SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS
ETERNUS4000 MODEL 500

SPC-1 V1.10

Submitted for Review: August 25, 2006
Submission Identifier: A00047

First Edition – August 2006

Trademarks

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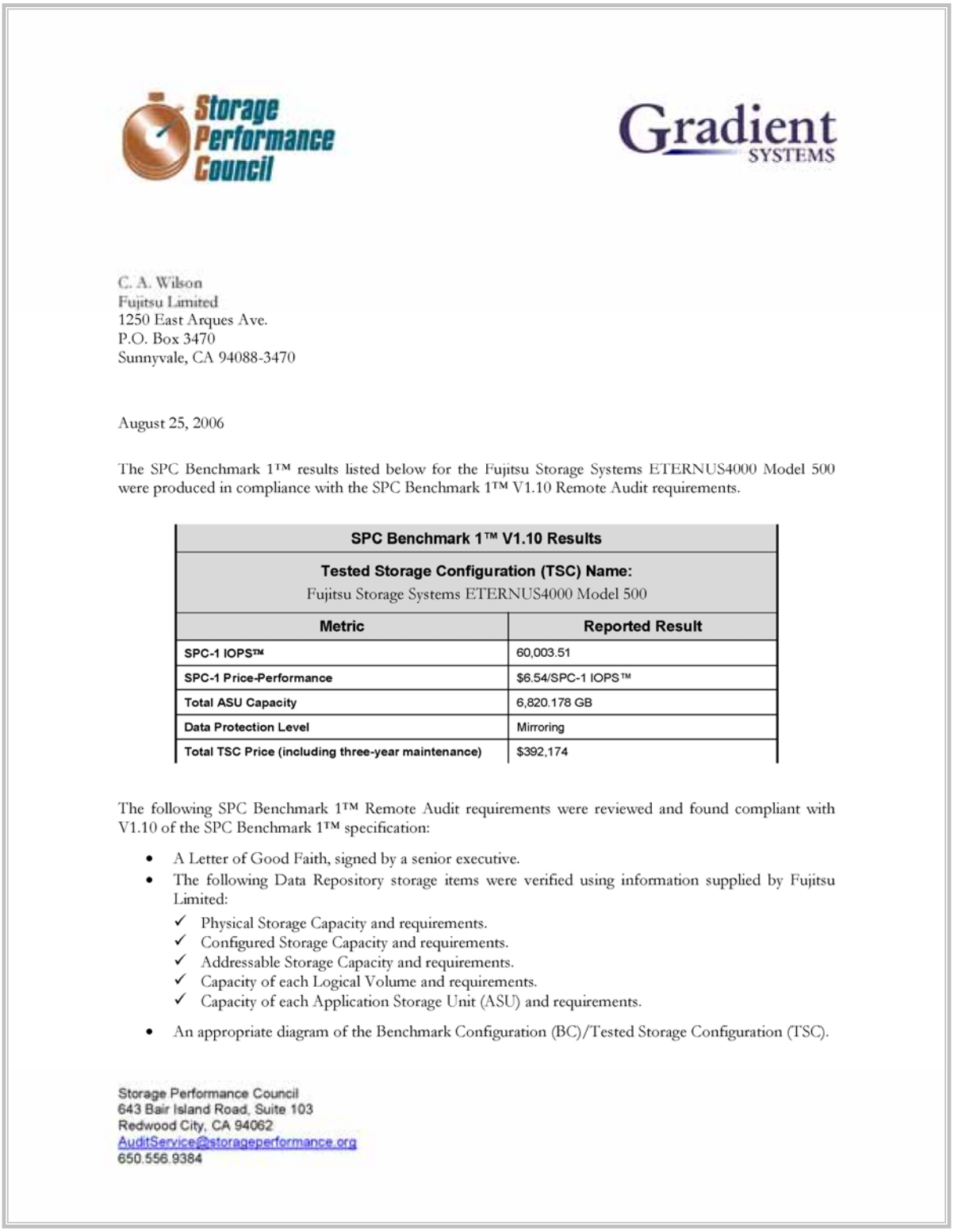
AUDIT CERTIFICATION



C. A. Wilson
Fujitsu Limited
1250 East Arques Ave.
P.O. Box 3470
Sunnyvale, CA 94088-3470

August 25, 2006

The SPC Benchmark 1™ results listed below for the Fujitsu Storage Systems ETERNUS4000 Model 500 were produced in compliance with the SPC Benchmark 1™ V1.10 Remote Audit requirements.

SPC Benchmark 1™ V1.10 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS4000 Model 500	
Metric	**Reported Result**
SPC-1 IOPS™	60,003.51
SPC-1 Price-Performance	$6.54/SPC-1 IOPS™
Total ASU Capacity	6,820.178 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$392,174

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with V1.10 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified using information supplied by Fujitsu Limited:
  - ✓ 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).

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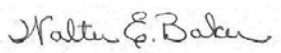
AUDIT CERTIFICATION *(CONT.)*

- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters.
- Commands and parameters used to configure the SPC-1 Workload Generator.
- The following Host System requirements were reviewed using documentation supplied by Fujitsu Limited:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The Test Results Files and resultant Summary Results Files received from Fujitsu Limited 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
- The difference documented between the Tested Storage Configuration (TSC) used for the benchmark and Priced Storage Configuration would have no performance impact if the TSC was configured identical to the Priced Storage Configuration.
- The final version of the pricing spreadsheet 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.

Respectfully,



Walter E. Baker
SPC Auditor

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LETTER OF GOOD FAITH

FUJITSU

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TEL: 044-754-3240, FAX: 044-754-3719

From: FujitsuLimited,Test Sponsor

Submittedby: Tetsurou Kudo ,
General Manager, Storage Systems Division
Kanagawa-ken,Kawasaki-shi,Nakahara-ku,Kamikodanaka4-1-1
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Contact Information: Carrel A. (Sandy)Wilson
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1250EastArquesAvePO Box 3470
Sunnyvale,CA 94088, U.S.A.

To: Walter E. Baker, SPC Auditor
Gradient Systems, Inc.
643 Bair Island Road, Suite 103
Redwood Citv, CA 94063-2755, U.S.A.

Subject: SPC-1 Letter of Good Faith for the ETERNUS4000 Model 500

Fujitsu Limited 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 V1.10.0 of the SPC-1 benchmark specification.

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

Signed: Tetsuro Kudo Date: 8/17/'06

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu Computer Systems Corp. C.A. (Sandy) Wilson Sandy_Wilson@us.fujitsu.com 1250 East Arques Ave PO Box 3470 Sunnyvale, CA 94088-3470 Phone: (916) 434-8593
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Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Kouichi Ueda ueda@jp.fujitsu.com Kanagawa-ken, Kawasaki-shi, Nakahara-ku, Kamikodanaka 4-1-1 Japan 211-8588 Phone: 044- 754-3651
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	V1.10
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	August 25, 2006
Date the FDR was submitted to the SPC	August 25, 2006
Date the TSC is available for shipment to customers	November 15, 2006
Date the TSC completed audit certification	August 24, 2006

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS4000 Model 500	
Metric	**Reported Result**
SPC-1 IOPS™	60,003.51
SPC-1 Price-Performance	$6.54/SPC-1 IOPS™
Total ASU Capacity	6,820.178 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$392,174

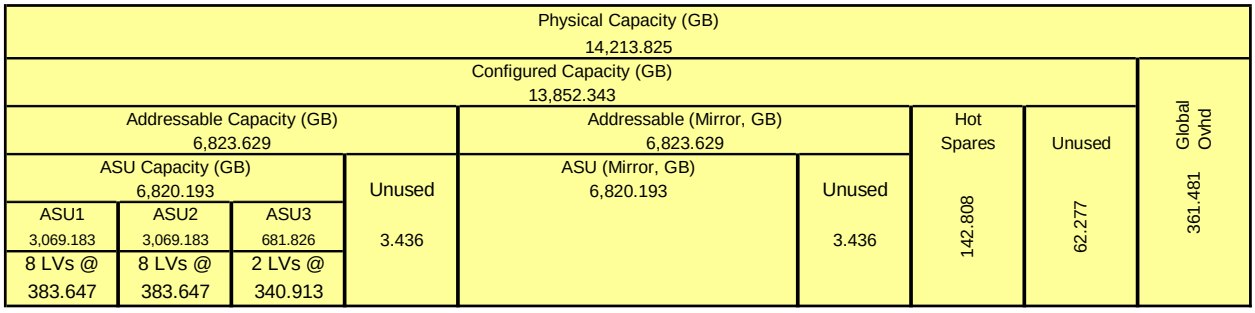
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

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

Storage Capacities and Relationships

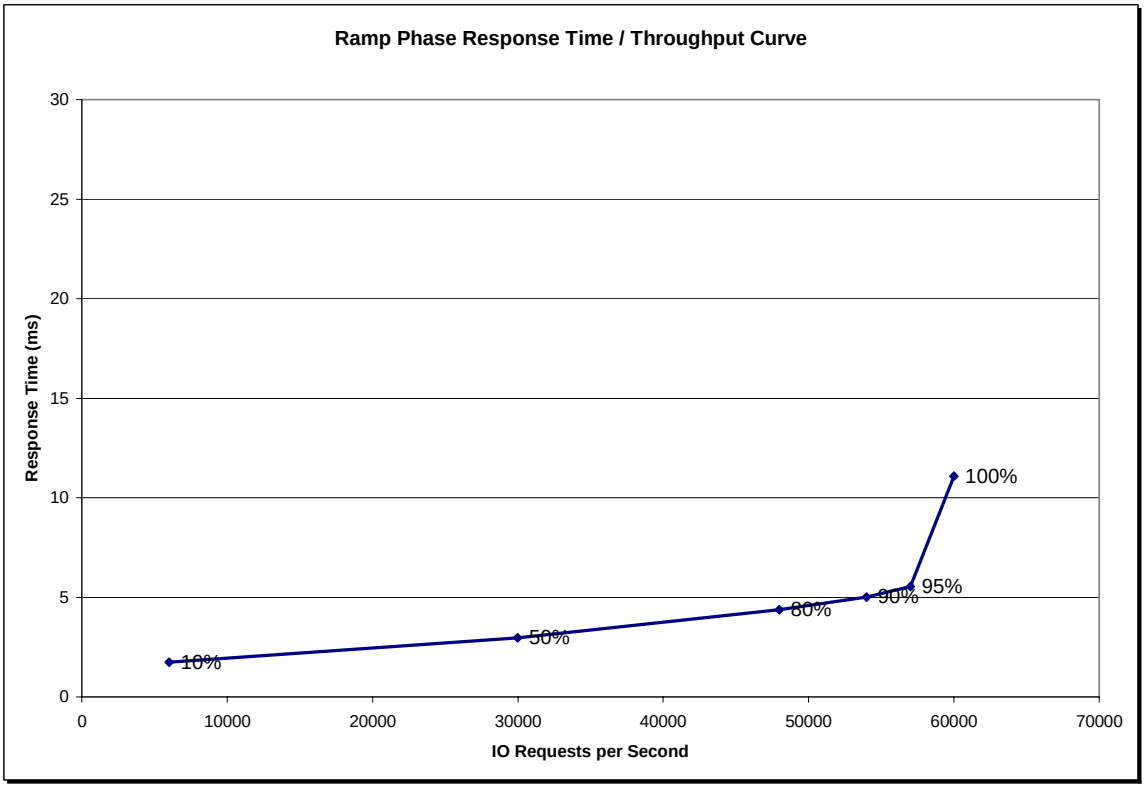
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-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	6,001.26	29,989.45	47,989.91	53,998.89	56,998.01	60,003.51
Average Response Time (ms):						
All ASUs	1.74	2.96	4.37	5.02	5.54	11.08
ASU-1	2.32	3.66	5.16	5.85	6.39	10.46
ASU-2	1.58	2.87	4.33	5.02	5.56	8.93
ASU-3	0.58	1.52	2.71	3.24	3.72	13.33
Reads	3.58	5.24	7.02	7.85	8.46	11.79
Writes	0.54	1.48	2.65	3.17	3.64	10.62

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Item	Product Id	Description	Qty	Unit $	Extd $
1	E450S20AU	ETERNUS4000 M500 Base Unit (floor stand) Includes: - 1x controller enclosure - 2x controller - 2x power supply unit - 3x battery unit - 2x drive enclosure - no cache memory - no host interface - no disk drive - 1x 1800mm rack - 1x Power Supply Enclosure (AC200V) - 1x Power distribution unit (AC200V) - 4x AC 200V power cord (NEMA:L6-30P 4m) - 1x ETERNUSmgr and drivers Note: Min. eight disk drives are required. At least one host interface option and one cache memory option are required.	1	$61,075	$61,075
2	E400CR1U	Expansion Rack for E4KM500 - 1x 1, 800 mm expansion rack - 2x Power distribution unit (AC200V) - 4x AC 200V power cord (NEMA:L6-30P 4m) Note: Max. 2 racks can be added to the Base Unit of model 500.	2	$4,450	$8,900
3	E400CE31U	Additional drive enclosure pair (2xDE) FC (Op) E4KM500 - 2x drive enclosure - 8x optical FC cable - 16x SFP module First two sets can be added to an Expansion Rack.. Up to 15 disk drives can be mounted in each drive enclosure. [6EIA unit (6U)]	2	$7,358	$14,716
4	E400CE22U	Additional drive enclosure pair (2xDE) E4KM500 - 2x drive enclosure Up to three sets can be installed to the Base Unit and two sets to the Expansion Rack. Up to 15 disk drives can be mounted in each drive enclosure [6EIA unit (6U)]	11	$7,358	$80,938
5	E400CM24U	16GB Cache Memory (2x 4GB x 2CM) E4KM500 - 4x 4GB DIMM Total 16GB (2x 4GB DIMM x2CM) One set must be mounted. Up to two set can be mounted.	2	$36,384	$72,768
6	E400CH24U	FC (4Gbps) host interface (4-port x 2CA) E4KM300/500 - 2x 4-port FC (4Gbps) CA	2	$6,558	$13,116
7	E400CB2U	36GB/15Krpm (4Gbps) disk drive(set of 2) RAID1E4KM300/M500 - Pre-formatted as RAID1(1D+1M) Only available when ordered with a base unit	2	$1,098	$2,196
8	E400CC2U	36GB/15Krpm (4Gbps) disk drive(set of 8) RAID0+1E4KM300/M500 - Pre-formatted as RAID0+1(4D+4M) Only available when ordered with a base unit	48	$4,393	$210,864
9	E400CA2U	36GB/15Krpm (4Gbps) disk drive (single) E4KM300/M500 - Defined as a hot-spare Only available when ordered with a base unit	4	$549	$2,196
10	61-350563-915	Fibre Channel Cable - LC-LC, 15 m	32	$125	$4,000
11	BR-240E-R0001-A	Brocade Silkworm 200E Fabric Switch 16 ports, 16 SFP, AWT, ADZ, Full Fabric	2	$7,967	$15,934
12	LP11000-M4	Emulex 4Gb PCI-X Single HBA (per quote from InfoX dated 8/23/2006)	16	$779	$12,464
13	ETE4M5-W004240-G000999	Enhanced Plus ETERNUS4000 Model 500 (2 year Warranty included) Phone 24x7, On-site 24x7, maintenance service with 4 hour response	1	$0	$0
14	ETE4M5-P004121-G000999	Enhanced Plus ETERNUS4000 Model 500 (3rd year) Phone 24x7, On-site 24x7, maintenance service with 4 hour response - 1 year Extended Service	1	$48,624	$48,624
15	BR200E-P004241-000	Brocade 200E, Enhanced Plus Maintenance, 2 years Phone 24x7, On-site 24x7, maintenance service with 4 hour response	2	$2,372	$4,744
16	BR200E-P004121-000	Brocade 200E, Enhanced Plus Maintenance (3rd year) Phone 24x7, On-site 24x7, maintenance service with 4 hour response - 1 year Extended Service	2	$1,186	$2,372
		Total Fujitsu Product List Price			$486,703
		Product Discount		30%	
		Net Product Price			$340,692
		Total Service List Price			$55,740
		Service Discount		30%	
		Net Service Price			$39,018
		Outside Quoted Product Price			$12,464
		Total Sell Price, including 3 years Service			$392,174

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

The Tested Storage Configuration used a large 64 port Fibre Channel Switch (Brocade Silkworm 4900), with only 32 ports utilized, based on what was available in the test environment. The Priced Storage Configuration includes two smaller 16 port switches, which provide functional equivalence and do not impact the performance of the system

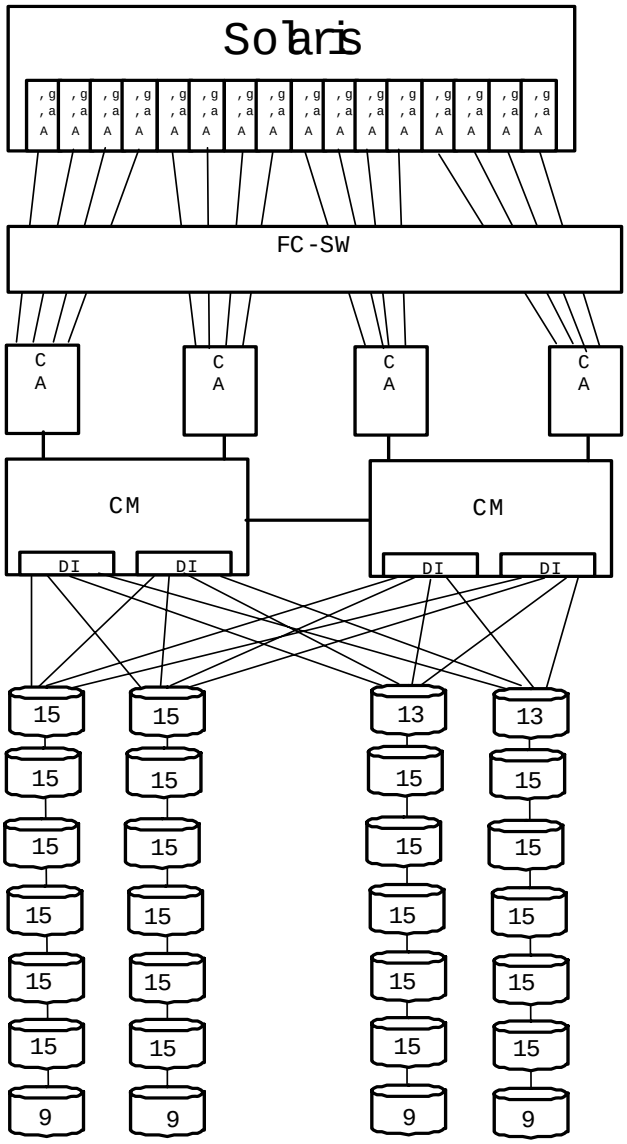
Benchmark Configuration/Tested Storage Configuration Diagram

PRIMEPOWER
HPC2500

SN200-M490

ETERNUS4000
MODEL500

CA-Channel Adapter
CM-Control Module
DI-Drive Interface



Benchmark Configuration/Tested Storage Configuration Components

<table>
<tr><th>Host System:</th><th>Tested Storage Configuration (TSC):</th></tr>
<tr><td>UID=HS-1
Fujitsu PRIMEPOWER 2500</td><td>16 – Emulex LP11000 Fibre Channel HBAs (4 Gbps)
Fujitsu SN200 M90 Fibre Channel Switch
(rebranded Brocade Silkworm 4900)</td></tr>
<tr><td>128 - SPARC64 V (1.3 GHz) CPUs, each with:
128 KB L1 instruction cache,
128 KB L1 data cache, and 2 MB L2 cache</td><td>UID=SC-1:
Fujitsu ETERNUS4000 Model 500</td></tr>
<tr><td>512 GB main memory</td><td rowspan="4">2 – Controller Modules (CM) each with 16 GB cache
4 – Channel Adapter (CA) Modules
4 – Drive Interfaces (DI)
16 – Front side fibre channels (4 Gbps each)
16 – Drive side fibre channel switched FC-AL loops
(4 Gbps each)</td></tr>
<tr><td>Solaris 9</td></tr>
<tr><td>PCI</td></tr>
<tr><td>WG</td></tr>
<tr><td></td><td>28 – Drive enclosure modules, each with
dual switched FC-AL interfaces
15 hot swap drive slots</td></tr>
<tr><td></td><td>392 – 36 GB 15K RPM disk drives</td></tr>
</table>

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 9.2.4.4.1

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

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

Storage Network Configuration

Clause 9.2.4.4.1

…

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 9.2.4.4.2.*

Clause 9.2.4.4.2

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration diagram described in Clause 9.2.4.4.1 contains a high-level illustration of the network configuration, the Executive Summary will contain a one page topology diagram of the storage network as illustrated in Figure 9-9.

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

Host System Configuration

Clause 9.2.4.4.3

The FDR shall minimally contain, for each Host System running the Workload Generator, a listing of the following:

1. *Number and type of CPUs.*
2. *Main memory capacity.*
3. *Cache memory capacity.*
4. *Number and type of disk controllers or Host Bus Adapters.*

The details of the Host System configuration may be found on page 15 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Customer Tunable Parameters and Options

Clause 9.2.4.5.1

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

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

Tested Storage Configuration (TSC) Description

Clause 9.2.4.5.2

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 72 contains the detailed information that describes how to create and configure the logical TSC.

SPC-1 Workload Generator Storage Configuration

Clause 9.2.4.5.3

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 114.

SPC-1 DATA REPOSITORY

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

Storage Capacities and Relationships

Clause 9.2.4.6.1

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)	6,820.178
Addressable Storage Capacity	Gigabytes (GB)	6,823.629
Configured Storage Capacity	Gigabytes (GB)	13,852.343
Physical Storage Capacity	Gigabytes (GB)	14,213.825
Data Protection (Mirroring)	Gigabytes (GB)	6,823.629
Required Storage/Spares	Gigabytes (GB)	142.808
Global Storage Overhead	Gigabytes (GB)	361.482
Total Unused Storage	Gigabytes (GB)	69.180

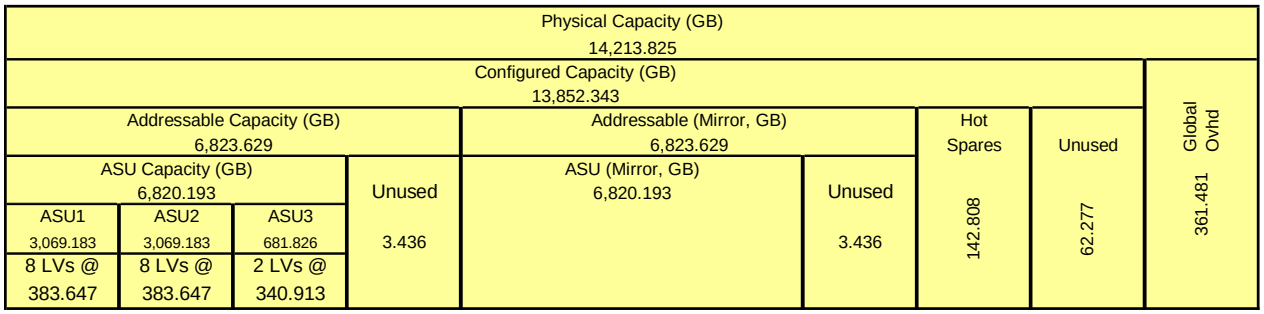
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	99.95%	49.23%	47.98%
Required for Data Protection (Mirroring)		49.26%	48.01%
Addressable Storage Capacity		49.26%	48.01%
Required Storage		1.03%	1.00%
Configured Storage Capacity			97.46%
Global Storage Overhead			2.54%
Unused Storage:			
Addressable	0.05%		
Configured		0.45%	
Physical			0.00%

The Physical Storage Capacity consisted of 14,213.825 GB distributed over 392 disk drives each with a formatted capacity of 36.260 GB. There was 0.00 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 361.482 GB (2.54%) of Physical Storage Capacity. There was 62.277 GB (0.45%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 99.95% of the Addressable Storage Capacity resulting in 3.451 GB (0.05%) of Unused Storage within the Addressable Storage Capacity.

