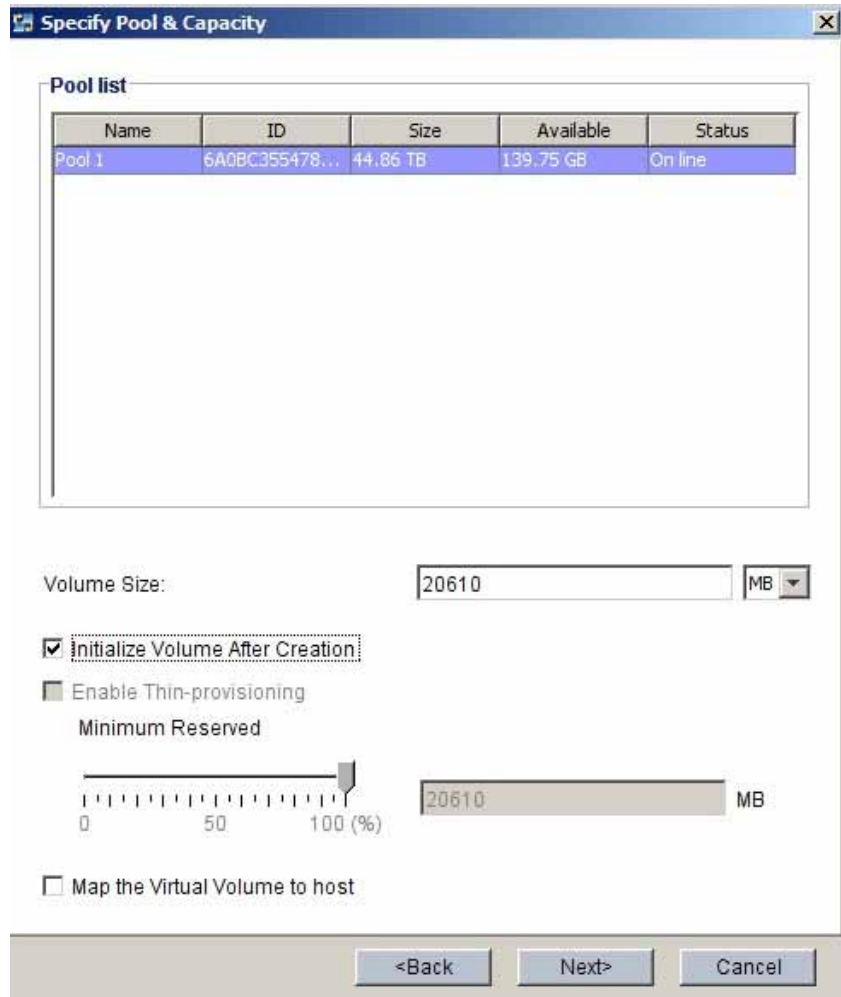
Select **Virtual Volume** icon by a left-click from the navigation panel. On the **Virtual Volume List** pane, left-click on the **Create** button.



Then the **Step 1** window will prompt. Enter a name and short descriptions for the volume to-be-created if necessary, and click **Next** to proceed.