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 9.2.4.6.2

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

Logical Volume Capacity and Mapping		
ASU-1 (3,069.176 GB)	**ASU-2 (3,069.176 GB)**	**ASU-3 (681.826 GB)**
8 Logical Volumes 383.863 GB per Logical Volume (383.647 GB used per Logical Volume)	8 Logical Volumes 383.863 GB per Logical Volume (383.647 GB used per Logical Volume)	2 Logical Volumes 340.913 GB per Logical Volume (340.913 GB used per Logical Volume)

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

Assignment of RAID Groups and LUNs

The 64 RAID Group Assignments are RAID0+1(3+3) sets, each divided into 18 Logical Volumes, for a total of 1152 LVs. These are grouped into sixteen separate sets of LUNs, using Host Affinity grouping, each with 72 LUNs.

The RAID Group assignments to drives in the array are illustrated by the following chart.

A02-5-1 Configuration using 384 drives in 64 groups with high activity portions in the middle of the drives.

BRT pair DE:	Drive Slot: 14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
#0,1 00	HS	RG-03			RG-02			RG-01			RG-00			SY	SY
#0,1 01	HS	RG-03			RG-02			RG-01			RG-00			SY	SY
#0,1 02	HS	RG-07			RG-06			RG-05			RG-04				
#0,1 03	HS	RG-07			RG-06			RG-05			RG-04				
#2,3 20	RG-12			RG-11			RG-10			RG-09			RG-08		
#2,3 21	RG-12			RG-11			RG-10			RG-09			RG-08		
#2,3 22	RG-17			RG-16			RG-15			RG-14			RG-13		
#2,3 23	RG-17			RG-16			RG-15			RG-14			RG-13		
#0,1 40	RG-22			RG-21			RG-20			RG-19			RG-18		
#0,1 41	RG-22			RG-21			RG-20			RG-19			RG-18		
#0,1 42	RG-27			RG-26			RG-25			RG-24			RG-23		
#0,1 43	RG-27			RG-26			RG-25			RG-24			RG-23		
#2,3 60	RG-32			RG-31			RG-30			RG-29			RG-28		
#2,3 61	RG-32			RG-31			RG-30			RG-29			RG-28		
#2,3 62	RG-37			RG-36			RG-35			RG-34			RG-33		
#2,3 63	RG-37			RG-36			RG-35			RG-34			RG-33		
#0,1 80	RG-42			RG-41			RG-40			RG-39			RG-38		
#0,1 81	RG-42			RG-41			RG-40			RG-39			RG-38		
#0,1 82	RG-47			RG-46			RG-45			RG-44			RG-43		
#0,1 83	RG-47			RG-46			RG-45			RG-44			RG-43		
#2,3 A0	RG-52			RG-51			RG-50			RG-49			RG-48		
#2,3 A1	RG-52			RG-51			RG-50			RG-49			RG-48		
#2,3 A2	RG-57			RG-56			RG-55			RG-54			RG-53		
#2,3 A3	RG-57			RG-56			RG-55			RG-54			RG-53		
#0,1 C0							RG-60			RG-59			RG-58		
#0,1 C1							RG-60			RG-59			RG-58		
#0,1 C2							RG-63			RG-62			RG-61		
#0,1 C3							RG-63			RG-62			RG-61		

The RAID Groups and LUN assignments are set up through a series of actions on the GUI Management Interface (ETERNUSmgr). The task of setting up the configuration for each customer is provided as part of the base system price by Fujitsu. Different techniques are applied, depending upon the needs of the customer. This configuration reflects the customary techniques that are applied when a high performance requirement dominates the customer environment. Other techniques are applied when the primary requirement is for maximum capacity. In the case of high performance, it is customary to define RAID Groups arranged in RAID0+1 configurations. In this configuration, all of the RAID Groups are 3+3 arrangements. Please see *"Appendix C: Tested Storage Configuration (TSC) Creation"* for further details on preparing the configuration.

There are four (4) of the drives reserved exclusively for system use, and four (4) Hot Spare drives have been included in the configuration. There are twenty-four (24) empty drive slots in this configuration, as well.

The LUNs, seen through the sixteen HBAs by Solaris, are grouped into Solaris Volume Groups, and used with 8 MB stripe unit depths across the sets. Eight Logical Volumes, each with 64 LUNs are used for ASU1 and another eight for ASU2, while two Volumes, also each with 64 LUNs are used for ASU3. The sizes are reflected in the ASU Logical Volume Mapping chart.

Two optional facilities in the ETERNUS4000 (GRPM and Trace), which are used for collection information during operation, were turned off during this benchmark run. They are normally not enabled during operations. Two secondary enhanced reliability features (Patrol and sampled Read after Write compare), which may be optionally enabled by a customer, were turned off during this benchmark run. Although the PRIMEPOWER HPC2500 was equipped with 128 CPUs, for this I/O dominated benchmark, only 24 were active, with the other 104 set off-line, during this benchmark run.

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 60 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

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

SPC-1 Tests, Test Phases, and Test Runs

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

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

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

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

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 9.2.4.7.1

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 115.

Sustainability Test Results File

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

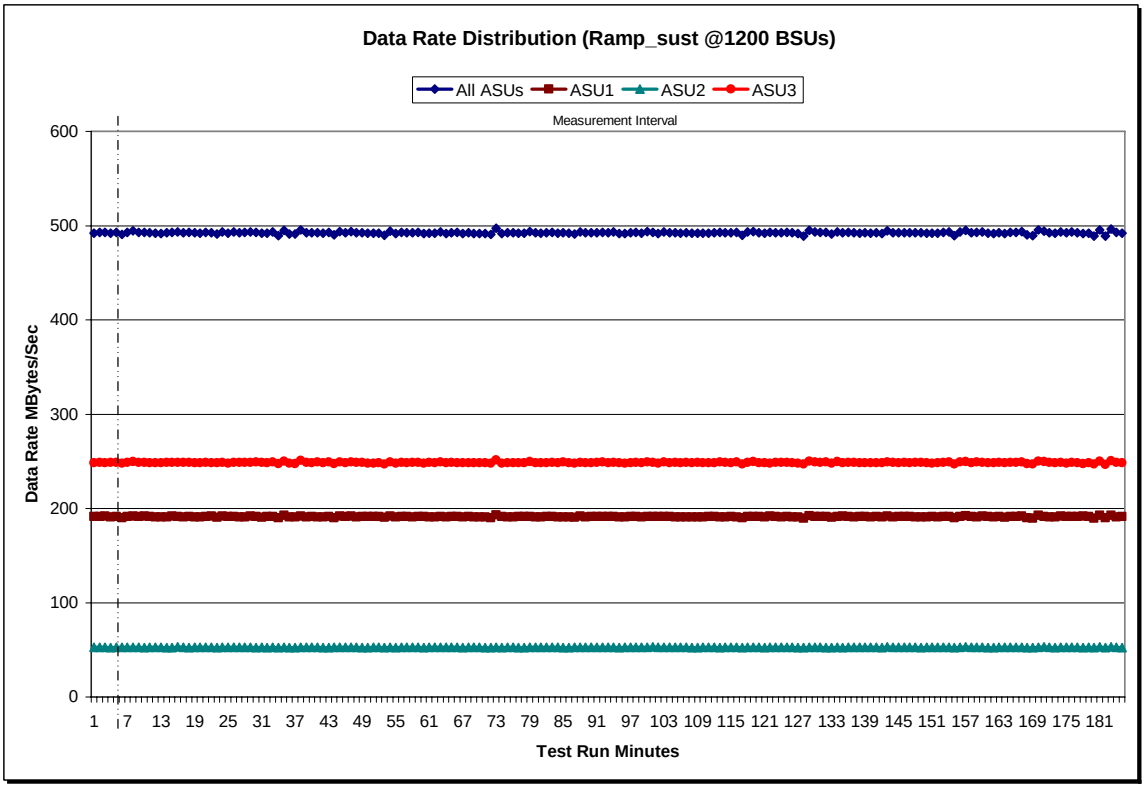
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	13:33:55	13:38:55	0-4	0:05:00
Measurement Interval	13:38:55	16:38:55	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	492.22	191.17	52.74	248.31	63	491.73	190.84	52.59	248.30	126	491.50	190.95	52.47	248.08
1	492.94	191.55	52.78	248.61	64	492.43	191.18	52.55	248.70	127	489.08	189.81	52.11	247.17
2	492.91	191.62	52.70	248.60	65	492.66	191.46	52.68	248.52	128	495.11	192.18	52.90	250.03
3	492.14	191.07	52.42	248.64	66	491.64	191.08	52.27	248.29	129	493.20	191.17	52.61	249.42
4	492.88	191.46	52.63	248.79	67	492.47	191.15	52.77	248.55	130	492.97	191.57	52.54	248.87
5	490.69	190.18	52.51	248.00	68	491.76	190.88	52.72	248.17	131	492.87	191.26	52.43	249.18
6	492.72	191.24	52.73	248.75	69	491.61	190.75	52.49	248.37	132	491.22	190.66	52.47	248.08
7	494.47	191.87	52.91	249.70	70	491.60	191.02	52.33	248.25	133	493.51	191.44	52.58	249.49
8	492.79	191.45	52.49	248.85	71	490.55	190.21	52.39	247.95	134	492.63	191.62	52.43	248.58
9	492.89	191.68	52.41	248.80	72	497.25	193.07	52.88	251.31	135	492.66	191.41	52.60	248.65
10	492.31	191.16	52.79	248.36	73	491.71	191.15	52.42	248.13	136	492.59	191.04	52.64	248.92
11	492.12	190.99	52.55	248.58	74	492.44	191.14	52.80	248.50	137	492.11	191.17	52.61	248.33
12	491.63	190.85	52.50	248.29	75	492.38	191.10	52.72	248.56	138	492.33	191.33	52.56	248.44
13	492.36	191.11	52.47	248.79	76	492.10	191.22	52.38	248.49	139	491.83	191.11	52.50	248.21
14	492.96	191.61	52.35	248.99	77	492.03	191.19	52.45	248.38	140	492.48	191.45	52.58	248.46
15	493.22	191.36	52.99	248.87	78	493.78	191.40	52.91	249.47	141	491.57	190.78	52.33	248.47
16	492.61	190.98	52.82	248.81	79	492.23	191.10	52.66	248.48	142	494.46	192.00	53.03	249.42
17	492.72	191.39	52.48	248.86	80	492.21	191.02	52.71	248.48	143	492.42	191.14	52.61	248.67
18	492.35	191.05	52.70	248.59	81	492.49	191.49	52.52	248.48	144	492.32	191.29	52.56	248.47
19	491.95	190.93	52.61	248.41	82	492.73	191.25	52.52	248.97	145	492.41	191.17	52.56	248.67
20	492.77	191.36	52.64	248.77	83	492.08	190.81	52.71	248.56	146	492.37	191.55	52.49	248.33
21	492.48	191.64	52.61	248.23	84	492.49	191.13	52.30	249.06	147	492.25	191.03	52.53	248.69
22	491.24	190.62	52.41	248.21	85	492.01	191.09	52.33	248.59	148	492.50	191.02	52.46	249.02
23	493.45	191.86	52.77	248.82	86	490.94	190.35	52.50	248.09	149	492.11	191.10	52.68	248.34
24	491.83	191.31	52.53	247.99	87	493.32	191.60	52.80	248.92	150	492.00	191.30	52.60	248.11
25	493.21	191.50	52.71	248.99	88	492.40	191.13	52.74	248.53	151	492.10	191.00	52.52	248.59
26	492.30	190.85	52.62	248.83	89	492.34	191.28	52.59	248.46	152	492.85	191.15	52.72	248.99
27	492.75	191.14	52.67	248.94	90	492.42	191.23	52.58	248.60	153	493.23	191.53	52.67	249.03
28	493.29	191.75	52.65	248.90	91	493.02	191.31	52.61	249.10	154	489.43	189.97	52.30	247.16
29	492.71	191.35	52.30	249.05	92	492.47	191.37	52.55	248.55	155	493.14	191.44	52.64	249.06
30	491.84	190.69	52.54	248.61	93	493.10	191.36	52.89	248.85	156	495.14	192.15	53.24	249.75
31	492.07	191.33	52.37	248.37	94	491.74	191.12	52.41	248.20	157	492.64	191.47	52.60	248.58
32	493.15	191.36	52.54	249.25	95	491.61	190.96	52.63	248.02	158	492.86	191.09	52.64	249.14
33	489.58	189.98	52.26	247.35	96	492.55	191.22	52.80	248.52	159	493.22	191.76	52.67	248.79
34	495.24	192.52	52.64	250.08	97	492.99	191.47	52.87	248.66	160	492.16	191.29	52.35	248.52
35	491.20	190.86	52.41	247.94	98	491.80	190.86	52.49	248.45	161	491.66	190.72	52.48	248.47
36	491.07	191.01	52.47	247.59	99	493.65	191.50	52.76	249.40	162	492.45	191.20	52.58	248.67
37	495.49	191.86	52.83	250.80	100	492.97	191.19	53.00	248.78	163	491.67	190.70	52.50	248.48
38	492.25	190.89	52.57	248.79	101	491.79	191.15	52.60	248.04	164	492.66	191.21	52.53	248.92
39	492.48	191.30	52.63	248.54	102	493.25	191.34	52.62	249.29	165	493.02	191.34	52.70	248.98
40	492.64	191.04	52.58	249.03	103	492.38	191.39	52.55	248.44	166	493.62	191.60	52.72	249.30
41	491.91	191.12	52.45	248.34	104	492.48	190.98	52.71	248.79	167	490.21	190.19	52.32	247.70
42	492.71	191.16	52.43	249.13	105	492.22	191.12	52.57	248.53	168	489.23	189.82	52.41	247.00
43	490.38	190.19	52.51	247.68	106	492.24	190.88	52.75	248.61	169	495.37	192.53	52.90	249.94
44	493.79	191.80	52.59	249.41	107	491.81	191.05	52.29	248.47	170	494.22	191.54	53.02	249.65
45	492.41	191.33	52.70	248.39	108	492.19	190.85	52.47	248.87	171	492.39	190.84	52.55	249.00
46	493.76	191.85	52.79	249.12	109	491.97	191.00	52.56	248.41	172	491.89	191.10	52.46	248.33
47	492.45	191.14	52.51	248.80	110	492.20	191.15	52.61	248.44	173	493.22	191.63	52.74	248.85
48	492.40	191.19	52.44	248.78	111	492.25	191.31	52.58	248.36	174	492.25	191.52	52.68	248.05
49	492.00	191.44	52.45	248.11	112	492.85	191.12	52.43	249.30	175	493.12	191.38	52.72	249.02
50	491.82	191.16	52.62	248.05	113	492.23	190.96	52.49	248.77	176	492.32	191.25	52.75	248.32
51	492.02	191.19	52.56	248.27	114	492.33	191.46	52.60	248.27	177	491.71	191.61	52.39	247.71
52	490.05	190.41	52.39	247.24	115	492.97	191.02	52.75	249.20	178	492.19	191.31	52.70	248.17
53	493.96	191.73	52.83	249.41	116	489.72	190.23	52.31	247.18	179	488.92	189.82	52.22	246.88
54	491.48	191.02	52.32	248.14	117	493.35	191.50	52.84	249.01	180	495.53	192.56	53.08	249.89
55	492.69	191.21	52.51	248.97	118	493.64	191.26	52.86	249.53	181	488.88	189.92	52.22	246.74
56	492.23	191.19	52.74	248.31	119	492.46	191.38	52.53	248.55	182	496.19	192.51	53.04	250.65
57	492.64	191.14	52.49	249.01	120	492.08	191.11	52.47	248.50	183	492.84	191.02	52.80	249.02
58	492.68	191.22	52.49	248.98	121	492.71	191.75	52.87	248.09	184	492.07	191.19	52.38	248.50
59	491.59	191.17	52.43	248.00	122	492.57	191.33	52.64	248.60					
60	492.19	190.86	52.67	248.66	123	492.49	190.75	52.77	248.97					
61	492.19	191.03	52.72	248.44	124	492.89	191.52	52.50	248.87					
62	493.26	191.18	52.86	249.22	125	492.31	191.13	52.75	248.43					

Sustainability – Data Rate Distribution Graph

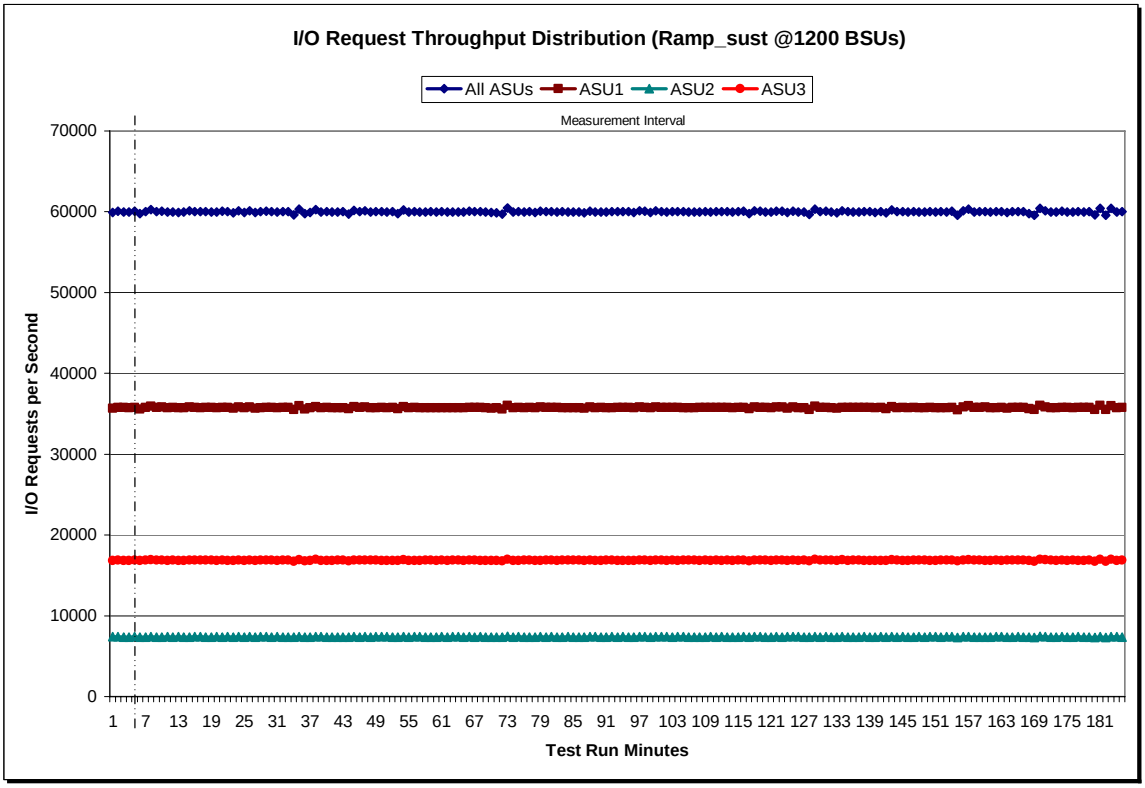


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	13:33:55	13:38:55	0-4	0:05:00
Measurement Interval	13:38:55	16:38:55	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	59,917.63	35,690.58	7,387.87	16,839.18	63	59,979.62	35,728.30	7,384.35	16,866.97	126	59,987.48	35,734.10	7,381.70	16,871.68
1	60,059.52	35,779.20	7,399.55	16,880.77	64	59,967.77	35,742.12	7,373.63	16,852.02	127	59,646.50	35,536.28	7,332.67	16,777.55
2	59,996.35	35,764.33	7,382.08	16,849.93	65	60,061.03	35,803.33	7,390.83	16,866.87	128	60,329.07	35,947.97	7,420.88	16,960.22
3	59,956.72	35,747.40	7,359.92	16,849.40	66	60,015.90	35,794.63	7,353.62	16,867.65	129	60,034.72	35,760.37	7,378.82	16,895.53
4	60,052.43	35,780.15	7,383.83	16,888.45	67	60,020.42	35,772.82	7,393.72	16,853.88	130	60,062.17	35,803.27	7,390.00	16,868.90
5	59,766.15	35,596.67	7,355.23	16,814.25	68	59,950.78	35,741.57	7,382.88	16,826.33	131	59,986.00	35,740.12	7,375.08	16,870.80
6	60,016.98	35,773.10	7,371.72	16,872.17	69	59,904.28	35,705.27	7,358.23	16,840.78	132	59,891.92	35,696.83	7,360.95	16,834.13
7	60,274.13	35,916.78	7,422.60	16,934.75	70	59,885.82	35,709.55	7,361.83	16,814.43	133	60,107.20	35,801.65	7,395.77	16,909.78
8	60,029.83	35,775.15	7,367.35	16,887.33	71	59,728.65	35,597.65	7,345.13	16,785.87	134	60,000.38	35,793.85	7,354.62	16,851.92
9	60,058.73	35,825.43	7,371.10	16,862.20	72	60,471.75	36,033.15	7,438.08	17,000.52	135	59,993.27	35,773.02	7,362.43	16,857.82
10	59,973.42	35,721.82	7,401.12	16,850.48	73	59,960.80	35,746.77	7,371.20	16,842.83	136	59,984.45	35,765.12	7,361.65	16,857.68
11	59,992.78	35,765.93	7,362.63	16,864.22	74	60,018.82	35,774.35	7,388.13	16,856.33	137	60,021.63	35,783.75	7,388.87	16,849.02
12	59,937.23	35,716.25	7,385.38	16,835.60	75	59,994.42	35,753.50	7,361.05	16,879.87	138	60,004.13	35,776.27	7,379.93	16,847.93
13	59,955.70	35,733.68	7,367.93	16,854.08	76	60,025.48	35,760.63	7,375.63	16,889.22	139	59,936.25	35,729.97	7,366.48	16,839.80
14	60,115.23	35,836.23	7,373.17	16,905.83	77	59,915.57	35,714.53	7,365.90	16,835.13	140	60,016.35	35,777.80	7,392.75	16,845.80
15	60,037.05	35,757.02	7,419.23	16,860.80	78	60,057.07	35,806.42	7,393.27	16,857.38	141	59,853.42	35,654.97	7,359.38	16,839.07
16	59,996.58	35,741.62	7,386.12	16,868.85	79	60,026.80	35,781.62	7,378.45	16,866.73	142	60,216.80	35,889.50	7,407.83	16,919.47
17	60,025.15	35,795.47	7,355.33	16,874.35	80	60,016.22	35,764.68	7,392.57	16,858.97	143	59,998.55	35,745.27	7,381.50	16,871.78
18	59,982.67	35,762.42	7,362.27	16,857.98	81	59,986.55	35,769.78	7,367.22	16,849.55	144	60,000.62	35,765.95	7,388.32	16,846.35
19	59,959.92	35,726.10	7,389.00	16,844.82	82	60,001.75	35,750.42	7,376.40	16,874.93	145	59,955.90	35,730.98	7,373.43	16,851.48
20	60,066.13	35,800.72	7,381.87	16,883.55	83	59,969.32	35,721.40	7,387.10	16,860.82	146	60,028.20	35,787.70	7,378.27	16,862.23
21	60,016.00	35,785.50	7,388.33	16,842.17	84	59,995.63	35,750.88	7,375.10	16,869.65	147	59,996.20	35,749.33	7,383.97	16,862.90
22	59,876.27	35,701.10	7,356.02	16,819.15	85	59,990.62	35,740.67	7,370.32	16,879.63	148	59,953.68	35,723.68	7,371.27	16,858.73
23	60,112.70	35,847.90	7,396.67	16,868.13	86	59,860.65	35,664.98	7,356.58	16,839.08	149	59,997.90	35,758.27	7,392.63	16,847.00
24	59,931.08	35,725.47	7,374.55	16,831.07	87	60,093.58	35,821.07	7,390.78	16,881.73	150	59,966.23	35,737.22	7,383.03	16,845.98
25	60,097.48	35,820.05	7,401.85	16,875.58	88	59,974.48	35,746.92	7,392.38	16,835.18	151	60,010.15	35,751.35	7,382.00	16,876.80
26	59,910.72	35,702.50	7,360.68	16,847.53	89	59,985.13	35,756.58	7,379.15	16,849.40	152	59,963.98	35,706.68	7,392.42	16,864.88
27	60,007.72	35,737.75	7,395.37	16,874.60	90	59,969.88	35,738.48	7,368.52	16,862.88	153	60,082.13	35,799.55	7,394.30	16,888.28
28	60,053.85	35,802.47	7,388.42	16,862.97	91	60,010.30	35,735.58	7,393.28	16,881.43	154	59,583.98	35,492.57	7,331.82	16,759.60
29	60,014.95	35,774.63	7,356.83	16,883.48	92	60,010.05	35,787.02	7,375.72	16,847.32	155	60,099.67	35,846.93	7,386.50	16,866.23
30	59,959.67	35,723.87	7,391.83	16,843.97	93	60,014.07	35,772.20	7,385.50	16,856.37	156	60,339.55	35,960.70	7,425.55	16,953.30
31	60,005.77	35,762.72	7,376.13	16,866.92	94	60,009.37	35,790.53	7,376.55	16,842.28	157	59,989.72	35,757.00	7,364.68	16,868.03
32	60,030.13	35,797.80	7,370.83	16,861.50	95	59,911.57	35,726.95	7,375.75	16,808.87	158	60,023.72	35,762.17	7,378.47	16,883.08
33	59,635.83	35,546.10	7,333.77	16,755.97	96	60,112.03	35,834.27	7,400.07	16,877.70	159	60,041.10	35,818.98	7,371.28	16,850.83
34	60,349.13	35,971.47	7,422.85	16,954.82	97	60,060.43	35,793.75	7,398.43	16,868.25	160	59,970.45	35,747.32	7,374.43	16,848.70
35	59,747.72	35,595.72	7,349.20	16,802.80	98	59,921.92	35,724.53	7,379.63	16,817.75	161	60,006.08	35,752.52	7,391.03	16,862.53
36	59,902.07	35,716.92	7,372.07	16,813.08	99	60,128.00	35,821.60	7,414.05	16,892.35	162	59,997.23	35,759.48	7,385.50	16,852.25
37	60,274.07	35,890.73	7,422.70	16,960.63	100	60,038.05	35,786.77	7,384.60	16,866.68	163	59,943.12	35,702.52	7,377.82	16,862.78
38	59,981.82	35,733.38	7,398.47	16,849.97	101	59,994.45	35,758.30	7,385.65	16,850.50	164	60,016.50	35,770.10	7,380.20	16,866.20
39	60,014.10	35,781.00	7,381.10	16,852.00	102	60,032.20	35,761.32	7,371.65	16,899.23	165	60,033.20	35,775.00	7,389.00	16,869.20
40	59,953.50	35,728.92	7,371.20	16,853.38	103	60,016.20	35,786.48	7,386.18	16,843.53	166	60,017.25	35,785.03	7,364.62	16,867.60
41	59,973.63	35,734.48	7,377.77	16,861.38	104	60,005.03	35,748.55	7,394.42	16,862.07	167	59,791.70	35,624.33	7,354.68	16,812.68
42	60,000.22	35,752.60	7,364.95	16,882.67	105	59,971.40	35,736.02	7,375.77	16,859.62	168	59,578.05	35,512.63	7,321.72	16,743.70
43	59,741.45	35,617.90	7,340.48	16,783.07	106	59,957.12	35,715.33	7,377.73	16,864.05	169	60,427.92	36,026.28	7,442.65	16,958.98
44	60,167.20	35,875.15	7,400.08	16,891.97	107	59,988.07	35,767.67	7,364.87	16,855.53	170	60,146.13	35,829.50	7,407.22	16,909.42
45	60,013.47	35,769.08	7,379.07	16,865.32	108	59,999.95	35,759.65	7,365.33	16,874.97	171	59,980.83	35,707.93	7,381.43	16,891.47
46	60,133.77	35,853.28	7,388.85	16,891.63	109	59,993.20	35,761.50	7,383.27	16,848.43	172	59,976.52	35,752.10	7,367.87	16,856.55
47	59,970.37	35,719.18	7,369.55	16,881.63	110	60,004.12	35,757.68	7,381.37	16,865.07	173	60,067.83	35,798.57	7,397.27	16,872.00
48	59,996.98	35,754.73	7,383.80	16,858.45	111	60,016.23	35,788.92	7,390.77	16,836.55	174	59,993.08	35,764.95	7,382.93	16,845.20
49	60,000.90	35,768.93	7,384.60	16,847.37	112	60,002.12	35,768.77	7,374.78	16,858.57	175	59,981.82	35,735.88	7,382.98	16,862.95
50	59,972.27	35,737.47	7,390.35	16,844.45	113	59,949.17	35,727.37	7,373.50	16,848.30	176	60,004.42	35,763.42	7,384.02	16,856.98
51	60,006.70	35,779.73	7,369.93	16,857.03	114	60,001.10	35,765.22	7,371.87	16,864.02	177	59,978.17	35,789.07	7,363.57	16,825.53
52	59,779.62	35,605.78	7,353.23	16,820.60	115	60,051.07	35,775.38	7,408.50	16,867.18	178	60,001.88	35,757.40	7,382.18	16,862.30
53	60,217.87	35,881.42	7,420.37	16,916.08	116	59,773.67	35,631.47	7,345.28	16,796.92	179	59,603.68	35,526.17	7,330.68	16,746.83
54	59,949.80	35,741.92	7,373.12	16,834.77	117	60,108.55	35,829.88	7,392.45	16,886.22	180	60,427.47	36,018.38	7,433.23	16,975.85
55	60,005.93	35,765.12	7,386.53	16,854.28	118	60,070.90	35,786.78	7,391.27	16,892.85	181	59,587.33	35,527.32	7,331.08	16,728.93
56	59,964.88	35,725.38	7,390.77	16,848.73	119	59,987.93	35,764.33	7,359.93	16,863.67	182	60,412.72	36,002.40	7,430.20	16,980.12
57	59,982.97	35,741.92	7,359.47	16,881.58	120	59,958.47	35,733.25	7,372.48	16,852.73	183	59,983.97	35,755.38	7,388.15	16,840.43
58	60,018.52	35,753.30	7,380.42	16,884.80	121	60,068.08	35,817.17	7,389.12	16,861.80	184	60,012.53	35,765.63	7,369.08	16,877.82
59	59,954.25	35,751.97	7,360.03	16,842.25	122	60,056.62	35,809.10	7,368.23	16,879.28	Average	59,999.93	35,759.37	7,379.84	16,860.72
60	60,001.00	35,735.52	7,388.57	16,876.92	123	59,921.20	35,682.47	7,392.23	16,846.50					
61	59,986.80	35,750.73	7,381.57	16,854.50	124	60,093.35	35,812.33	7,390.80	16,890.22					
62	59,993.45	35,723.08	7,384.32	16,886.05	125	59,985.85	35,739.37	7,396.72	16,849.77					

Sustainability – I/O Request Throughput Distribution Graph

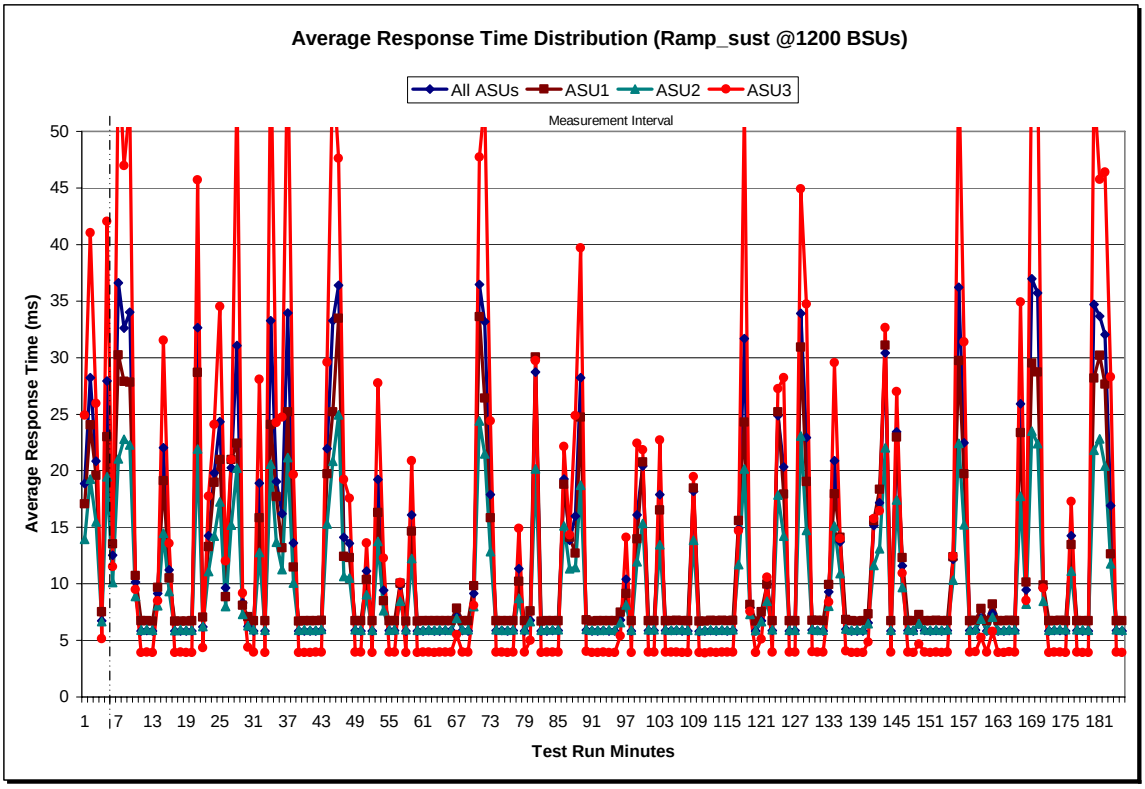


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	13:33:55	13:38:55	0-4	0:05:00
Measurement Interval	13:38:55	16:38:55	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	18.88	17.06	13.94	24.89	63	5.84	6.72	5.92	3.94	126	5.85	6.74	5.90	3.95
1	28.23	24.04	19.26	41.03	64	5.86	6.74	5.93	3.96	127	33.89	30.92	23.07	44.92
2	20.85	19.57	15.47	25.94	65	5.85	6.73	5.91	3.95	128	22.93	19.06	14.72	34.72
3	6.74	7.51	6.68	5.13	66	7.09	7.86	6.94	5.52	129	5.90	6.78	5.97	4.01
4	27.92	22.99	19.46	42.06	67	5.86	6.74	5.94	3.95	130	5.87	6.75	5.92	3.97
5	12.54	13.53	10.12	11.52	68	5.84	6.72	5.93	3.94	131	5.85	6.73	5.91	3.94
6	36.62	30.25	21.06	56.92	69	9.13	9.84	8.00	8.11	132	9.28	9.95	8.03	8.39
7	32.62	27.89	22.79	46.96	70	36.46	33.64	24.41	47.73	133	20.87	17.96	15.12	29.54
8	34.01	27.81	22.29	52.27	71	33.19	26.42	21.50	52.66	134	13.70	14.13	10.92	14.02
9	10.15	10.72	8.89	9.49	72	17.88	15.84	12.86	24.42	135	5.96	6.83	6.03	4.08
10	5.83	6.71	5.91	3.93	73	5.85	6.72	5.94	3.95	136	5.84	6.72	5.92	3.94
11	5.87	6.75	5.97	3.97	74	5.86	6.74	5.91	3.96	137	5.83	6.71	5.93	3.93
12	5.82	6.71	5.89	3.92	75	5.84	6.72	5.91	3.94	138	5.84	6.72	5.93	3.94
13	9.15	9.68	8.08	8.50	76	5.85	6.73	5.93	3.96	139	6.54	7.35	6.47	4.86
14	22.04	19.13	14.47	31.53	77	11.34	10.21	8.71	14.89	140	15.16	15.60	11.64	15.76
15	11.23	10.53	9.34	13.56	78	5.85	6.73	5.93	3.95	141	17.18	18.37	13.09	16.45
16	5.83	6.71	5.88	3.93	79	6.75	7.60	6.67	4.99	142	30.42	31.10	22.03	32.66
17	5.84	6.71	5.93	3.95	80	28.74	30.05	20.16	29.72	143	5.84	6.73	5.91	3.95
18	5.83	6.70	5.92	3.93	81	5.83	6.71	5.91	3.93	144	23.42	22.97	17.41	27.01
19	5.84	6.73	5.91	3.94	82	5.85	6.73	5.93	3.95	145	11.60	12.30	9.69	10.96
20	32.64	28.68	21.93	45.73	83	5.86	6.74	5.93	3.97	146	5.86	6.74	5.93	3.96
21	6.19	7.05	6.22	4.35	84	5.86	6.74	5.93	3.96	147	5.83	6.72	5.89	3.93
22	14.25	13.27	11.07	17.73	85	19.28	18.77	15.13	22.15	148	6.45	7.28	6.47	4.69
23	19.81	18.96	14.20	24.10	86	13.84	14.12	11.35	14.34	149	5.86	6.74	5.93	3.96
24	24.32	20.98	17.24	34.53	87	15.97	12.71	11.46	24.88	150	5.85	6.73	5.90	3.94
25	9.64	8.85	7.99	12.03	88	28.20	24.75	18.71	39.72	151	5.87	6.75	5.94	3.97
26	20.27	20.99	15.18	20.98	89	5.91	6.79	5.97	4.03	152	5.84	6.72	5.91	3.94
27	31.07	22.41	20.23	54.16	90	5.83	6.71	5.90	3.94	153	5.86	6.75	5.95	3.95
28	8.31	8.11	7.32	9.18	91	5.84	6.72	5.90	3.93	154	12.15	12.38	10.32	12.45
29	6.23	7.08	6.30	4.39	92	5.86	6.74	5.92	3.96	155	36.21	29.72	22.43	56.04
30	5.85	6.72	5.95	3.95	93	5.85	6.73	5.94	3.94	156	22.46	19.74	15.22	31.39
31	18.90	15.85	12.80	28.06	94	5.85	6.73	5.90	3.94	157	5.85	6.74	5.92	3.96
32	5.84	6.72	5.92	3.93	95	6.80	7.50	6.59	5.40	158	5.89	6.77	5.96	3.99
33	33.26	24.07	20.59	58.30	96	10.42	9.15	8.14	14.10	159	6.98	7.82	6.86	5.24
34	19.06	17.71	13.68	24.26	97	5.84	6.72	5.92	3.93	160	5.85	6.73	5.89	3.95
35	16.20	13.19	11.27	24.73	98	16.10	13.98	11.96	22.43	161	7.39	8.22	7.04	5.79
36	33.95	25.19	21.17	58.17	99	20.41	20.77	15.34	21.87	162	5.84	6.73	5.92	3.93
37	13.61	11.49	10.07	19.64	100	5.86	6.75	5.93	3.96	163	5.83	6.72	5.91	3.92
38	5.83	6.71	5.92	3.92	101	5.87	6.75	5.95	3.97	164	5.89	6.77	5.96	3.98
39	5.85	6.73	5.93	3.94	102	17.88	16.51	13.45	22.70	165	5.85	6.73	5.93	3.95
40	5.84	6.73	5.92	3.94	103	5.86	6.74	5.92	3.96	166	25.93	23.38	17.75	34.93
41	5.85	6.72	5.92	3.96	104	5.85	6.74	5.91	3.95	167	9.46	10.16	8.19	8.55
42	5.88	6.76	5.97	3.98	105	5.86	6.75	5.92	3.95	168	36.96	29.53	23.50	58.61
43	21.95	19.73	15.30	29.59	106	5.84	6.72	5.93	3.94	169	35.70	28.74	22.38	56.33
44	33.27	25.19	20.83	55.86	107	5.84	6.72	5.91	3.94	170	9.65	9.91	8.47	9.62
45	36.41	33.49	24.94	47.61	108	18.17	18.46	13.84	19.46	171	5.83	6.71	5.91	3.93
46	14.12	12.42	10.66	19.22	109	5.81	6.70	5.86	3.91	172	5.85	6.73	5.93	3.95
47	13.58	12.32	10.53	17.57	110	5.82	6.71	5.89	3.90	173	5.88	6.76	5.96	3.97
48	5.85	6.73	5.92	3.96	111	5.87	6.75	5.93	3.97	174	5.84	6.72	5.92	3.93
49	5.85	6.73	5.91	3.95	112	5.85	6.74	5.92	3.93	175	14.24	13.45	11.12	17.28
50	11.11	10.37	9.04	13.59	113	5.87	6.75	5.95	3.97	176	5.85	6.73	5.92	3.95
51	5.84	6.72	5.91	3.94	114	5.85	6.73	5.92	3.94	177	5.84	6.72	5.93	3.93
52	19.21	16.31	13.76	27.76	115	5.87	6.75	5.93	3.96	178	5.84	6.73	5.90	3.94
53	9.45	8.49	7.62	12.28	116	14.85	15.59	11.69	14.68	179	34.69	28.18	21.81	54.14
54	5.85	6.74	5.92	3.95	117	31.67	24.29	20.16	52.36	180	33.67	30.21	22.81	45.75
55	5.87	6.74	5.95	3.97	118	7.89	8.16	7.32	7.56	181	32.02	27.66	20.40	46.39
56	9.86	10.03	8.46	10.11	119	5.82	6.70	5.88	3.91	182	16.92	12.62	11.79	28.28
57	5.84	6.71	5.94	3.94	120	6.73	7.52	6.65	5.10	183	5.86	6.75	5.93	3.95
58	16.09	14.63	12.23	20.87	121	9.95	9.96	8.47	10.58	184	5.83	6.72	5.91	3.93
59	5.82	6.71	5.89	3.92	122	5.86	6.74	5.94	3.96	Average	12.17	11.75	9.64	14.18
60	5.84	6.73	5.89	3.95	123	24.86	25.18	17.85	27.26					
61	5.86	6.74	5.93	3.96	124	20.36	17.91	14.23	28.21					
62	5.83	6.72	5.89	3.94	125	5.85	6.73	5.91	3.95					

Sustainability – Average Response Time (ms) Distribution Graph



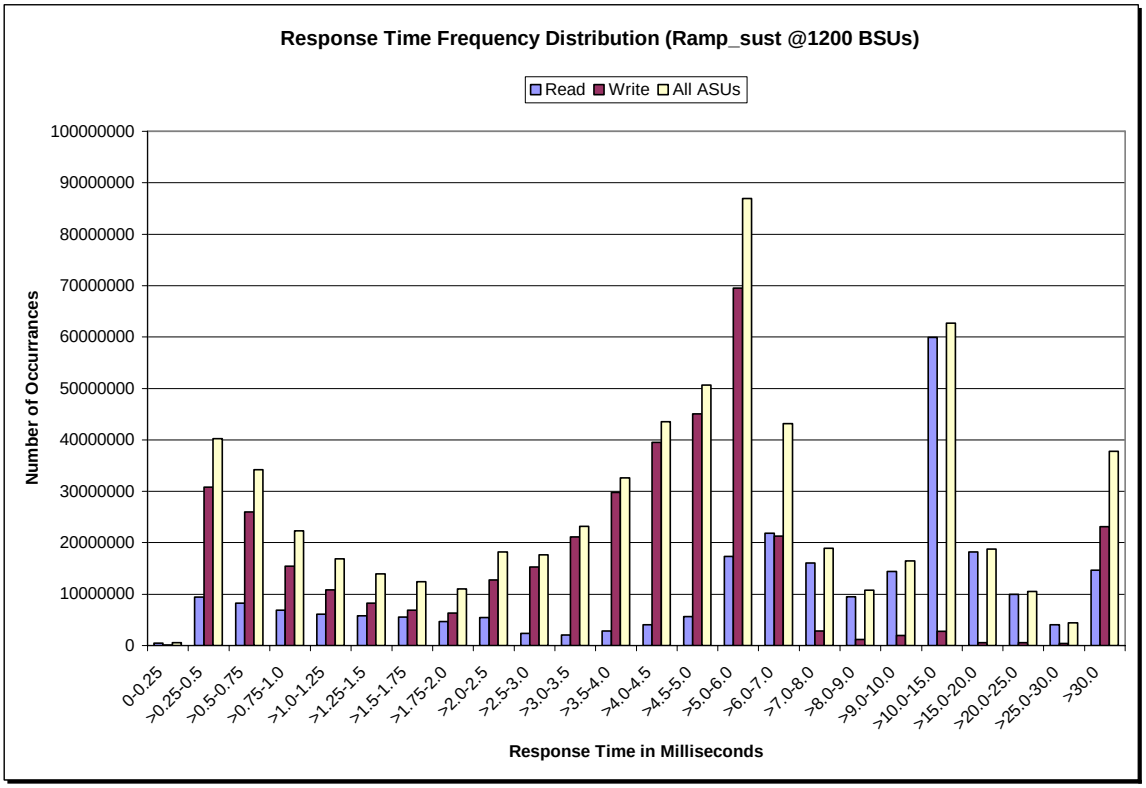
Sustainability – Response Time Frequency Distribution Data

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	493,330	9,435,465	8,268,418	6,877,339	6,057,466	5,745,673	5,505,861	4,679,406
Write	85,747	30,770,406	25,956,899	15,455,220	10,846,076	8,211,409	6,893,229	6,349,678
All ASUs	579,077	40,205,871	34,225,317	22,332,559	16,903,542	13,957,082	12,399,090	11,029,084
ASU1	430,022	22,745,816	17,382,973	11,468,676	8,869,081	7,660,923	7,009,952	6,206,503
ASU2	121,467	5,956,359	4,893,008	3,371,322	2,639,604	2,289,264	2,094,523	1,828,170
ASU3	27,588	11,503,696	11,949,336	7,492,561	5,394,857	4,006,895	3,294,615	2,994,411

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	5,439,793	2,341,045	2,079,966	2,849,228	4,040,034	5,643,153	17,373,261	21,854,358
Write	12,767,452	15,296,447	21,113,497	29,785,822	39,521,373	45,067,223	69,528,350	21,324,112
All ASUs	18,207,245	17,637,492	23,193,463	32,635,050	43,561,407	50,710,376	86,901,611	43,178,470
ASU1	9,576,785	8,417,381	10,815,190	15,244,853	20,507,597	24,342,540	45,226,957	28,477,096
ASU2	2,666,983	2,126,055	2,626,737	3,631,545	4,758,532	5,382,028	8,724,502	4,184,700
ASU3	5,963,477	7,094,056	9,751,536	13,758,652	18,295,278	20,985,808	32,950,152	10,516,674

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	16,038,128	9,537,716	14,432,258	59,971,770	18,236,398	9,964,484	4,023,427	14,675,481
Write	2,877,725	1,205,495	2,014,519	2,761,555	553,191	533,624	409,494	23,106,993
All ASUs	18,915,853	10,743,211	16,446,777	62,733,325	18,789,589	10,498,108	4,432,921	37,782,474
ASU1	15,329,661	8,938,582	13,768,145	54,007,912	15,862,112	8,490,358	3,293,638	22,128,269
ASU2	2,104,023	1,213,703	1,712,883	7,386,668	2,609,158	1,737,279	915,770	4,727,958
ASU3	1,482,169	590,926	965,749	1,338,745	318,319	270,471	223,513	10,926,247

Sustainability – Response Time Frequency Distribution Graph



Sustainability – Measured Intensity Multiplier and Coefficient of Variation

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

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 5.1.0 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.*

Primary Metrics Test – IOPS Test Phase

Clause 5.4.2.2

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 9.2.4.7.2

For the IOPS Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 115.