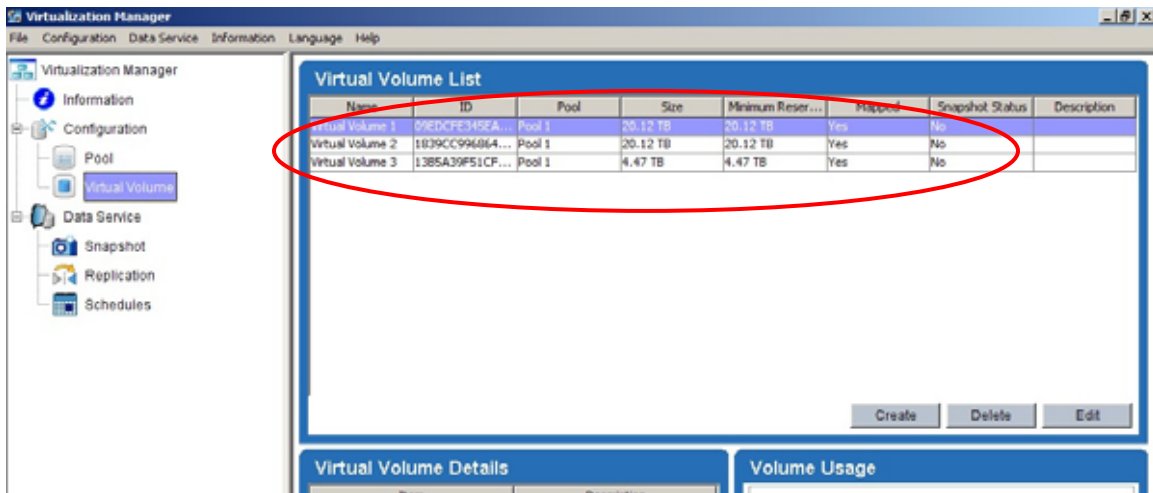


When the **Specify Pool & Capacity** window prompts, select the virtual pool just created from the **Pool** list. Set 20,610 GB as the volume size. Tick off the checkbox for **Enable Thin-provisioning**, and then tick the checkbox for **Initialize Volume After Creation**.



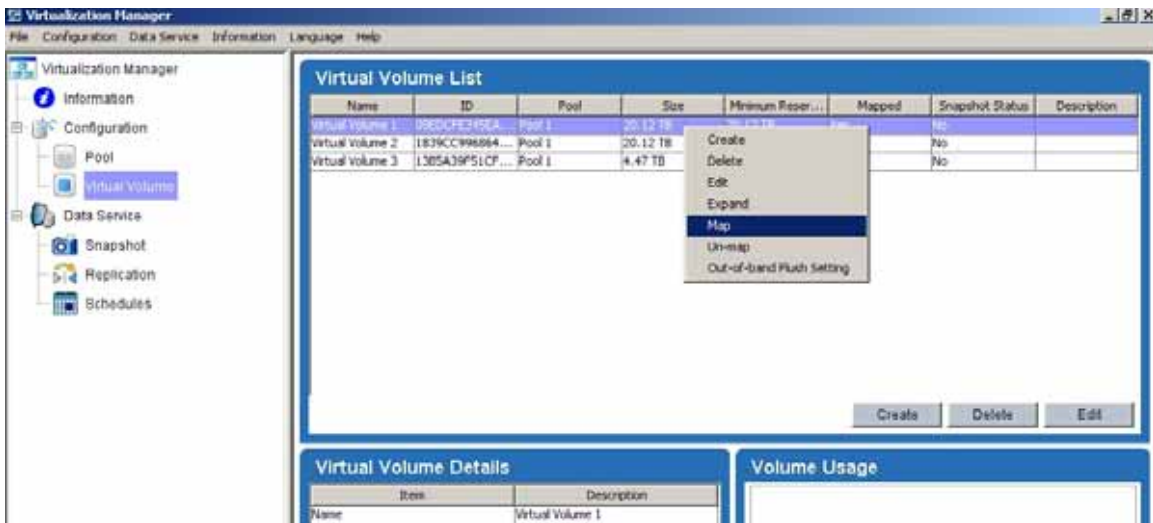
Click **Next**, and then the virtual volume used as ASU1 is successfully created.

Repeat the process to create one virtual volume as ASU2, sized 20,610 GB and one as ASU3, sized 4,580 GB. Once the virtual volumes are created, their entries can be found on the **Virtual Volume List**.