IOPS Test Results File

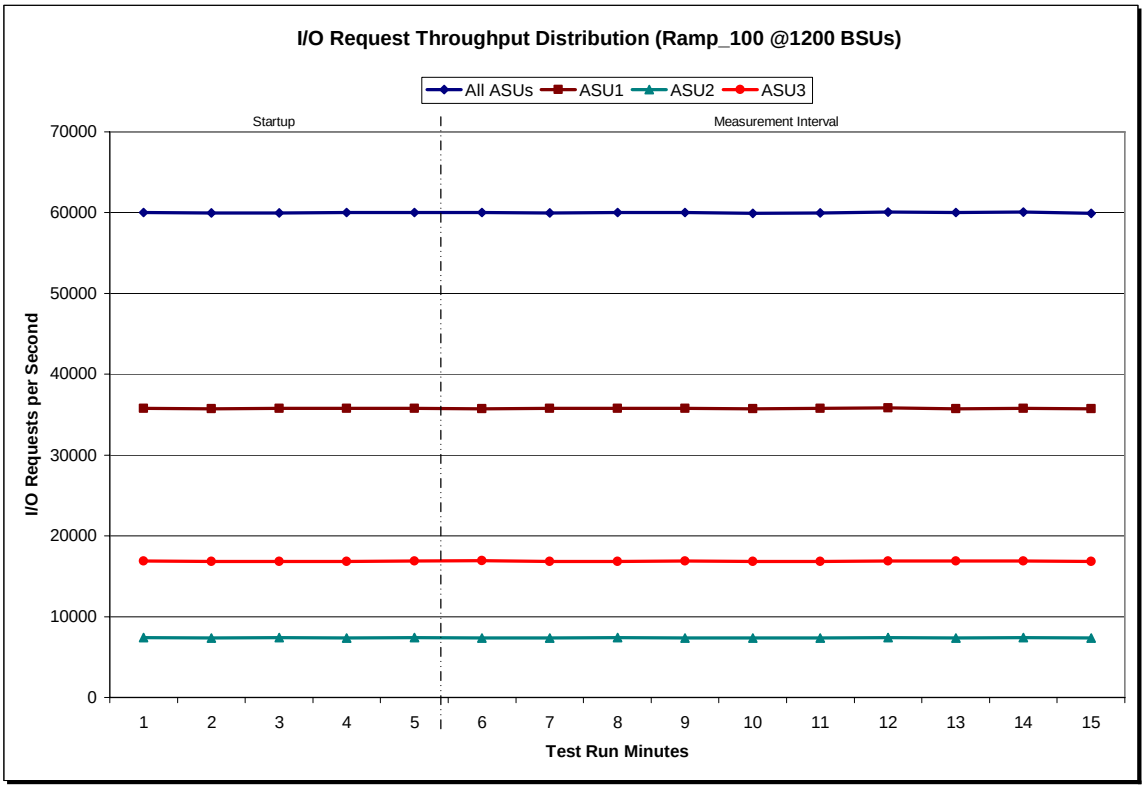
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:39:44	16:44:45	0-4	0:05:01
Measurement Interval	16:44:45	16:54:45	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	60,037.77	35,760.53	7,393.85	16,883.38
1	59,958.20	35,736.17	7,367.97	16,854.07
2	59,990.58	35,759.90	7,385.30	16,845.38
3	60,002.78	35,781.42	7,370.43	16,850.93
4	60,021.20	35,767.67	7,384.00	16,869.53
5	60,043.00	35,752.20	7,378.88	16,911.92
6	59,972.73	35,761.48	7,369.25	16,842.00
7	60,012.97	35,776.28	7,391.13	16,845.55
8	60,011.37	35,782.87	7,356.55	16,871.95
9	59,945.30	35,721.93	7,377.90	16,845.47
10	59,988.93	35,788.92	7,369.93	16,830.08
11	60,072.38	35,817.35	7,387.20	16,867.83
12	59,997.27	35,751.00	7,372.30	16,873.97
13	60,056.32	35,779.88	7,390.78	16,885.65
14	59,934.85	35,747.08	7,362.20	16,825.57
Average	60,003.51	35,767.90	7,375.61	16,860.00

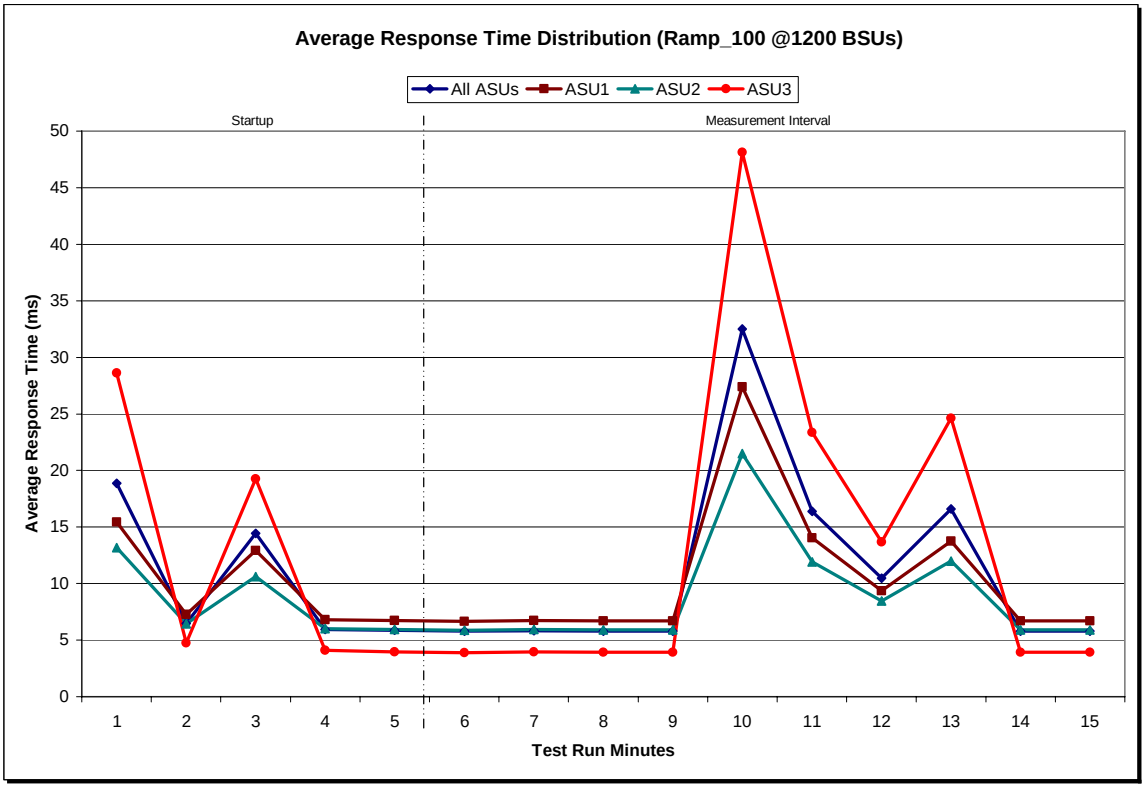
IOPS Test Run – I/O Request Throughput Distribution Graph



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

1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:39:44	16:44:45	0-4	0:05:01
Measurement Interval	16:44:45	16:54:45	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	18.86	15.44	13.16	28.61
1	6.47	7.29	6.44	4.75
2	14.42	12.93	10.62	19.27
3	5.95	6.81	6.02	4.09
4	5.85	6.72	5.93	3.97
5	5.78	6.66	5.87	3.89
6	5.84	6.71	5.93	3.96
7	5.81	6.69	5.91	3.91
8	5.81	6.69	5.89	3.92
9	32.50	27.39	21.50	48.13
10	16.38	14.02	11.92	23.35
11	10.46	9.35	8.47	13.67
12	16.60	13.76	12.00	24.64
13	5.81	6.68	5.89	3.92
14	5.81	6.69	5.89	3.91
Average	11.08	10.46	8.93	13.33

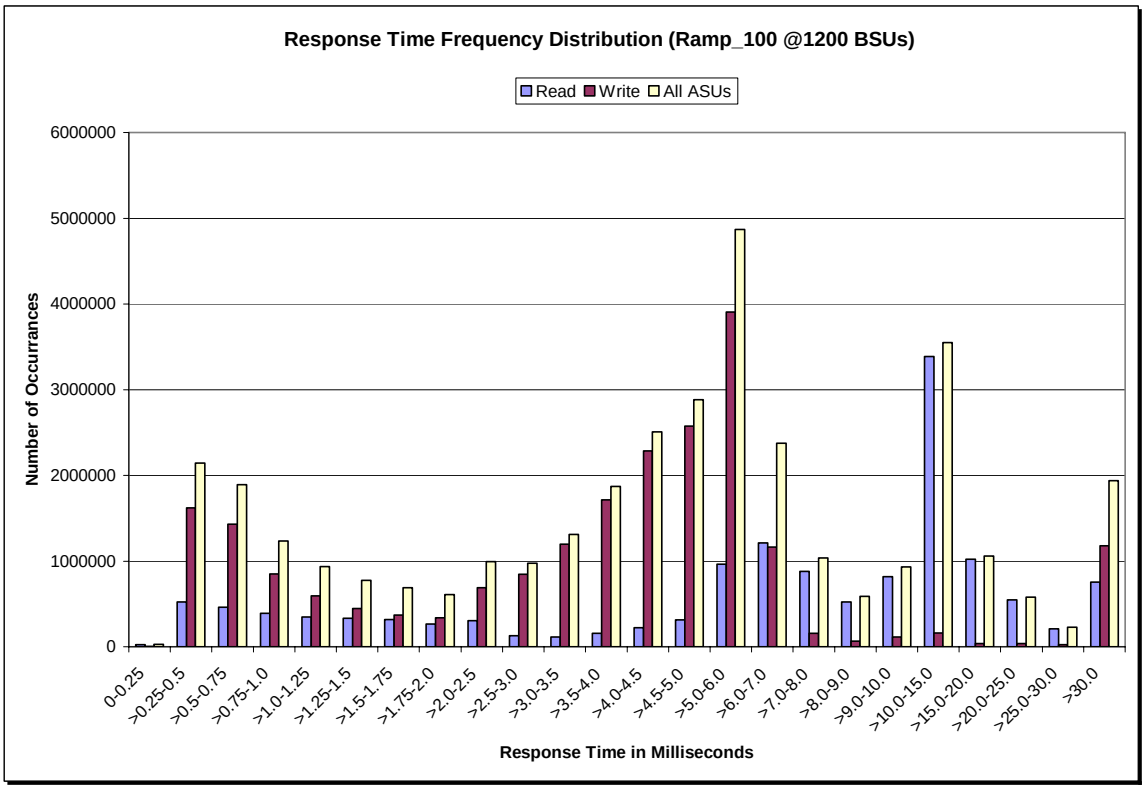
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	24,170	521,602	461,454	387,611	344,825	330,322	316,602	268,150
Write	3,808	1,622,191	1,429,164	849,259	592,148	445,701	370,429	339,648
All ASUs	27,978	2,143,793	1,890,618	1,236,870	936,973	776,023	687,031	607,798
ASU1	20,936	1,220,159	964,109	638,870	495,575	430,679	393,753	346,293
ASU2	5,793	319,049	270,304	186,729	146,881	127,457	116,400	101,423
ASU3	1,249	604,585	656,205	411,271	294,517	217,887	176,878	160,082
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	304,639	128,188	113,388	156,286	222,457	311,464	963,837	1,209,801
Write	689,504	845,005	1,195,621	1,716,842	2,287,089	2,573,145	3,904,542	1,166,137
All ASUs	994,143	973,193	1,309,009	1,873,128	2,509,546	2,884,609	4,868,379	2,375,938
ASU1	525,587	465,481	608,853	872,680	1,176,564	1,379,077	2,528,507	1,570,937
ASU2	146,856	117,487	148,579	208,735	274,860	306,406	487,680	229,653
ASU3	321,700	390,225	551,577	791,713	1,058,122	1,199,126	1,852,192	575,348
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	876,777	523,026	816,662	3,386,880	1,021,510	544,892	206,723	755,728
Write	157,613	66,531	115,021	159,683	36,628	36,340	22,171	1,180,491
All ASUs	1,034,390	589,557	931,683	3,546,563	1,058,138	581,232	228,894	1,936,219
ASU1	837,845	490,482	779,284	3,049,694	889,888	469,297	170,540	1,135,369
ASU2	115,715	66,500	97,833	420,245	148,047	93,789	46,147	242,751
ASU3	80,830	32,575	54,566	76,624	20,203	18,146	12,207	558,099

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
36,001,705	34,065,486	1,936,219

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2811	0.0700	0.2100	0.0180	0.0490	0.0350	0.2810
COV	0.002	0.001	0.001	0.001	0.003	0.002	0.002	0.001

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 5.1.0 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.*

Primary Metrics Test – Response Time Ramp Test Phase

Clause 5.4.2.3

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 12.

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 9.2.4.7.3

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 115.

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 - 1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:39:44	16:44:45	0-4	0:05:01
Measurement Interval	16:44:45	16:54:45	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	60,037.77	35,760.53	7,393.85	16,883.38
1	59,958.20	35,736.17	7,367.97	16,854.07
2	59,990.58	35,759.90	7,385.30	16,845.38
3	60,002.78	35,781.42	7,370.43	16,850.93
4	60,021.20	35,767.67	7,384.00	16,869.53
5	60,043.00	35,752.20	7,378.88	16,911.92
6	59,972.73	35,761.48	7,369.25	16,842.00
7	60,012.97	35,776.28	7,391.13	16,845.55
8	60,011.37	35,782.87	7,356.55	16,871.95
9	59,945.30	35,721.93	7,377.90	16,845.47
10	59,988.93	35,788.92	7,369.93	16,830.08
11	60,072.38	35,817.35	7,387.20	16,867.83
12	59,997.27	35,751.00	7,372.30	16,873.97
13	60,056.32	35,779.88	7,390.78	16,885.65
14	59,934.85	35,747.08	7,362.20	16,825.57
Average	60,003.51	35,767.90	7,375.61	16,860.00

95% Load Level - 1140 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:55:25	17:00:26	0-4	0:05:01
Measurement Interval	17:00:26	17:10:26	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	57,054.00	33,993.65	7,018.37	16,041.98
1	56,964.70	33,932.63	7,003.28	16,028.78
2	56,976.47	33,980.20	7,006.62	15,989.65
3	57,009.15	33,985.53	7,020.37	16,003.25
4	56,983.77	33,981.68	7,005.25	15,996.83
5	56,956.77	33,948.35	6,988.57	16,019.85
6	57,027.18	33,999.00	7,009.67	16,018.52
7	56,928.12	33,935.73	7,008.07	15,984.32
8	56,983.32	33,959.47	7,009.75	16,014.10
9	56,951.65	33,931.97	7,008.27	16,011.42
10	56,995.03	33,985.25	7,004.27	16,005.52
11	57,076.47	34,023.37	7,016.03	16,037.07
12	56,998.88	33,966.18	7,006.07	16,026.63
13	57,015.42	33,986.88	7,015.93	16,012.60
14	57,047.28	34,031.53	7,013.87	16,001.88
Average	56,998.01	33,976.77	7,008.05	16,013.19

90% Load Level - 1080 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	17:11:06	17:16:07	0-4	0:05:01
Measurement Interval	17:16:07	17:26:07	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	54,065.20	32,239.32	6,643.62	15,182.27
1	54,016.87	32,195.03	6,626.58	15,195.25
2	54,036.33	32,192.92	6,651.58	15,191.83
3	54,044.32	32,211.07	6,653.58	15,179.67
4	53,962.18	32,153.88	6,638.45	15,169.85
5	53,962.32	32,198.88	6,628.45	15,134.98
6	54,013.78	32,177.28	6,646.43	15,190.07
7	53,950.62	32,148.18	6,643.42	15,159.02
8	54,036.28	32,201.50	6,651.67	15,183.12
9	54,005.88	32,169.68	6,650.30	15,185.90
10	54,000.82	32,160.25	6,662.93	15,177.63
11	54,003.15	32,185.03	6,655.77	15,162.35
12	54,025.32	32,201.63	6,644.58	15,179.10
13	54,056.03	32,241.33	6,641.55	15,173.15
14	53,934.72	32,147.10	6,638.58	15,149.03
Average	53,998.89	32,183.09	6,646.37	15,169.44

80% Load Level - 960 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	17:26:47	17:31:48	0-4	0:05:01
Measurement Interval	17:31:48	17:41:48	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	48,015.53	28,616.88	5,905.22	13,493.43
1	47,988.27	28,625.15	5,899.33	13,463.78
2	47,963.18	28,570.65	5,913.05	13,479.48
3	47,993.77	28,601.13	5,904.58	13,488.05
4	47,992.48	28,591.27	5,892.93	13,508.28
5	47,968.72	28,609.13	5,891.98	13,467.60
6	47,971.65	28,613.52	5,885.40	13,472.73
7	47,982.10	28,612.53	5,890.65	13,478.92
8	48,015.03	28,626.78	5,899.55	13,488.70
9	47,972.15	28,584.83	5,897.93	13,489.38
10	48,031.88	28,641.25	5,894.83	13,495.80
11	47,985.58	28,563.48	5,896.25	13,525.85
12	47,944.35	28,554.17	5,896.35	13,493.83
13	47,985.53	28,615.23	5,891.88	13,478.42
14	48,042.10	28,614.13	5,924.55	13,503.42
Average	47,989.91	28,603.51	5,896.94	13,489.47

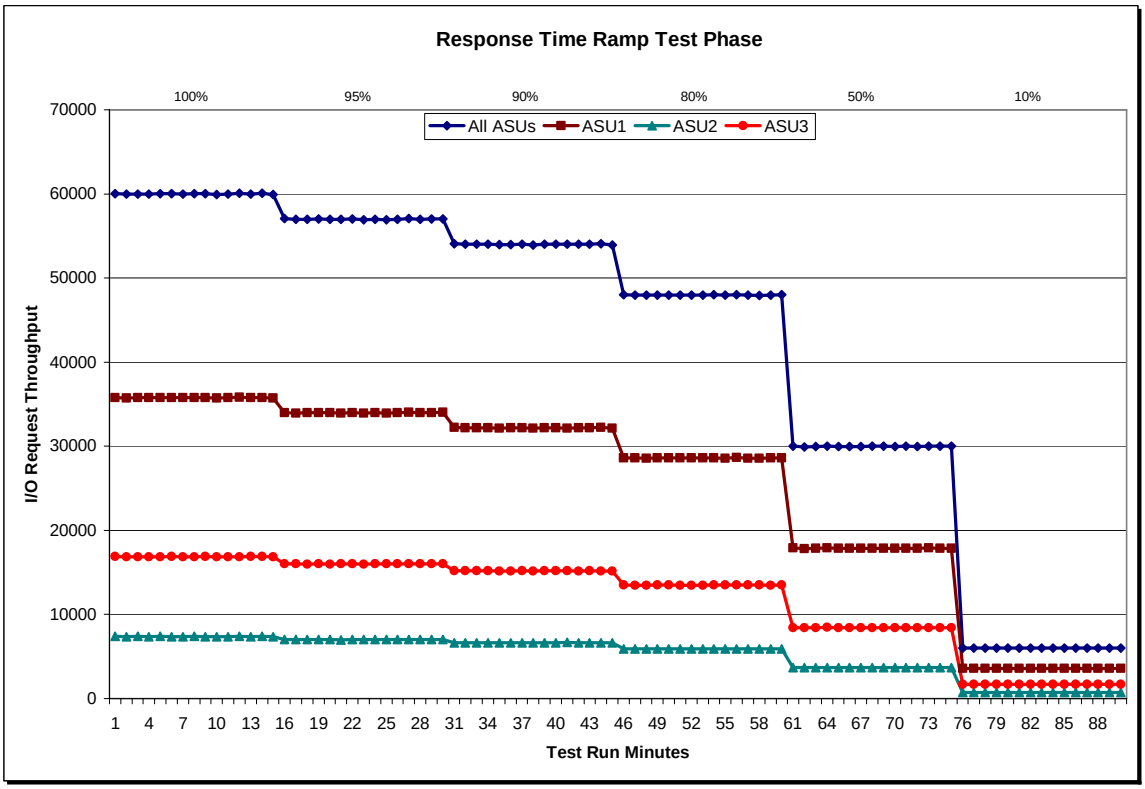
50% Load Level - 600 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	17:42:27	17:47:28	0-4	0:05:01
Measurement Interval	17:47:28	17:57:28	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	30,020.75	17,898.15	3,678.77	8,443.83
1	29,927.12	17,825.97	3,682.28	8,418.87
2	29,973.82	17,850.15	3,691.77	8,431.90
3	30,029.38	17,893.87	3,686.42	8,449.10
4	29,979.92	17,870.27	3,684.02	8,425.63
5	29,973.18	17,871.82	3,676.02	8,425.35
6	29,983.68	17,859.43	3,685.72	8,438.53
7	29,990.08	17,885.52	3,686.75	8,417.82
8	29,997.68	17,878.50	3,692.17	8,427.02
9	29,972.88	17,874.28	3,685.70	8,412.90
10	29,994.13	17,867.08	3,683.85	8,443.20
11	29,959.12	17,866.28	3,678.30	8,414.53
12	30,026.78	17,895.67	3,691.93	8,439.18
13	29,995.25	17,885.45	3,695.27	8,414.53
14	30,001.73	17,880.07	3,693.03	8,428.63
Average	29,989.45	17,876.41	3,686.87	8,426.17

10% Load Level - 120 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	17:58:07	18:03:08	0-4	0:05:01
Measurement Interval	18:03:08	18:13:08	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	6,009.63	3,586.37	735.92	1,687.35
1	5,984.55	3,569.27	734.75	1,680.53
2	5,994.90	3,558.60	741.63	1,694.67
3	5,995.27	3,570.25	735.18	1,689.83
4	6,008.50	3,585.55	734.52	1,688.43
5	6,002.52	3,582.07	736.63	1,683.82
6	5,991.80	3,567.08	742.17	1,682.55
7	6,003.85	3,576.17	737.45	1,690.23
8	6,001.97	3,573.35	738.43	1,690.18
9	6,005.22	3,583.15	734.93	1,687.13
10	5,990.52	3,573.03	736.25	1,681.23
11	6,010.83	3,578.75	743.45	1,688.63
12	6,002.35	3,582.00	735.87	1,684.48
13	6,021.78	3,601.05	743.12	1,677.62
14	5,981.75	3,567.98	738.55	1,675.22
Average	6,001.26	3,578.46	738.69	1,684.11

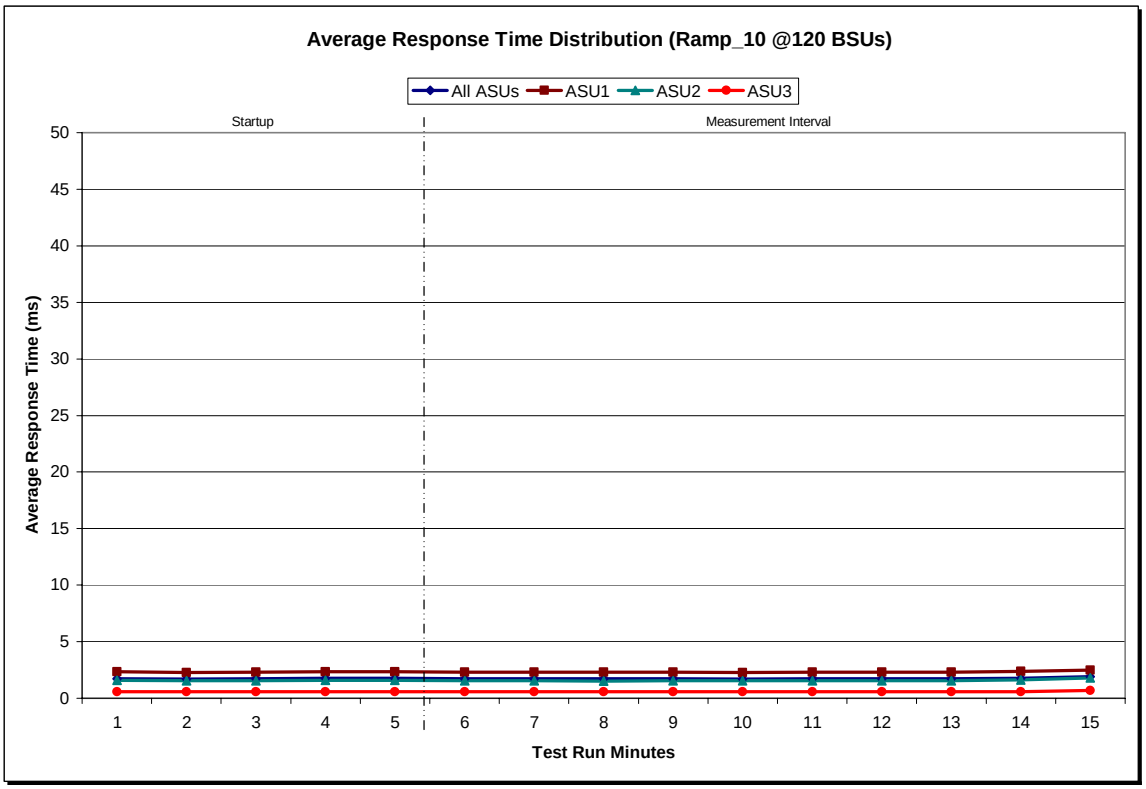
Response Time Ramp Distribution (IOPS) Graph



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

120 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	17:58:07	18:03:08	0-4	0:05:01
Measurement Interval	18:03:08	18:13:08	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.75	2.33	1.59	0.57
1	1.71	2.28	1.54	0.57
2	1.72	2.30	1.55	0.57
3	1.76	2.35	1.59	0.57
4	1.75	2.35	1.57	0.57
5	1.72	2.30	1.56	0.57
6	1.71	2.29	1.54	0.56
7	1.71	2.29	1.53	0.57
8	1.71	2.29	1.56	0.57
9	1.71	2.28	1.54	0.56
10	1.71	2.29	1.55	0.56
11	1.71	2.29	1.55	0.57
12	1.73	2.31	1.56	0.57
13	1.77	2.36	1.60	0.57
14	1.90	2.49	1.80	0.68
Average	1.74	2.32	1.58	0.58

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



SPC-1 LRT™ (10%) – 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	0.2808	0.0699	0.2105	0.0180	0.0701	0.0350	0.2806
COV	0.008	0.003	0.006	0.003	0.012	0.007	0.005	0.003

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 5.1.0 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.*

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%.

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 9.2.4.7.4

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 115.

Repeatability Test Results File

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

	SPC-1 IOPS™	SPC-1 LRT™
Primary Metrics	***60,003.51***	***1.74***
Repeatability Test Phase 1	59,974.01	1.73
Repeatability Test Phase 2	60,006.22	1.73

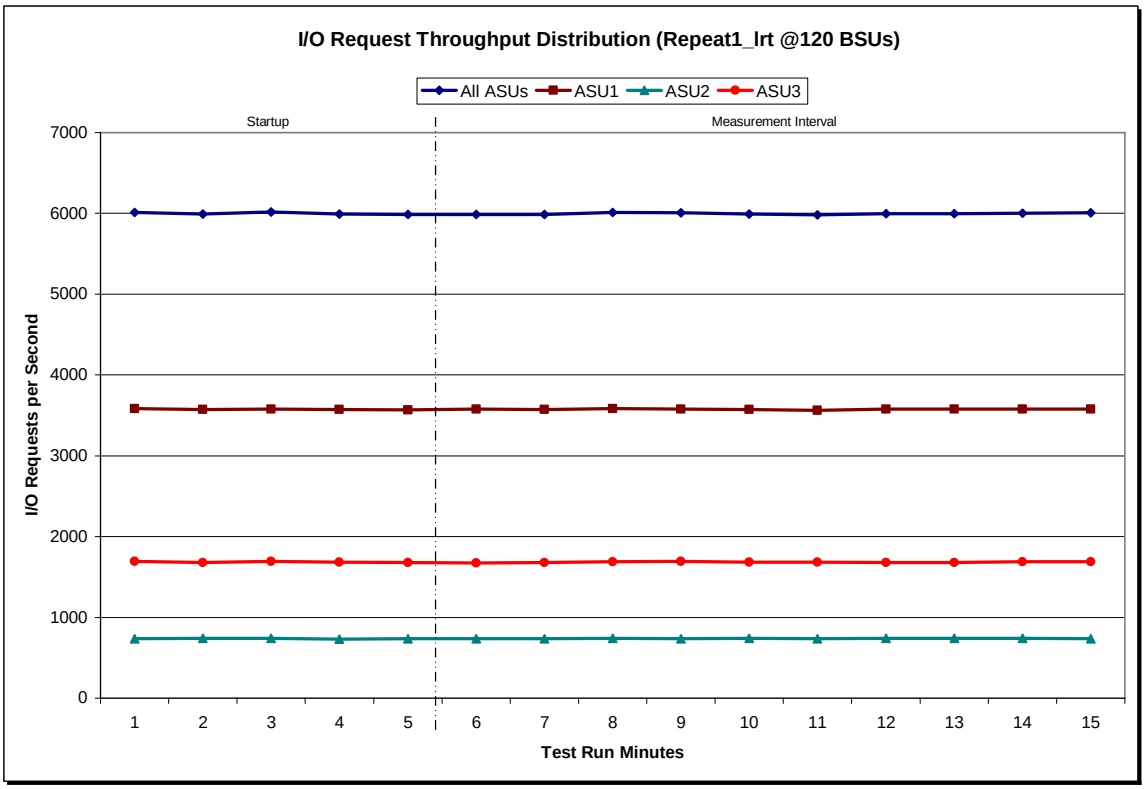
A link to the test result file generated from each Repeatability Test Run list is listed below.

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

120 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	18:14:23	18:19:23	0-4	0:05:00
Measurement Interval	18:19:23	18:29:23	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	6,012.83	3,583.05	736.97	1,692.82
1	5,990.80	3,571.48	740.85	1,678.47
2	6,017.80	3,579.93	742.97	1,694.90
3	5,989.68	3,574.82	731.12	1,683.75
4	5,987.50	3,569.47	737.98	1,680.05
5	5,987.90	3,579.78	735.28	1,672.83
6	5,987.30	3,572.55	734.52	1,680.23
7	6,012.35	3,583.22	740.50	1,688.63
8	6,007.68	3,579.75	736.88	1,691.05
9	5,993.93	3,570.60	739.53	1,683.80
10	5,979.52	3,561.20	734.32	1,684.00
11	5,996.87	3,577.12	739.32	1,680.43
12	5,996.68	3,578.75	741.57	1,676.37
13	6,003.50	3,577.57	739.42	1,686.52
14	6,005.55	3,579.98	735.20	1,690.37
Average	5,997.13	3,576.05	737.65	1,683.42

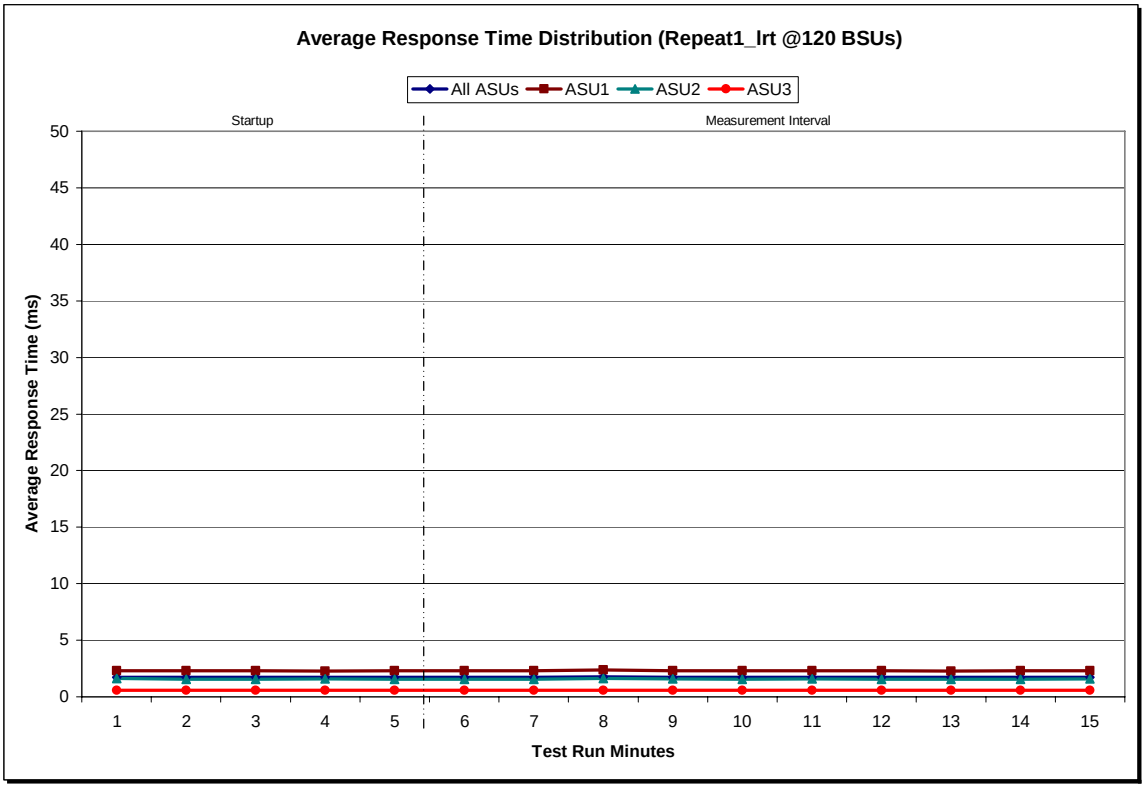
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

120 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	18:14:23	18:19:23	0-4	0:05:00
Measurement Interval	18:19:23	18:29:23	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.74	2.32	1.61	0.56
1	1.72	2.29	1.56	0.57
2	1.72	2.30	1.56	0.57
3	1.72	2.28	1.59	0.57
4	1.72	2.29	1.56	0.57
5	1.73	2.31	1.56	0.57
6	1.73	2.31	1.56	0.57
7	1.77	2.38	1.60	0.57
8	1.73	2.31	1.57	0.57
9	1.72	2.29	1.56	0.57
10	1.72	2.30	1.57	0.57
11	1.72	2.30	1.55	0.57
12	1.71	2.28	1.56	0.57
13	1.71	2.29	1.56	0.57
14	1.73	2.31	1.57	0.57
Average	1.73	2.31	1.57	0.57

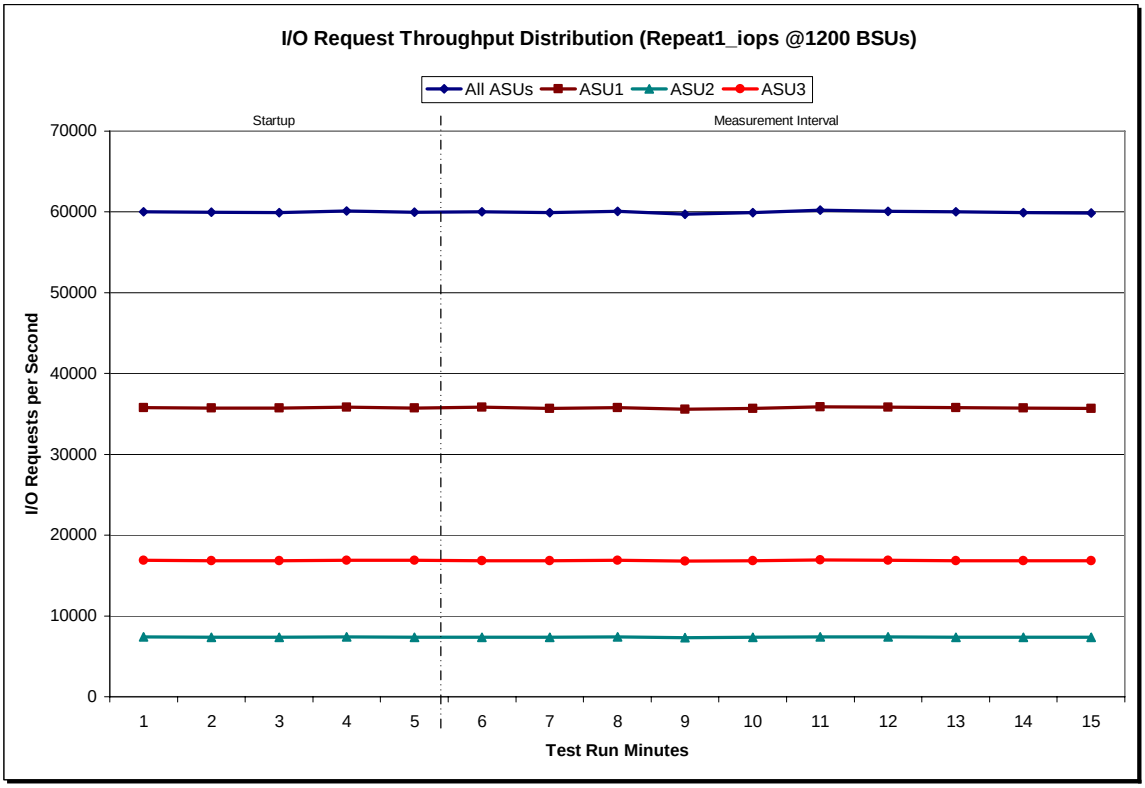
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	18:29:58	18:34:59	0-4	0:05:01
Measurement Interval	18:34:59	18:44:59	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	60,036.35	35,787.52	7,383.77	16,865.07
1	59,972.65	35,748.90	7,369.53	16,854.22
2	59,917.37	35,731.95	7,366.92	16,818.50
3	60,134.25	35,837.48	7,408.65	16,888.12
4	59,980.35	35,736.93	7,361.28	16,882.13
5	60,044.35	35,813.35	7,377.73	16,853.27
6	59,920.33	35,701.13	7,376.15	16,843.05
7	60,070.10	35,765.38	7,404.48	16,900.23
8	59,696.30	35,599.65	7,319.73	16,776.92
9	59,900.40	35,687.23	7,375.03	16,838.13
10	60,223.47	35,861.97	7,430.43	16,931.07
11	60,086.72	35,813.45	7,393.18	16,880.08
12	60,000.20	35,773.27	7,377.42	16,849.52
13	59,941.53	35,710.80	7,375.38	16,855.35
14	59,856.68	35,682.85	7,355.43	16,818.40
Average	59,974.01	35,740.91	7,378.50	16,854.60

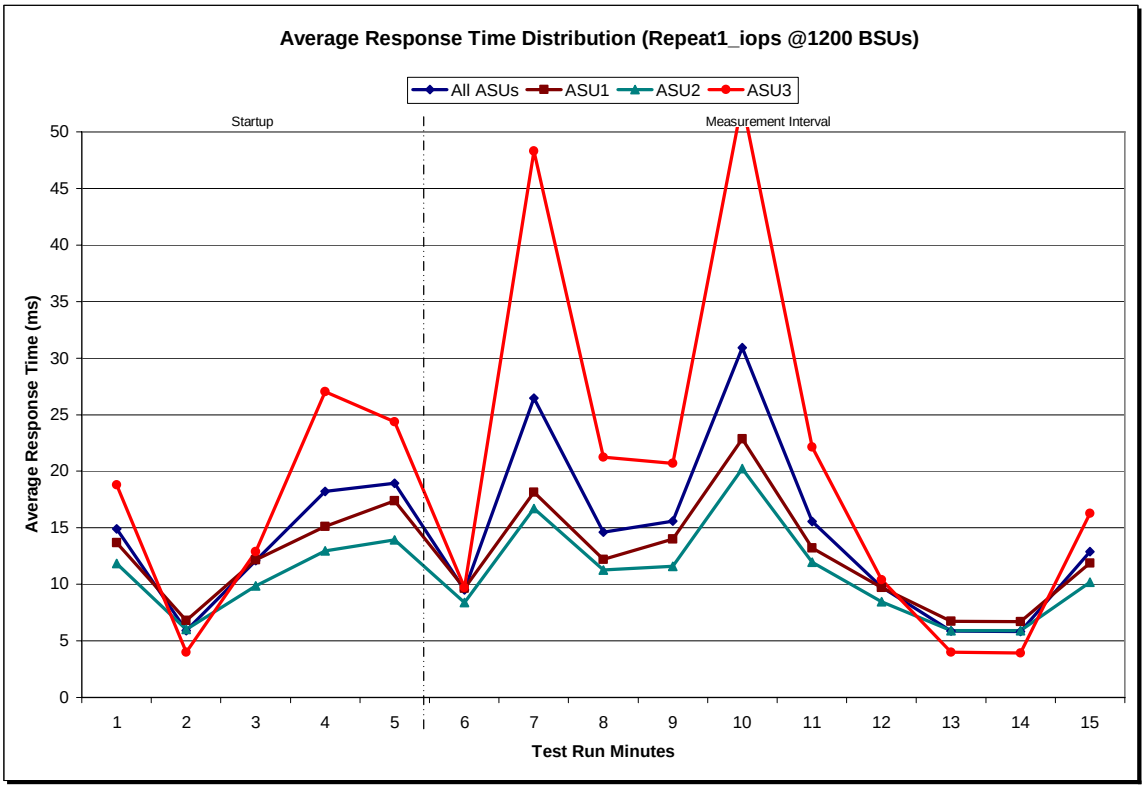
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	18:29:58	18:34:59	0-4	0:05:01
Measurement Interval	18:34:59	18:44:59	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.89	13.67	11.85	18.79
1	5.91	6.79	6.00	4.01
2	12.09	12.18	9.85	12.90
3	18.20	15.11	12.97	27.05
4	18.94	17.40	13.95	24.37
5	9.51	9.64	8.40	9.72
6	26.45	18.15	16.71	48.30
7	14.63	12.20	11.28	21.25
8	15.59	13.99	11.59	20.71
9	30.91	22.85	20.22	52.67
10	15.56	13.21	11.93	22.14
11	9.76	9.72	8.46	10.42
12	5.87	6.75	5.92	3.99
13	5.83	6.71	5.90	3.94
14	12.90	11.87	10.20	16.27
Average	14.70	12.51	11.06	20.94