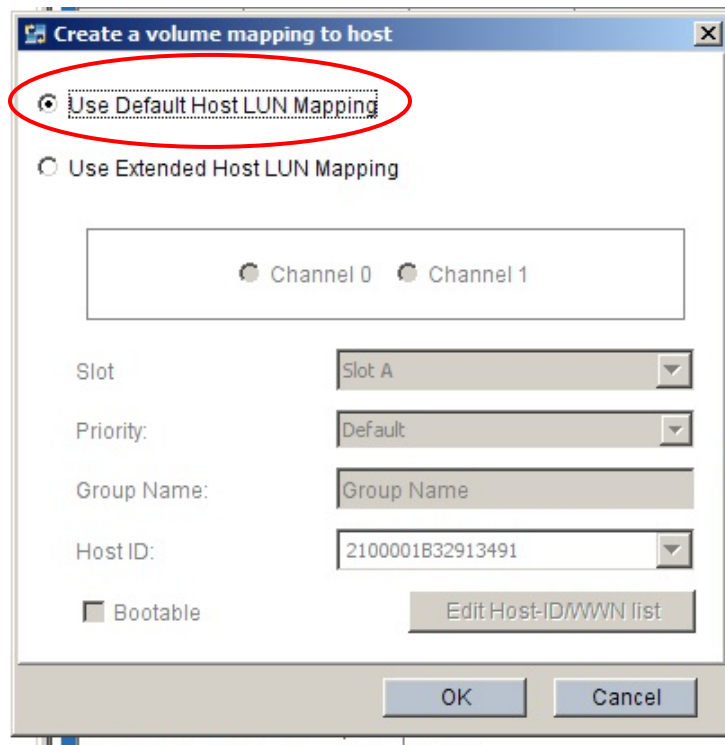


4. Map virtual volumes.

Left-click to select the virtual volume in the Virtual Volume List. Then right-click to display the command menu, and select Map.



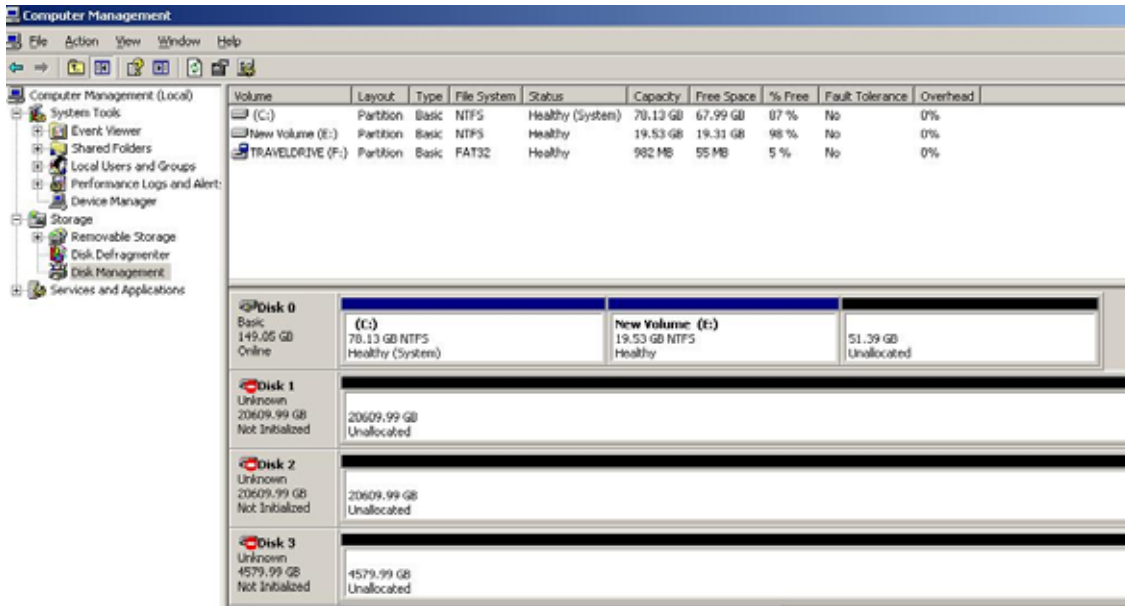
A mapping window will prompt. Click **Use Default Host LUN Mapping** and then click **OK**.



Repeat the process until all virtual volumes are mapped.

5. Verify virtual volume mapping

Go to the host system, start **Computer Management**, and click **Disk Management** under **Storage** in the left-hand system tree pane. Check the right-hand window to see whether the virtual volumes you mapped are correctly shown as new disks.



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

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

```
host=master

slaves=(slave1,slave11,slave12,slave13,slave14,slave15,slave16,slave17,slave18,slave19,slave1a,slave1b,slave1c,slave2,slave21,slave22,slave23,slave24,slave25,slave26,slave27,slave28,slave29,slave2a,slave2b,slave2c,slave3,slave31,slave32,slave33,slave34,slave35,slave36,slave37,slave38,slave39,slave3a,slave3b,slave3c)

sd=asu1_1,lun=\\.PhysicalDrive1
sd=asu2_1,lun=\\.PhysicalDrive2
sd=asu3_1,lun=\\.PhysicalDrive3
```