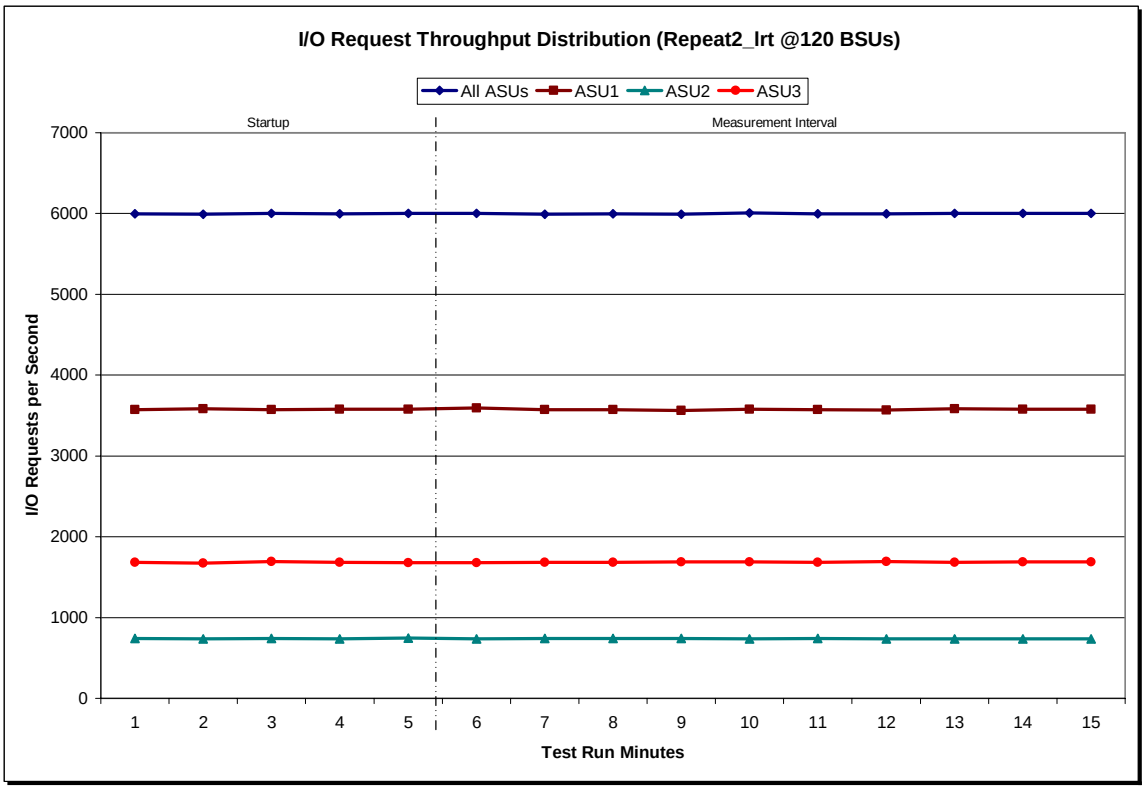
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

120 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	18:46:14	18:51:14	0-4	0:05:00
Measurement Interval	18:51:14	19:01:14	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	5,995.85	3,573.12	739.18	1,683.55
1	5,994.38	3,583.38	736.98	1,674.02
2	6,003.55	3,572.62	739.05	1,691.88
3	5,995.42	3,576.82	735.40	1,683.20
4	6,003.58	3,578.65	745.80	1,679.13
5	6,000.30	3,590.82	733.62	1,675.87
6	5,992.03	3,571.85	739.27	1,680.92
7	5,995.88	3,570.70	742.75	1,682.43
8	5,992.72	3,564.93	738.45	1,689.33
9	6,007.00	3,580.47	737.82	1,688.72
10	5,996.43	3,572.22	740.62	1,683.60
11	5,996.55	3,567.63	736.90	1,692.02
12	6,002.77	3,583.75	736.62	1,682.40
13	6,001.38	3,576.63	736.97	1,687.78
14	6,000.43	3,576.42	736.23	1,687.78
Average	5,998.55	3,575.54	737.92	1,685.09

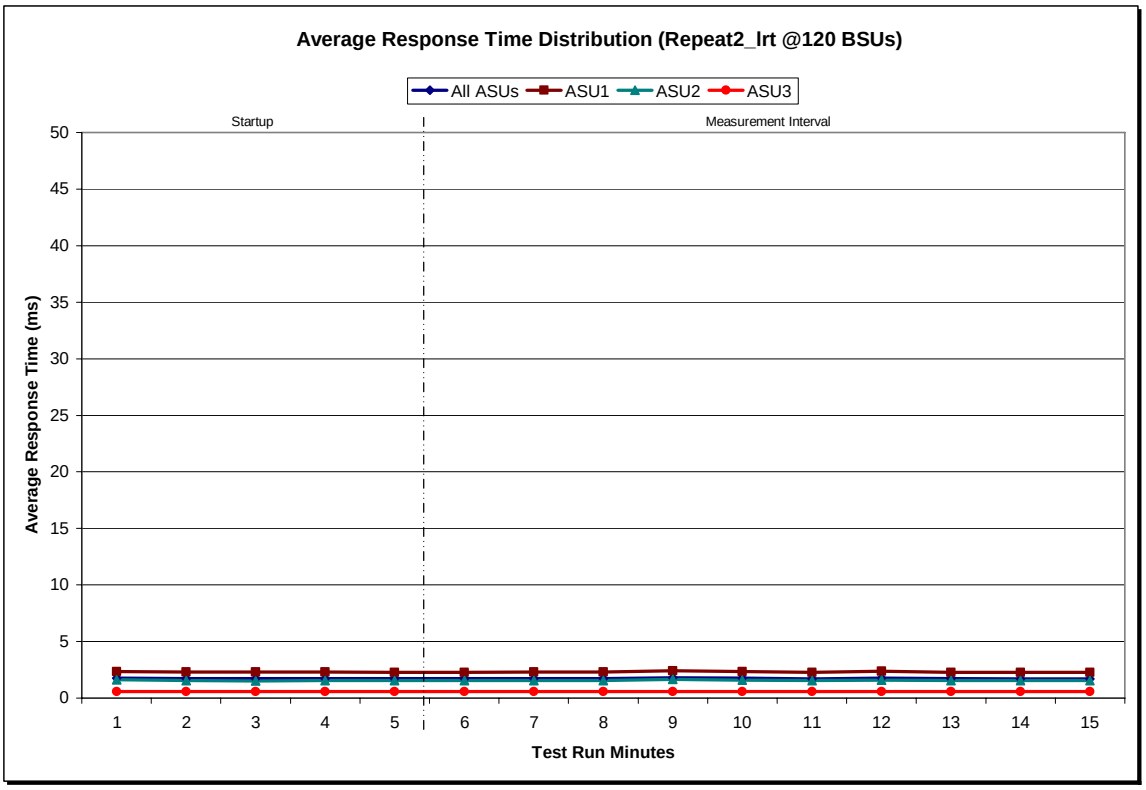
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

120 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	18:46:14	18:51:14	0-4	0:05:00
Measurement Interval	18:51:14	19:01:14	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.75	2.34	1.60	0.56
1	1.72	2.29	1.56	0.57
2	1.71	2.30	1.51	0.57
3	1.71	2.29	1.54	0.56
4	1.71	2.28	1.55	0.57
5	1.71	2.28	1.54	0.57
6	1.72	2.29	1.55	0.57
7	1.72	2.29	1.54	0.57
8	1.79	2.39	1.64	0.57
9	1.75	2.35	1.58	0.57
10	1.71	2.28	1.54	0.57
11	1.76	2.36	1.58	0.57
12	1.71	2.28	1.55	0.57
13	1.71	2.28	1.54	0.57
14	1.70	2.27	1.55	0.56
Average	1.73	2.31	1.56	0.57

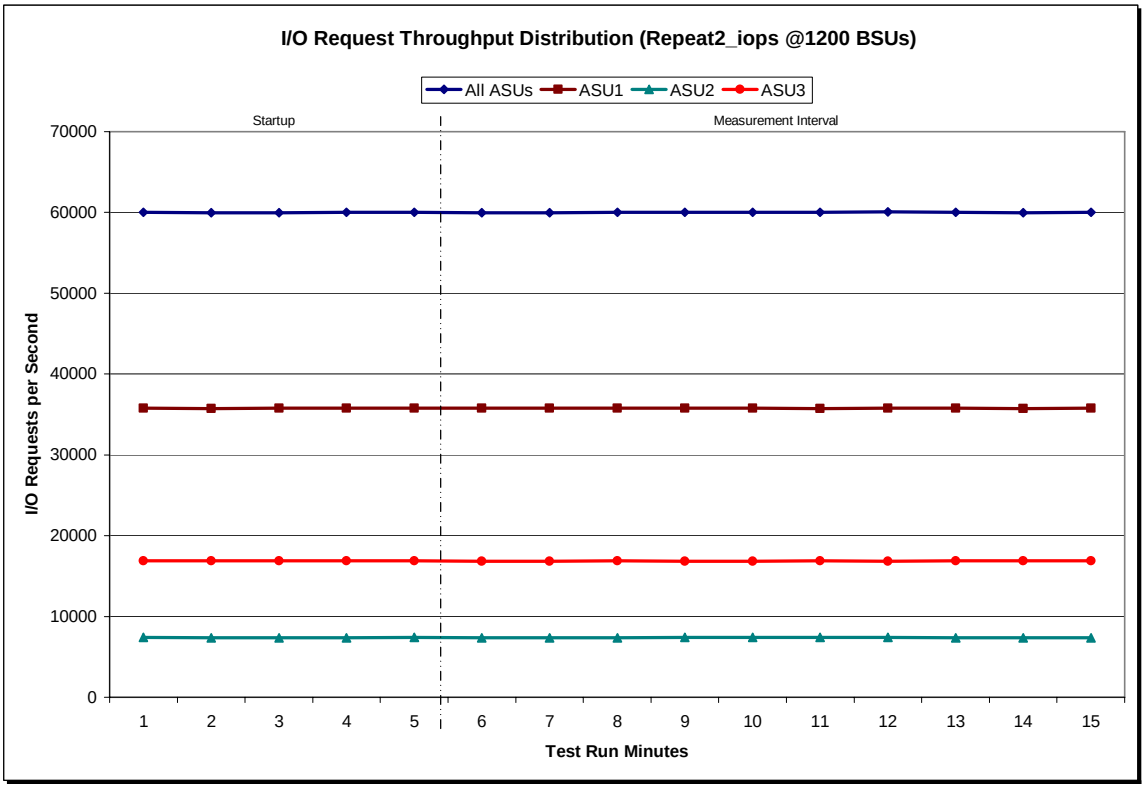
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	19:01:54	19:06:55	0-4	0:05:01
Measurement Interval	19:06:55	19:16:55	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	60,033.30	35,766.37	7,389.68	16,877.25
1	59,981.67	35,735.87	7,366.68	16,879.12
2	59,995.57	35,757.08	7,356.27	16,882.22
3	60,032.22	35,789.07	7,369.50	16,873.65
4	60,040.47	35,778.02	7,398.05	16,864.40
5	59,983.80	35,765.23	7,382.15	16,836.42
6	59,980.92	35,787.80	7,381.42	16,811.70
7	60,011.43	35,763.90	7,363.85	16,883.68
8	60,033.60	35,789.28	7,394.00	16,850.32
9	59,996.67	35,762.70	7,388.60	16,845.37
10	60,005.78	35,752.68	7,388.27	16,864.83
11	60,055.22	35,802.95	7,395.33	16,856.93
12	60,014.98	35,765.13	7,372.43	16,877.42
13	59,967.75	35,736.53	7,367.72	16,863.50
14	60,012.02	35,759.05	7,379.80	16,873.17
Average	60,006.22	35,768.53	7,381.36	16,856.33

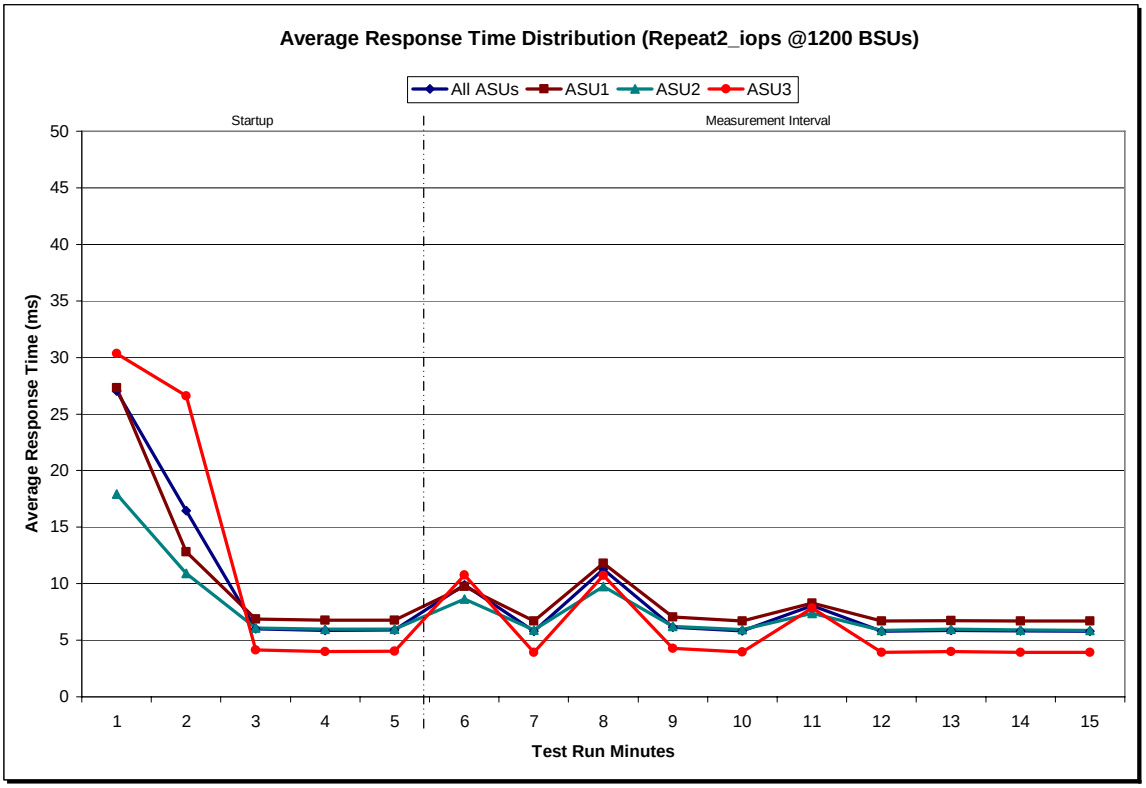
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

1200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	19:01:54	19:06:55	0-4	0:05:01
Measurement Interval	19:06:55	19:16:55	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	27.02	27.34	17.94	30.33
1	16.45	12.81	10.90	26.59
2	6.00	6.86	6.07	4.16
3	5.89	6.76	5.96	4.01
4	5.89	6.76	5.97	4.01
5	9.91	9.77	8.63	10.76
6	5.81	6.68	5.89	3.92
7	11.25	11.80	9.76	10.73
8	6.17	7.05	6.22	4.27
9	5.83	6.70	5.92	3.95
10	8.06	8.29	7.38	7.86
11	5.81	6.68	5.88	3.91
12	5.87	6.74	5.96	3.98
13	5.82	6.70	5.91	3.93
14	5.81	6.69	5.88	3.93
Average	7.03	7.71	6.75	5.72

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



Repeatability 1 (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	0.2812	0.0700	0.2100	0.0181	0.0699	0.0350	0.2807
COV	0.010	0.003	0.007	0.003	0.009	0.006	0.009	0.003

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 5.1.0 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.*

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	0.2101	0.0180	0.0700	0.0350	0.2810
COV	0.004	0.001	0.002	0.001	0.004	0.002	0.003	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	0.0352	0.2813	0.0698	0.2099	0.0180	0.0700	0.0350	0.2809
COV	0.008	0.003	0.007	0.003	0.016	0.007	0.008	0.003

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

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

Data Persistence Test

Clause 6

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

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

The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 IOP™ 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 Benchmark Configuration will be shutdown and restarted using a power off/power on cycle at the end of the above sequence of write operations. In addition, any caches employing battery backup must be flushed/emptied.

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

Clause 9.2.4.8

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 115.

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	124,014,064
Total Number of Logical Blocks Verified	96,399,888
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	10 minutes
Size in Bytes of each Logical Block	512
Number of Failed I/O Requests in the process of the Test	0

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

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 9.2.4.9

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

The FDR shall state: "The Priced Storage Configuration, as documented in this Full Disclosure Report will be available for shipment to customers on MMMM DD, YYYY." Where Priced Storage Configuration is the TSC Configuration Name as described in Clause 9.2.4.3.3 and MMMM is the alphanumeric month, DD is the numeric day, and YYYY is the numeric year of the date that the Priced Storage Configuration, as documented, is available for shipment to customers as described above.

The Fujitsu Storage Systems ETERNUS4000 Model 500, as documented in this Full Disclosure Report will be available on November 15, 2006 for customer purchase and shipment.

PRICING INFORMATION

Clause 9.2.4.11

A statement of the respective calculations for pricing must be included.

Clause 9.2.4.11.3

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration must be included.

Pricing information may found in the Tested Storage Configuration Pricing section on page 13. 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 13.

ANOMALIES OR IRREGULARITIES

Clause 9.2.4.10

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

There were no anomalies or irregularities encountered during the SPC-1 Remote Audit of the Fujitsu Storage Systems ETERNUS4000 Model 500.

APPENDIX A: SPC-1 GLOSSARY

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

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

- A kilobyte (KB) is equal to 1,000 (10^3) bytes.
- A megabyte (MB) is equal to 1,000,000 (10^6) bytes.
- A gigabyte (GB) is equal to 1,000,000,000 (10^9) bytes.
- A terabyte (TB) is equal to 1,000,000,000,000 (10^{12}) bytes.
- A petabyte (PB) is equal to 1,000,000,000,000,000 (10^{15}) bytes
- An exabyte (EB) is equal to 1,000,000,000,000,000,000 (10^{18}) bytes

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

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

- A kibibyte (KiB) is equal to 1,024 (2^{10}) bytes.
- A mebibyte (MiB) is equal to 1,048,576 (2^{20}) bytes.
- A gigibyte (GiB) is equal to 1,073,741,824 (2^{30}) bytes.
- A tebibyte (TiB) is equal to 1,099,511,627,776 (2^{40}) bytes.
- A pebibyte (PiB) is equal to 1,125,899,906,842,624 (2^{50}) bytes.
- An exbibyte (EiB) is equal to 1,152,921,504,606,846,967 (2^{60}) bytes.

SPC-1 Data Repository Definitions

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

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

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

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

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

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

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

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

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

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

SPC-1 Data Protection Levels

RAID5: User data is distributed across the disks in the array. Check data corresponding to user data is distributed across multiple disks in the form of bit-by-bit parity.

Mirroring: Two or more identical copies of user data are maintained on separate disks.

Other Protection Level: Any data protection other than **RAID5** or **Mirroring**.

Unprotected: There is no data protection provided.

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.

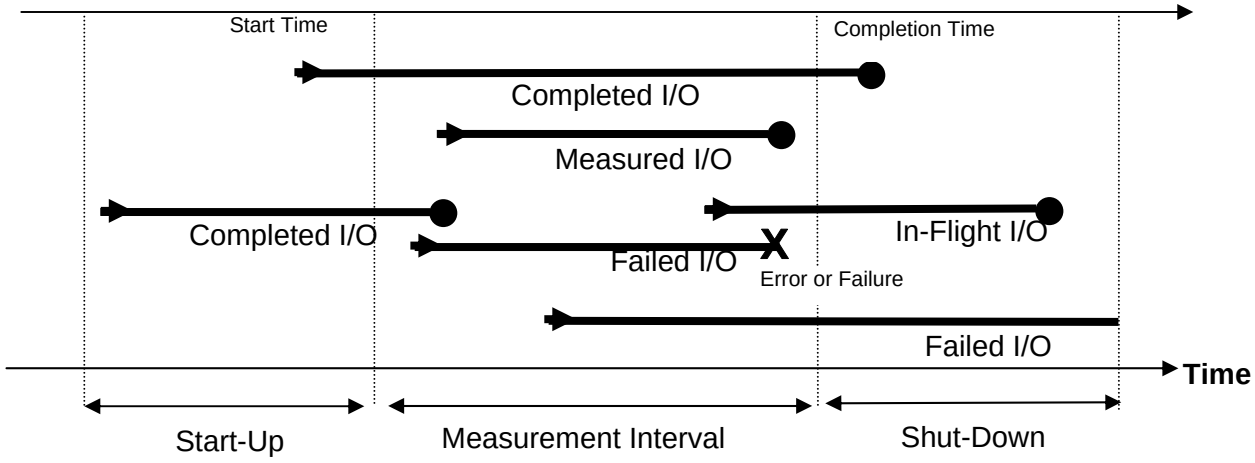
Test: A collection of Test Phases and or Test Runs sharing a common objective.

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

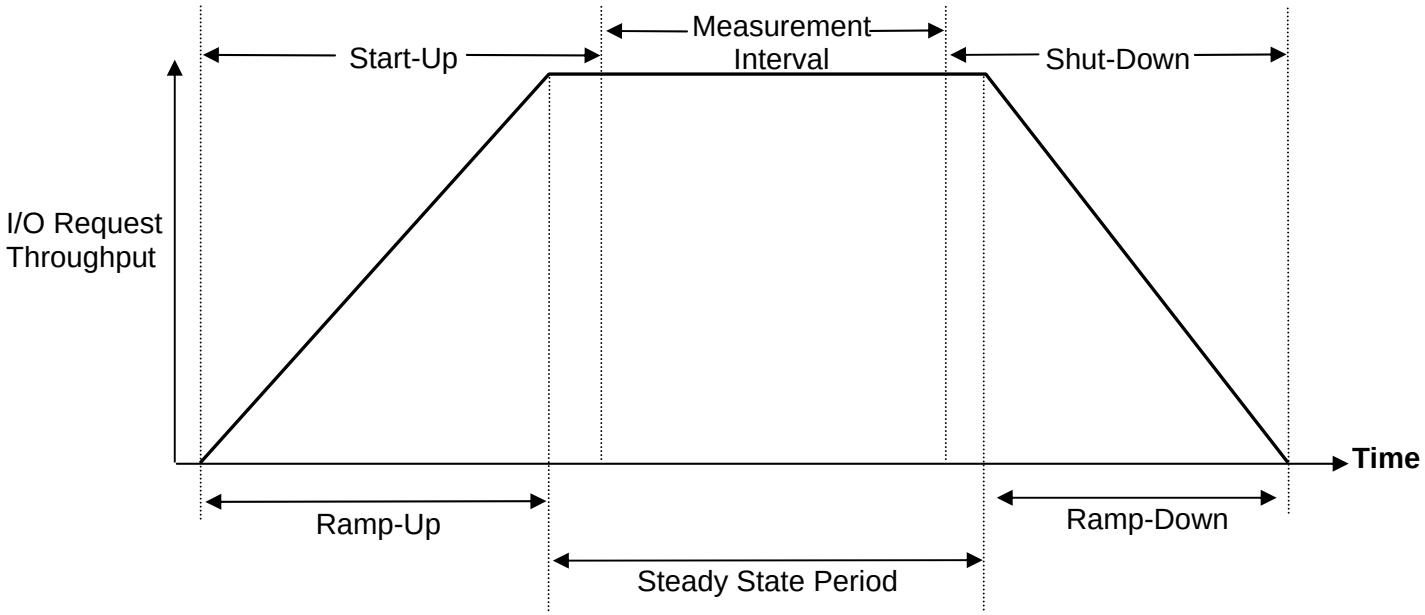
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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

Solaris Parameter Adjustments

The following settings were made in the Solaris /etc/system control file information for execution of the Workload Generator on the PRIMEPOWER2500:

```
*ident      "@(#)system  1.18   97/06/27 SMI" /* SVR4 1.5 */
*
* SYSTEM SPECIFICATION FILE
*

* moddir:
*
*    Set the search path for modules.  This has a format similar to the
*    csh path variable. If the module isn't found in the first directory
*    it tries the second and so on. The default is /kernel /usr/kernel
*
*    Example:
*           moddir: /kernel /usr/kernel /other/modules



* root device and root filesystem configuration:
*
*    The following may be used to override the defaults provided by
*    the boot program:
*
*    rootfs:             Set the filesystem type of the root.
*
*    rootdev:      Set the root device.  This should be a fully
*                  expanded physical pathname.  The default is the
*                  physical pathname of the device where the boot
*                  program resides.  The physical pathname is
*                  highly platform and configuration dependent.
*
*    Example:
*           rootfs:ufs
*           rootdev:/sbus@1,f8000000/esp@0,800000/sd@3,0:a
*
*    (Swap device configuration should be specified in /etc/vfstab.)



* exclude:
*
*    Modules appearing in the moddir path which are NOT to be loaded,
*    even if referenced. Note that `exclude' accepts either a module name,
*    or a filename which includes the directory.
*
*    Examples:
*           exclude: win
*           exclude: sys/shmsys



* forceload:
*
*    Cause these modules to be loaded at boot time, (just before mounting
*    the root filesystem) rather than at first reference. Note that
```

```
*    forceload expects a filename which includes the directory. Also
*    note that loading a module does not necessarily imply that it will
*    be installed.
*
*    Example:
*           forceload: drv/foo



* set:
*
*    Set an integer variable in the kernel or a module to a new value.
*    This facility should be used with caution.  See system(4).
*
*    Examples:
*
*    To set variables in 'unix':
*
*           set nautopush=32
*           set maxusers=40
*
*    To set a variable named 'debug' in the module named 'test_module'
*
*           set test_module:debug = 0x13

* Begin FJSVscd3 (do not edit)
forceload:  drv/FJSVscf3
* End FJSVscd3 (do not edit)
* Begin FJSVssf (do not edit)
set ftrace_atboot = 1
set kmem_flags = 0x100
set kmem_lite_maxalign = 8192
set disable_memscrub = 1
* End FJSVssf (do not edit)
* Begin FJSVpnl (do not edit)
forceload:  drv/FJSVpanel
* End FJSVpnl (do not edit)
forceload:  drv/se
forceload:  drv/fjmse

* The forceload of drv/clone is required for successful
* IP operation of Emulex fibre channel drivers lpfc / lpfs
* and for the diagnostics (dfc) interface.
forceload: drv/clone
```

Emulex HBA Configuration Parameters

These parameters are set in "lpfc.conf" for controlling the operation of the Emulex Fibre Channel HBAs. The following values have been changed from their default values for accessing the ETERNUS4000 Model 500 Storage System:

```
#
# Copyright (c) 2005, Emulex
# 3333 Susan Street, Costa Mesa, CA 92626
#
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# is protected by copyright and distributed under licenses restricting
# its use, copying, distribution and decompilation. This computer
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# Corporation is a violation of the copyright laws and may subject you to
# criminal prosecution.
#
#
# Solaris LightPulse lpfc (SCSI) / lpfn (IP) driver: global initialized data.
#
# lpfc.conf 1.29 2005/01/18 11:58:16PST

# Verbosity:  only turn this flag on if you are willing to risk being
# deluged with LOTS of information.
# You can set a bit mask to record specific types of verbose messages:
#
# 0x1    ELS events
# 0x2    Device Discovery events
# 0x4    Mailbox Command events
# 0x8    Initialization events
# 0x10   Link Attention events
# 0x20   IP events
# 0x40   FCP events
# 0x80   Node table events
# 0x400  Miscellaneous events
# 0x800  SLI events
# 0x2000 IOCtl events
# 0xffff Log All Events
log-verbose=0x0;

# Setting log-only to 0 causes log messages to be printed on the
# console and to be logged to syslog (which may send them to the
# console again if it's configured to do so).
# Setting log-only to 1 causes log messages to go to syslog only.
log-only=1;

#
# +++ Variables relating to FCP (SCSI) support. +++
#
# specifies the method of binding to be used. This
# binding method is used for persistent binding and automaped
# binding. A value of 1 will force WWNN binding, value
```

```
# of 2 will force WWPN binding, value of 3 will force
# DID binding and value of 4 will force the driver to derive
# binding from ALPA (hard addressed) in a private loop environment.
# Any persistent binding whose type does not match with the
# bind method of the port will be ignored.
#fcp-bind-method=4;

lpfc1-fcp-bind-method=2;
lpfc5-fcp-bind-method=2;
lpfc9-fcp-bind-method=2;
lpfc13-fcp-bind-method=2;
lpfc2-fcp-bind-method=2;
lpfc6-fcp-bind-method=2;
lpfc10-fcp-bind-method=2;
lpfc14-fcp-bind-method=2;
lpfc16-fcp-bind-method=2;
lpfc22-fcp-bind-method=2;
lpfc28-fcp-bind-method=2;
lpfc33-fcp-bind-method=2;
lpfc18-fcp-bind-method=2;
lpfc24-fcp-bind-method=2;
lpfc30-fcp-bind-method=2;
lpfc34-fcp-bind-method=2;

# Setup FCP persistent bindings,
# fcp-bind-WWPN binds a specific WorldWide PortName to a target id,
# fcp-bind-WWNN binds a specific WorldWide NodeName to a target id,
# fcp-bind-DID binds a specific DID to a target id.
# Binding method must match with the bind method of that HBA, else the
# binding will be ignored.
# fcp-bind-method should NOT be set to 4 when one of these binding methods
# is used.
# WWNN, WWPN and DID are hexadecimal values.
# WWNN must be 16 digit BCD with leading 0s.
# WWPN must be 16 digit BCD with leading 0s.
# DID must be 6 digit BCD with leading 0s.
# The SCSI ID to bind to consists of two parts, the lpfc interface
# to bind to, and the target number for that interface.
# Thus lpfc0t2 specifies target 2 on interface lpfc0.
# NOTE: Target ids, with all luns supported, must also be in sd.conf.

# Here are some examples:
#                WWNN             SCSI ID
# fcp-bind-WWNN="2000123456789abc:lpfc1t0",
#               "20000020370c27f7:lpfc0t2";
#
#                WWPN             SCSI ID
# fcp-bind-WWPN="2100123456789abc:lpfc0t0",
#               "21000020370c2855:lpfc0t1",
#               "2100122222222222:lpfc2t2";
#
#                DID   SCSI ID
# fcp-bind-DID="0000ef:lpfc0t3";
# BEGIN: LPUTIL-managed Persistent Bindings

fcp-bind-WWPN="2040000B5D6A0000:lpfc1t16",
"2140000B5D6A0000:lpfc5t17",
"2048000B5D6A0000:lpfc9t18",
"2148000B5D6A0000:lpfc13t19",
"2050000B5D6A0000:lpfc2t16",
"2150000B5D6A0000:lpfc6t17",
"2058000B5D6A0000:lpfc10t18",
"2158000B5D6A0000:lpfc14t19",
```

```
  "2041000B5D6A0000:lpfc16t16",
  "2141000B5D6A0000:lpfc22t17",
  "2049000B5D6A0000:lpfc28t18",
  "2149000B5D6A0000:lpfc33t19",
  "2051000B5D6A0000:lpfc18t16",
  "2151000B5D6A0000:lpfc24t17",
  "2059000B5D6A0000:lpfc30t18",
  "2159000B5D6A0000:lpfc34t19";


  # If automap is set, SCSI IDs for all FCP nodes without
  # persistent bindings will be automatically generated.
  # If new FCP devices are added to the network when the system is down,
  # there is no guarantee that these SCSI IDs will remain the same
  # when the system is booted again.
  # The bind method of the port is used as the binding method of
  # automap devices to preserve SCSI IDs between link down and link up.
  # If automap is 0, only devices with persistent bindings will be
  # recognized by the system.
  lpfc1-automap=0;
  lpfc5-automap=0;
  lpfc9-automap=0;
  lpfc13-automap=0;
  lpfc2-automap=0;
  lpfc6-automap=0;
  lpfc10-automap=0;
  lpfc14-automap=0;
  lpfc16-automap=0;
  lpfc22-automap=0;
  lpfc28-automap=0;
  lpfc33-automap=0;
  lpfc18-automap=0;
  lpfc24-automap=0;
  lpfc30-automap=0;
  lpfc34-automap=0;

  # lun-queue-depth [1 to 128] - The default value lpfc will use to
  # limit the number of outstanding commands per FCP LUN.  This value
  # is global, affecting each LUN recognized by the driver, but may be
  # overridden on a per-LUN basis (see below). RAID arrays may want
  # to be configured using the per-LUN tunable throttles.
  #lun-queue-depth=20;
  lpfc1-lun-queue-depth=10;
  lpfc5-lun-queue-depth=10;
  lpfc9-lun-queue-depth=10;
  lpfc13-lun-queue-depth=10;
  lpfc2-lun-queue-depth=10;
  lpfc6-lun-queue-depth=10;
  lpfc10-lun-queue-depth=10;
  lpfc14-lun-queue-depth=10;
  lpfc16-lun-queue-depth=10;
  lpfc22-lun-queue-depth=10;
  lpfc28-lun-queue-depth=10;
  lpfc33-lun-queue-depth=10;
  lpfc18-lun-queue-depth=10;
  lpfc24-lun-queue-depth=10;
  lpfc30-lun-queue-depth=10;
  lpfc34-lun-queue-depth=10;

  # tgt-queue-depth [0 to 10240] - The default value lpfc will use to
  # limit the number of outstanding commands per FCP target.  This value
  # is global, affecting each target recognized by the driver, but may be
  # overridden on a per-target basis (see below). RAID arrays may want
```

```
  # to be configured using the per-target tunable throttles. A value
  # of 0 means don't throttle the target.
  #tgt-queue-depth=90;
  lpfc1-tgt-queue-depth=45;
  lpfc5-tgt-queue-depth=45;
  lpfc9-tgt-queue-depth=45;
  lpfc13-tgt-queue-depth=45;
  lpfc2-tgt-queue-depth=45;
  lpfc6-tgt-queue-depth=45;
  lpfc10-tgt-queue-depth=45;
  lpfc14-tgt-queue-depth=45;
  lpfc16-tgt-queue-depth=45;
  lpfc22-tgt-queue-depth=45;
  lpfc28-tgt-queue-depth=45;
  lpfc33-tgt-queue-depth=45;
  lpfc18-tgt-queue-depth=45;
  lpfc24-tgt-queue-depth=45;
  lpfc30-tgt-queue-depth=45;
  lpfc34-tgt-queue-depth=45;

  # lpfcNtM-lun-throttle:  the maximum number of outstanding commands to
  # permit for each LUN of an FCP target that supports multiple LUNs.
  # The default throttle for the number of commands outstanding to a single
  # LUN of a multiple-LUN target is lun-queue-depth. For a target that
  # can support multiple LUNs, it may be useful to specify a LUN throttle
  # that differs from the default.
  # Example: lpfc0t17-lun-throttle=48;
  # says that each LUN on target 17, interface lpfc0 should be allowed
  # up to 48 simultaneously outstanding commands.
  #lpfc1t39-lun-throttle=10;
  #lpfc0t40-lun-throttle=30;

  # lpfcNtM-tgt-throttle:  the maximum number of outstanding commands to
  # permit for a FCP target.
  # By default, target throttle is diabled.
  # Example: lpfc0t17-tgt-throttle=48;
  # says that target 17, interface lpfc0 should be allowed
  # up to 48 simultaneously outstanding commands.
  #lpfc1t39-tgt-throttle=10;
  #lpfc0t40-tgt-throttle=30;

  # no-device-delay [0 to 30] - determines the length of
  # the interval between deciding to fail back an I/O because there is no way
  # to communicate with its particular FCP device (e.g., due to device failure)
  # and the actual fail back.  A value of zero implies no delay whatsoever.
  # Cautions:  (1)  This value is in seconds.
  # (2)  Setting a long delay value may permit I/O to build up,
  # each with a pending timeout, which could result in the exhaustion of
  # critical Solaris kernel resources.  In this case, you may see a fatal
  # message such as
  #           PANIC:  Timeout table overflow
  #
  # Note that this value can have an impact on the speed with which a
  # system can shut down with I/Os pending and with the HBA not able to
  # communicate with the loop or fabric, e.g., with a cable pulled.
  no-device-delay=0;

  #
  # +++ Variables relating to IP networking support. +++
  #

  # network-on:  true (1) if networking is enabled, false (0) if not
  # This variable will be set during the installation of the driver
```

```
# via pkgadd.
network-on=0;

# xmt-que-size [128 to 10240] - size of the transmit queue for mbufs
xmt-que-size=256;

#
# +++ Variables common to both SCSI (FCP) and IP networking support. +++
#

#
# If scan-down = 0, scan the devices on the private loop in increasing
# order of ALPA. If scan-down = 1, scan the devices on the private loop
# in decreasing order of ALPA.
# NOTE: scan-down does not apply if a loop map is obtained.
#
#scan-down=1;
lpfc1-scan-down=0;
lpfc5-scan-down=0;
lpfc9-scan-down=0;
lpfc13-scan-down=0;
lpfc2-scan-down=0;
lpfc6-scan-down=0;
lpfc10-scan-down=0;
lpfc14-scan-down=0;
lpfc16-scan-down=0;
lpfc22-scan-down=0;
lpfc28-scan-down=0;
lpfc33-scan-down=0;
lpfc18-scan-down=0;
lpfc24-scan-down=0;
lpfc30-scan-down=0;
lpfc34-scan-down=0;

# If set, nodev-holdio will hold all I/O errors on FCP devices that disappear
# until they come back. Default is 0, return errors with no-device-delay.
# This parameter is ignored, if scsi commands are issued in polled mode.
nodev-holdio=0;

# If set, nodev-tmo will hold all I/O errors on devices that disappear
# until the timer [0 to 255 secs] expires. Default is 30, return errors
# with no-device-delay.
nodev-tmo=40;

# Use no-device-delay to delay FCP RSP errors and certain check conditions.
delay-rsp-err=0;

# num-iocbs [128 to 10240] - number of iocb buffers to allocate
num-iocbs=1024;

# num-bufs [64 to 4096] - number of buffers to allocate
# Buffers are needed to support Fibre channel Extended Link Services.
# Also used for SLI-2 FCP buffers, one per FCP command, and Mailbox commands.
num-bufs=1024;

# topology:  link topology for initializing the Fibre Channel connection.
#          0 = attempt loop mode, if it fails attempt point-to-point mode
#          2 = attempt point-to-point mode only
#          4 = attempt loop mode only
#          6 = attempt point-to-point mode, if it fails attempt loop mode
# Set point-to-point mode if you want to run as an N_Port.
# Set loop mode if you want to run as an NL_Port.
#topology=4;
```

```
lpfc1-topology=2;
lpfc5-topology=2;
lpfc9-topology=2;
lpfc13-topology=2;
lpfc2-topology=2;
lpfc6-topology=2;
lpfc10-topology=2;
lpfc14-topology=2;
lpfc16-topology=2;
lpfc22-topology=2;
lpfc28-topology=2;
lpfc33-topology=2;
lpfc18-topology=2;
lpfc24-topology=2;
lpfc30-topology=2;
lpfc34-topology=2;

# Set a preferred ALPA for the adapter, only valid if topology is loop.
# lpfc0-assign-alpa=2;  Request ALPA 2 for lpfc0

# ip-class:  FC class (2 or 3) to use for the IP protocol.
ip-class=3;

# fcp-class:  FC class (2 or 3) to use for the FCP protocol.
fcp-class=3;

# Use ADISC for FCP rediscovery instead of PLOGI.
use-adisc=0;

# Extra IO timeout [0 to 255 secs] for fabrics
extra-io-tmo=0;

# Number of 4k STREAMS buffers [64 to 1024] to post to IP ring.
post-ip-buf=128;

# Use dqfull-throttle-up-time [0 to 30 secs] to specify when to increment
# the current Q depth.
dqfull-throttle-up-time=1;

# Increment the current Q depth by dqfull-throttle-up-inc [0 to 128]
dqfull-throttle-up-inc=1;

# Use ACK0, instead of ACK1 for class 2 acknowledgement.
ack0=0;

# cr-delay: Coalesce Response Delay
# This value specifies a count of milliseconds [0 to 63] after which an
# interrupt response is generated if cr-count has not been satisfied.
# This value is set to 0 to disable the Coalesce Response feature.
cr-delay=0;

# cr-count: Coalesce Response Count
# This value specifies a count of I/O completions [1 to 255] after which an
# interrupt response is generated. This feature is disabled if cr-delay is
# set to 0.
cr-count=0;

# discovery-threads [1 to 32] - This value specifies the maximum number of
# ELS commands during discovery
discovery-threads=1;

# link-speed:  link speed selection for initializing the Fibre Channel connection.
#       0 = auto select (default)
```

```
#       1 = 1 Gigabaud
#       2 = 2 Gigabaud
#       4 = 4 Gigabaud
#ink-speed=0;
lpfc1-link-speed=0;
lpfc5-link-speed=0;
lpfc9-link-speed=0;
lpfc13-link-speed=0;
lpfc2-link-speed=0;
lpfc6-link-speed=0;
lpfc10-link-speed=0;
lpfc14-link-speed=0;
lpfc16-link-speed=0;
lpfc22-link-speed=0;
lpfc28-link-speed=0;
lpfc33-link-speed=0;
lpfc18-link-speed=0;
lpfc24-link-speed=0;
lpfc30-link-speed=0;
lpfc34-link-speed=0;

# fdmi-on:  0 = disable fdmi
#           1 = enable fdmi without registration of "host name" port attribute
#           2 = enable fdmi and "host name" port attribute
fdmi-on=0;

# Used only by i386 FCP (SCSI)
# flow_control="duplx" queue="qfifo" disk="scdk" tape="sctp";
```