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

Persistence Test 1 (write phase)

```
host=localhost,jvms=4,maxstreams=200

sd=sd1,lun=\\.PhysicalDrive1,size=22129818992640
sd=sd2,lun=\\.PhysicalDrive2,size=22129818992640
sd=sd3,lun=\\.PhysicalDrive3,size=4917737553920
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=TR1-124s_SPC-2-persist-w,streams=124
```

Persistence Test 2 (read phase)

```
host=localhost,jvms=4,maxstreams=200

sd=sd1,lun=\\.PhysicalDrive1,size=22129818992640
sd=sd2,lun=\\.PhysicalDrive2,size=22129818992640
sd=sd3,lun=\\.PhysicalDrive3,size=4917737553920
maxlatestart=1
reportinginterval=5
segmentlength=512m

maxpersistenceerrors=10

rd=default,buffers=1,rdpct=100,xfersize=1024k
rd=TR1-124s_SPC-2-persist-r
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

Primary Metrics and Repeatability Tests

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

```
copy /Y spc1.cfg1 spc1.cfg

java -Xmx1024m -Xss64k metrics -b 3610
java -Xmx1024m -Xss64k repeat1 -b 3610
java -Xmx1024m -Xss64k repeat2 -b 3610
```

Persistence Test

The following scripts was used to execute Persistence Test.

Persistence Test Run 1 (write phase)

```
./install/spc2.bat -f persist1.cfg -o init -init
./install/spc2.bat -f persist1.cfg -o persist1
```

Persistence Test Run 2 (read phase)

```
./install/spc2.bat -f persist2.cfg -o persist2
```


APPENDIX F: THIRD-PARTY QUOTATIONS



Aboutscan.com LLC
780 Montague Expwy
Suite 302
San Jose, CA 95131
Phone: 1-888-799-SCAN
Fax: 408-519-0799
EIN: 611-526-120

QUOTE

QUOTE NUMBER: 10166
DATE: 01-31-2010
CUSTOMER ID: INFOR00001

TO Behrouz Zali
Infotrend Corporation
2200 Zanker Rd
San Jose, CA 95131
408-988-5764

SALES PERSON	PROJECT DESCRIPTION	EXPIRATION DATE
Darwin Malloy	Infotrend SPC-1 Quote	05-28-2010

PART NUMBER	DESCRIPTION	QTY	UNIT PRICE	EXTENDED PRICE
<i>ESVA Storage Solution</i>				
F60-1830A	Control Module, Cooling Module, Battery Module, Power Supply Unit, 16 x 147GB magazine with MUX board plus 15K RPM disk drive, 4 x 5m cable lc-lc 1.8mm x 2mm-62.5/125 DUPLEX LSZH	12	23920.00	\$ 287,040.00
J60-130A	Controller Module, Battery Module, power Supply Unit, 16 x 147GB magazine with MUX board plus 15K RPM hard drive	36	9880.00	\$ 355,680.00
SERV-PRERA-0010	3 Years Premium Service Upgrade for ESVA Storage	12	6571.00	\$ 78,852.00
SERV-PREJB-0010	3 Years Premium Service Upgrade for ESVA Expansion StorAGE	36	4571.00	\$ 164,556.00
<i>3rd Party Host System Attach hardware and Software</i>				
SYS-6024H-I2	SuperMicro X7DBE Xe on Quad-Core E5405 2.0GHz 16GM DDR memory	1	2221.15	\$ 2,221.15
SB5802V-08A	Qlogic SanBox 5800 Fibre Switch	4	3548.00	\$ 14,192.00
LK-5802-4PORT	Qlogic port Expansion license	12	737.00	\$ 8,844.00
QLE2562-CK	Qlogic HBA QLE2562 8GB	3	890.00	\$ 2,670.00
PCE-417560-19	42U AMS2000 Rackmount	7	437.5	\$ 3,062.50
IFT-9270CFCCab02	5m cable lc-lc 1.8 mm x 2 mm-62.5/125 DUPLEX LSZH	6	30.00	\$ 180.00
FTLF8528P2BNV	Finnisar 8 GB SFP	54	120.00	\$ 6,480.00
XPAK-SW-01	XPAK Connector Cable	2	227.00	\$ 454.00
TOTAL				\$924,231.65

Quotation prepared by: Darwin Malloy

To accept this quotation, sign here and return: _____

THANK YOU FOR YOUR BUSINESS!