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

HBA to LUN Access – *Entries in "sd.conf"*

The following entries in **sd.conf** were defined to enable the Emulex HBAs for accessing the LUNs defined in the ETERNUS4000 Model 500.

```
# Copyright (c) 1992, by Sun Microsystems, Inc.
#
#ident      "@(#)sd.conf  1.9    98/01/11 SMI"

name="sd" class="scsi" class_prop="atapi"
     target=0 lun=0;

name="sd" class="scsi" class_prop="atapi"
     target=1 lun=0;

name="sd" class="scsi" class_prop="atapi"
     target=2 lun=0;

name="sd" class="scsi" class_prop="atapi"
     target=3 lun=0;

name="sd" class="scsi"
     target=4 lun=0;

name="sd" class="scsi"
     target=5 lun=0;

name="sd" class="scsi"
     target=6 lun=0;

name="sd" class="scsi"
     target=8 lun=0;

name="sd" class="scsi"
     target=9 lun=0;

name="sd" class="scsi"
     target=10 lun=0;

name="sd" class="scsi"
     target=11 lun=0;

name="sd" class="scsi"
     target=12 lun=0;

name="sd" class="scsi"
     target=13 lun=0;

name="sd" class="scsi"
     target=14 lun=0;

name="sd" class="scsi"
     target=15 lun=0;

name="sd" class="scsi"
     target=16 lun=0;

name="sd" class="scsi"
```

```
      target=17 lun=0;

  name="sd" class="scsi"
      target=18 lun=0;

  name="sd" class="scsi"
      target=19 lun=0;

  # Start lpfc auto-generated configuration -- do NOT alter or delete this line
  # WARNING:  anything you put within this auto-generated section will
  # be DELETED if you execute pkgrm to remove the lpfc driver package.
  # You may need to add additional lines to probe for additional LUNs
  # or targets. You SHOULD delete any lines that represent lpfc targets
  # or LUNs that are not used.
  # You should add any new entries between this line
  # and the End lpfc auto generated configuration line
  # name="sd" parent="lpfc" target=16 lun=0;
  # name="sd" parent="lpfc" target=17 lun=0;
  # A small number of LUNs for a RAID array
  # name="sd" parent="lpfc" target=17 lun=1;
  # name="sd" parent="lpfc" target=17 lun=2;
  # name="sd" parent="lpfc" target=17 lun=3;
  name="sd" parent="lpfc" target=16 lun=0;
  name="sd" parent="lpfc" target=16 lun=1;
  name="sd" parent="lpfc" target=16 lun=2;
  name="sd" parent="lpfc" target=16 lun=3;
  name="sd" parent="lpfc" target=16 lun=4;
  name="sd" parent="lpfc" target=16 lun=5;
  name="sd" parent="lpfc" target=16 lun=6;
  name="sd" parent="lpfc" target=16 lun=7;
  name="sd" parent="lpfc" target=16 lun=8;
  name="sd" parent="lpfc" target=16 lun=9;
  name="sd" parent="lpfc" target=16 lun=10;
  name="sd" parent="lpfc" target=16 lun=11;
  name="sd" parent="lpfc" target=16 lun=12;
  name="sd" parent="lpfc" target=16 lun=13;
  name="sd" parent="lpfc" target=16 lun=14;
  name="sd" parent="lpfc" target=16 lun=15;
  name="sd" parent="lpfc" target=16 lun=16;
  name="sd" parent="lpfc" target=16 lun=17;
  name="sd" parent="lpfc" target=16 lun=18;
  name="sd" parent="lpfc" target=16 lun=19;
  name="sd" parent="lpfc" target=16 lun=20;
  name="sd" parent="lpfc" target=16 lun=21;
  name="sd" parent="lpfc" target=16 lun=22;
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  name="sd" parent="lpfc" target=16 lun=36;
  name="sd" parent="lpfc" target=16 lun=37;
  name="sd" parent="lpfc" target=16 lun=38;
  name="sd" parent="lpfc" target=16 lun=39;
  name="sd" parent="lpfc" target=16 lun=40;
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name="sd" parent="lpfc" target=19 lun=192;
# End lpfc auto-generated configuration -- do NOT alter or delete this line
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Configuring the ETERNUS4000 Storage Array

The ETERNUS4000 Storage Array is configured using an interactive on-line tool called ETERNUSmgr. When an ETERNUS4000 unit is delivered from the factory, there are a set of default RAID Groups and LUNs defined, and the tool is used to modify the configuration to that needed in the customer environment. The following paragraphs outline use of this tool to define the configuration outlined within this FDR. The primary definitions for use in making the configuration are provided through an Excel spreadsheet, called a Design Sheet. The Design sheet for the TSC may be accessed via the following URLs:

Design Sheet/Configuration Plan

This design sheet is developed by the Fujitsu SE, in consultation with the customer, and is provided to the Fujitsu factory when the order for the system is placed. The factory will configure the system according to this design, using internal Fujitsu tools.

Should a customer need to change the delivered configuration, then a series of steps must be followed, using ETERNUSmgr. The User Guide for the ETERNUSmgr is available for download from:

http://www.fujitsu.com/downloads/STRSYS/system/e8kmgrm700m1100-e4kmgrm300m500_setting.pdf

To define a new RAID Group the following steps are used:

1. Assuming that there are available drives to assign to a new RAID Group, select "Setting RAID / Setting Host" in the Main menu.
2. Select "Create RAID Group" in the Setting RAID / Setting Host menu
3. The Create RAID Group screen will be presented, with the available drives shown. Select the drives to be included in the RAID Group and the desired RAID Level, leaving the Assigned CM selection to Auto, and click the "Set" button. A confirmation screen is provided before the action is committed.
4. Additional RAID Groups can be defined by repeating the process, or the user may move directly to the Create Logical Volume screen noted below.

It is necessary to define one or more Logical Volumes within each of the defined RAID Groups, using the following steps:

1. Again, select "Setting RAID / Setting Host" in the Main menu.
2. Select "Create Logical Volume" in the Setting RAID / Setting Host menu.
3. The Create Logical Volume screen will be presented, with the current Logical Volume List shown. Select "Register Logical volume".
4. The Create Logical Volume Screen (Volume Creation) screen will be presented, with a list of the RAID Groups defined, and the capacity of each (in MiB). Select the RAID Group in which a Logical Volume is to be defined.
5. Select an Open type of volume with the Capacity desired. Use the entire RAID Group by putting in the capacity listed for the selected RAID Group, and click the "Set" button. A confirmation screen is provided before the action is committed.
6. Additional Logical Volumes can be defined by repeating the process for other RAID Groups, or the user may return to the Main menu to continue.

The configuration plan for the SPC-1 Benchmark configuration has a PRIMEPOWER 2500 server connected with 32 HBAs through a FC switch to the 16 Channel Adapter ports, with two HBAs connected to each CA port, via the switch. However, it was not necessary to use all 32 HBAs, so only 16 HBAs were present in the Tested Storage Configuration. The connections were made through the FC switch as shown in the configuration diagram, with each CA port set up using the following steps:

1. Again, select "Setting RAID / Setting Host" in the Main menu.
2. Select "Set CA Parameters' in the Setting RAID / Setting Host menu.
3. The Set CA Parameters CA Selection screen will be presented. Select the CA Port for which the parameters are to be set, based on the configuration plan.

4. The Set CA Parameters screen will be presented. As this is a fabric connection from the server HBA port to the storage CA port, the default selection of Fabric Connection, 0x00, Class 3, and Affinity Mode Off with default Host Response apply. The only item that was changed for the benchmark was the selection of 4G for the Transfer Rate.
5. With the selections complete, click the "Set" button to reach the confirmation screen – click "OK" to apply the selection for the port.

The configuration plan for the SPC-1 Benchmark configuration assigns the 72 Logical Volumes as LUNs 0-71 on each of the Channel Adapter ports. There are 1152 Logical Volumes in the defined configuration, 18 on each of the 64 RAID Groups, according to the configuration plan. The following steps are used to set the LUN mapping for each of the CA ports:

1. Again, select "Setting RAID / Setting Host" in the Main menu.
2. Select "Set LUN Mapping" in the Setting RAID / Setting Host menu.
3. The Set LUN Mapping CA Selection screen will be presented. Select the CA Port that needs the LUNs to be mapped.
4. The Set LUN Mapping Volume Selection screen will be presented. Using the information on the configuration planning sheets, the "Set Range" mode should be selected, the range of LUN#s to be mapped, and the starting Logical Volume# specified, to define the set of mapping to be applied.
5. The "Open Volume List" facility can be used to identify the Logical Volumes that are defined, and which can be mapped within the CA port. Once the mapping parameters are set, click the "Execute" button to set up this part of the mapping. Additional ranges can be selected and set up for mapping on the port. Once all of the desired mapping has been set up in the list provided, click on the "Set" button to proceed to the confirmation screen – click "OK" to apply the mapping to the port definitions.

The configuration plan also includes Hot Spare drives, which are defined in much the same way as RAID Groups, using the following steps:

1. Select "Setting RAID / Setting Host" in the Main menu
2. Select "Create Hot Spare" in the Setting RAID / Setting Host menu
3. The Create Hot Spare selection screen will be presented. Select the drives to be designated as Hot Spare drives, according to the configuration plan, and click the "Set" button to proceed to the confirmation screen – click "OK" to apply the designations of Hot Spare to the selected drives.

Each step along the way to completing the configuration does a small part, and the configuration plan provides the details of the specific entries that are defined, using the ETERNUSmgr interface. For most customer systems, where the design sheets provide the complete configuration plan, the ETERNUS4000 system is pre-configured at the factory. However, when the plan is not complete or not supplied with an order, a default configuration will be applied by the factory, based on the complement of components ordered.

Scripts and Commands to Configure Storage

The following script (**makesol**) and commands were used to create and configure the logical representation of the TSC used in the benchmark measurement for the ETERNUS4000 Model 500.

1. makesol

The **makesol** script is used to create the Solaris Volume Manager (SVM) logical volumes based on a configuration description file, **Test_A02_Views_A02-5-1_view-1_size_8M_svmake.txt**. This script is called by:

./makesol Test_A02_Views_A02-5-1_view-1_size_8M_svmake.txt

2. Test_A02_Views_A02-5-1_view-1_size_8M_svmake.txt

This file contains the list of the raw disks that are used to create the SVM logical volumes assigned to ASU1, ASU2, and ASU3. This file is used by the **makesol** script.

The details follow:

makesol

```
#!/bin/ksh
# Usage: usage
#           makesol configFile
#
LABELFILE="/tmp/makesollabel"
STATFILE="/tmp/makesolstat"
AWK=nawk
usage()
{
        echo "\nUsage: $0 configFile\n"
        exit 1
}

labelDisk()
{
     echo "l" > $LABELFILE
     echo "q" >> $LABELFILE
     format -s -f $LABELFILE $1
}

checkStat()
{
     typeset -i i=0
     del1=`grep $1 $STATFILE|$AWK '{ print $1 }'`
     if [ "$del1" != "" ] ; then
            for del in $del1
            do
                   i=0
                   while (( $i < $delete ))
                   do
                          if [ ${DELETE[(($i+1))]} == $del ] ; then
                                 break
                          fi
                          i=$i+1
                   done
                   if (( $i == $delete )) ; then
                          delete=$delete+1
```

```
                        DELETE[$delete]=$del
                fi
        done
    fi
}

getDiskSlice()
{
    vDisks=""
    for disk in ${DISKS[$1]}
    do
        ndisk=`echo $disk|$AWK 'BEGIN { FS="s"} ; { print $1 }'`
        vDisks=$vDisks$ndisk"s"$2" "
    done
}

makevol()
{
    typeset -i count=0
    typeset -i i=0
    typeset -i vcount
       tmp=`/usr/sbin/metastat -p|$AWK '{ print substr( $1, 2, length($1)-1 )}'`
    if [ "$tmp" == "" ] ; then
        i=0
    else
        for dgroup in $tmp
        do
            if (( $dgroup > $i )) ; then
                i=$dgroup
            fi
        done
        i=$i+1
    fi
    while (( $count < $groups ))
    do
        count=$count+1
#echo "/usr/sbin/metainit d$i 1 ${DISK_COUNT[$count]} ${DISKS[$count]}
${STRIPE[$count]}"
        tmp=`/usr/sbin/metainit d$i 1 ${DISK_COUNT[$count]} ${DISKS[$count]}
${STRIPE[$count]}`
        i=$i+1
        if [ "${VCOUNT[$count]}" != "" ] ; then
            vcount=1
            while (( $vcount < ${VCOUNT[$count]} ))
            do
                getSlice $vcount
                getDiskSlice $count $num
                tmp=`/usr/sbin/metainit d$i 1 ${DISK_COUNT[$count]} $vDisks
${STRIPE[$count]}`
                i=$i+1
                vcount=$vcount+1
            done
        fi
    done
}

checkDisk()
{
    typeset -i i=0
    tmp=$1"s"
    test=`grep $tmp /etc/vfstab`
    if [ "$test" != "" ] ; then
        echo "Found disk $1 in /etc/vfstab, we really shouldn't use it here"
```

```
                exit 4
        fi
        while (( $i < $groups ))
        do
                i=$i+1
                for disk in ${DISKS[$i]}
                do
                        tmp=$1"s0"
                        if [ "$disk" == $tmp ] ; then
                                echo "disk $1 repeated at line $lineno"
                                exit 4
                        fi
                done
           done
           disks=$disks+1
        part=$1"s0"
        DISKS[$groups]=${DISKS[$groups]}$part" "
        tmp=`prtvtoc -h /dev/dsk/$part 2>/dev/null`
        if [ $? != 0 ] ; then
                labelDisk $part
                tmp=`prtvtoc -h /dev/dsk/$part 2>/dev/null`
                if [ $? != 0 ] ; then
                        echo "prtvtoc failed for $part"
                        exit 4
                fi
        fi
        checkStat $1"s"
}

getSlice()
{
        num=0
           case $1 in
           0)
                num=0
                    ;;
           1)
                    num=1
                    ;;
           2|3|4|5|6)
                    (( num=$1+1 ))
                    ;;
           esac
}

setVtoc()
{
        typeset -i count=0
           typeset -i i=0
           while (( $i < $groups ))
           do
                    i=$i+1
                    for disk in ${DISKS[$i]}
                    do
                      if [ "${VCOUNT[$i]}" != "" ] ; then
                            sectors=`prtvtoc /dev/dsk/$disk 2>/dev/null|grep
"accessible cylinders"|$AWK '{ print $2 }'`
                            seccyl=`prtvtoc /dev/dsk/$disk 2>/dev/null|grep
"sectors/cylinder"|$AWK '{ print $2 }'`
                            (( sectors=$sectors-1 ))
                      fi
                      tmp=`prtvtoc -h /dev/dsk/$disk 2>/dev/null`
                      set $tmp
```

```
                    while (( $# > 5 ))
                    do
                           if (( $1 == 2 )) ; then
                                  if [ "${VCOUNT[$i]}" == "" ] ; then
                                         echo "0 4 $3 $4 $5 $6" > $LABELFILE
                                  else
                                         echo "* labelfile" > $LABELFILE
                                         (( secCount=$sectors/${VCOUNT[$i]} ))
                                         count=0
                                                (( sc=$secCount*$seccyl ))
                                                fs=$seccyl
                                         while (( $count < ${VCOUNT[$i]} ))
                                         do
                                                (( ls=$fs+$sc ))
                                                getSlice $count
                                                echo "$num 4 $3 $fs $sc $ls" >>
  $LABELFILE
                                                           count=$count+1
                                                (( fs=$fs+$sc ))
                                         done
                                  fi
                                  echo "$1 $2 $3 $4 $5 $6" >> $LABELFILE
                                  tmp=`fmthard -s $LABELFILE /dev/rdsk/$disk`
                                  break
                           fi
                           shift 6
                    done
                  done
          done
  }

  delGroups()
  {
       typeset -i i=0
       if [ $DELETE_ALL == "yes" ] ; then
              tmp=`/usr/sbin/metastat -p |$AWK '{ print $1 }'`
              for del in $tmp
              do
                     tmp=`/usr/sbin/metaclear $del`
                     if [ $? != 0 ] ; then
                            echo "Failed to delete volume $del"
                            exit 4
                     fi
              done
              return
       fi
       while (( $i < $delete ))
       do
              i=$i+1
              tmp=`/usr/sbin/metaclear ${DELETE[$i]}`
              if [ $? != 0 ] ; then
                     echo "Failed to delete volume ${DELETE[$i]}"
                     exit 4
              fi
       done
  }

  addDisks()
  {
          typeset -i diskNum=0
          typeset -i count=$name
          typeset -i jump=1
          diskNum=${label#*d}
```

```
        if (( $diskNum < 10 ))
        then
                diskPrefix=`echo $label|awk '{ print substr( $1, 0, length($1)-1 )
}'`
        elif (( $diskNum < 100 ))
        then
                diskPrefix=`echo $label|awk '{ print substr( $1, 0, length($1)-2 )
}'`
        else
                diskPrefix=`echo $label|awk '{ print substr( $1, 0, length($1)-3 )
}'`
        fi
        if [ "$skip" != "" ]
        then
                jump=$skip
        fi
        count=$count-1
        while [ $count != 0 ]
        do
                count=$count-1
                diskNum=$diskNum+$jump
                diskName=$diskPrefix$diskNum
                checkDisk $diskName
        done

}

checkConfig()
{
        typeset -i lineno=1
        invg="no"
     DELETE_ALL="no"
        while read -r label name skip
        do
                case $label in
                "VOLUME_GROUP:")
                        VGNAME=$VGNAME$name" "
                        invg="yes"
                        groups=$groups+1
                        getSize="yes"
                        ;;
                "#")
                        ;;
                "")
                        ;;
            "VOLUME")
                        if [ "$invg" != "yes" ]
                        then
                                echo "invalid line in config file line=$lineno
data=\"$label $name\""
                         echo "VOLUME line must be in a volume_group definition"
                                exit 4
                        fi
                  tmp=`echo $name|grep ^[1-7]$`
                  if [ "$tmp" == "" ] ; then
                         echo "invalid line in config file line=$lineno
data=\"$label $name\""
                         echo "VOLUME count must be from 1-7"
                         exit 4
                  fi
                  VCOUNT[groups]=$name
                  ;;
                "STRIPE")
```

```
                        if [ "$invg" != "yes" ]
                        then
                                echo "invalid line in config file line=$lineno
 data=\"$label $name\""
                                echo "STRIPE line must be in a volume_group
 definition"
                                exit 4
                        fi
                        STRIPE[groups]="-i $name"
                        ;;
            "DELETE_ALL")
                  DELETE_ALL="yes"
                  ;;
              "END")
                DISK_COUNT[$groups]=$disks
                disks=0
                      invg="no"
                      ;;
              *)
                      if [ "$invg" != "yes" ]
                      then
                              echo "invalid line in config file line=$lineno
 data=\"$label $name\""
                              exit 4
                      fi
                      diskName=$label
                      checkDisk $diskName
                      if [ "$name" != "" ]
                      then
                              addDisks
                      fi
              esac
              lineno=$lineno+1
        done < $CONFIG
 }


 # main()

        typeset -i delete=0
        typeset -i groups=0
        typeset -i disks=0
        test=`uname -a|grep "Linux"`
        if [ "$test" != "" ]
        then
                AWK=awk
        fi
     case $# in
     1)
           CONFIG=$1
           echo "Doing solvm config from $1"
           ;;
     *)
           usage
           ;;
     esac
     tmp=`/usr/sbin/metadb`
     if [ "$tmp" == "" ] ; then
           echo "No replica database is defined"
           exit 4
     fi
     tmp=`/usr/sbin/metastat -p > $STATFILE`
     checkConfig
```

```
delGroups
setVtoc
makevol
```

Test_A02_Views_A02-5-1_view-1_size_8M_svmake.txt

```
DELETE_ALL
VOLUME_GROUP: asu1-1 (d0)
STRIPE 8m
VOLUME 1
c96t16d4
c98t17d4
c120t16d4
c122t17d4
c97t16d4
c99t17d4
c157t16d4
c160t17d4
c100t18d4
c102t19d4
c124t18d4
c126t19d4
c101t18d4
c103t19d4
c163t18d4
c166t19d4
c96t16d22
c98t17d22
c120t16d22
c122t17d22
c97t16d22
c99t17d22
c157t16d22
c160t17d22
c100t18d22
c102t19d22
c124t18d22
c126t19d22
c101t18d22
c103t19d22
c163t18d22
c166t19d22
c96t16d40
c98t17d40
c120t16d40
c122t17d40
c97t16d40
c99t17d40
c157t16d40
c160t17d40
c100t18d40
c102t19d40
c124t18d40
c126t19d40
c101t18d40
c103t19d40
c163t18d40
c166t19d40
c96t16d58
c98t17d58
c120t16d58
c122t17d58
```

```
c97t16d58
c99t17d58
c157t16d58
c160t17d58
c100t18d58
c102t19d58
c124t18d58
c126t19d58
c101t18d58
c103t19d58
c163t18d58
c166t19d58
END
VOLUME_GROUP: asu1-2 (d1)
STRIPE 8m
VOLUME 1
c96t16d5
c98t17d5
c120t16d5
c122t17d5
c97t16d5
c99t17d5
c157t16d5
c160t17d5
c100t18d5
c102t19d5
c124t18d5
c126t19d5
c101t18d5
c103t19d5
c163t18d5
c166t19d5
c96t16d23
c98t17d23
c120t16d23
c122t17d23
c97t16d23
c99t17d23
c157t16d23
c160t17d23
c100t18d23
c102t19d23
c124t18d23
c126t19d23
c101t18d23
c103t19d23
c163t18d23
c166t19d23
c96t16d41
c98t17d41
c120t16d41
c122t17d41
c97t16d41
c99t17d41
c157t16d41
c160t17d41
c100t18d41
c102t19d41
c124t18d41
c126t19d41
c101t18d41
c103t19d41
c163t18d41
```

```
  c166t19d41
  c96t16d59
  c98t17d59
  c120t16d59
  c122t17d59
  c97t16d59
  c99t17d59
  c157t16d59
  c160t17d59
  c100t18d59
  c102t19d59
  c124t18d59
  c126t19d59
  c101t18d59
  c103t19d59
  c163t18d59
  c166t19d59
  END
  VOLUME_GROUP: asu1-3 (d2)
  STRIPE 8m
  VOLUME 1
  c96t16d6
  c98t17d6
  c120t16d6
  c122t17d6
  c97t16d6
  c99t17d6
  c157t16d6
  c160t17d6
  c100t18d6
  c102t19d6
  c124t18d6
  c126t19d6
  c101t18d6
  c103t19d6
  c163t18d6
  c166t19d6
  c96t16d24
  c98t17d24
  c120t16d24
  c122t17d24
  c97t16d24
  c99t17d24
  c157t16d24
  c160t17d24
  c100t18d24
  c102t19d24
  c124t18d24
  c126t19d24
  c101t18d24
  c103t19d24
  c163t18d24
  c166t19d24
  c96t16d42
  c98t17d42
  c120t16d42
  c122t17d42
  c97t16d42
  c99t17d42
  c157t16d42
  c160t17d42
  c100t18d42
  c102t19d42
```

```
c124t18d42
c126t19d42
c101t18d42
c103t19d42
c163t18d42
c166t19d42
c96t16d60
c98t17d60
c120t16d60
c122t17d60
c97t16d60
c99t17d60
c157t16d60
c160t17d60
c100t18d60
c102t19d60
c124t18d60
c126t19d60
c101t18d60
c103t19d60
c163t18d60
c166t19d60
END
VOLUME_GROUP: asu1-4 (d3)
STRIPE 8m
VOLUME 1
c96t16d7
c98t17d7
c120t16d7
c122t17d7
c97t16d7
c99t17d7
c157t16d7
c160t17d7
c100t18d7
c102t19d7
c124t18d7
c126t19d7
c101t18d7
c103t19d7
c163t18d7
c166t19d7
c96t16d25
c98t17d25
c120t16d25
c122t17d25
c97t16d25
c99t17d25
c157t16d25
c160t17d25
c100t18d25
c102t19d25
c124t18d25
c126t19d25
c101t18d25
c103t19d25
c163t18d25
c166t19d25
c96t16d43
c98t17d43
c120t16d43
c122t17d43
c97t16d43
```

```
c99t17d43
c157t16d43
c160t17d43
c100t18d43
c102t19d43
c124t18d43
c126t19d43
c101t18d43
c103t19d43
c163t18d43
c166t19d43
c96t16d61
c98t17d61
c120t16d61
c122t17d61
c97t16d61
c99t17d61
c157t16d61
c160t17d61
c100t18d61
c102t19d61
c124t18d61
c126t19d61
c101t18d61
c103t19d61
c163t18d61
c166t19d61
END
VOLUME_GROUP: asu1-5 (d4)
STRIPE 8m
VOLUME 1
c96t16d10
c98t17d10
c120t16d10
c122t17d10
c97t16d10
c99t17d10
c157t16d10
c160t17d10
c100t18d10
c102t19d10
c124t18d10
c126t19d10
c101t18d10
c103t19d10
c163t18d10
c166t19d10
c96t16d28
c98t17d28
c120t16d28
c122t17d28
c97t16d28
c99t17d28
c157t16d28
c160t17d28
c100t18d28
c102t19d28
c124t18d28
c126t19d28
c101t18d28
c103t19d28
c163t18d28
c166t19d28
```

```
c96t16d46
c98t17d46
c120t16d46
c122t17d46
c97t16d46
c99t17d46
c157t16d46
c160t17d46
c100t18d46
c102t19d46
c124t18d46
c126t19d46
c101t18d46
c103t19d46
c163t18d46
c166t19d46
c96t16d64
c98t17d64
c120t16d64
c122t17d64
c97t16d64
c99t17d64
c157t16d64
c160t17d64
c100t18d64
c102t19d64
c124t18d64
c126t19d64
c101t18d64
c103t19d64
c163t18d64
c166t19d64
END
VOLUME_GROUP: asu1-6 (d5)
STRIPE 8m
VOLUME 1
c96t16d11
c98t17d11
c120t16d11
c122t17d11
c97t16d11
c99t17d11
c157t16d11
c160t17d11
c100t18d11
c102t19d11
c124t18d11
c126t19d11
c101t18d11
c103t19d11
c163t18d11
c166t19d11
c96t16d29
c98t17d29
c120t16d29
c122t17d29
c97t16d29
c99t17d29
c157t16d29
c160t17d29
c100t18d29
c102t19d29
c124t18d29
```

```
c126t19d29
c101t18d29
c103t19d29
c163t18d29
c166t19d29
c96t16d47
c98t17d47
c120t16d47
c122t17d47
c97t16d47
c99t17d47
c157t16d47
c160t17d47
c100t18d47
c102t19d47
c124t18d47
c126t19d47
c101t18d47
c103t19d47
c163t18d47
c166t19d47
c96t16d65
c98t17d65
c120t16d65
c122t17d65
c97t16d65
c99t17d65
c157t16d65
c160t17d65
c100t18d65
c102t19d65
c124t18d65
c126t19d65
c101t18d65
c103t19d65
c163t18d65
c166t19d65
END
VOLUME_GROUP: asu1-7 (d6)
STRIPE 8m
VOLUME 1
c96t16d12
c98t17d12
c120t16d12
c122t17d12
c97t16d12
c99t17d12
c157t16d12
c160t17d12
c100t18d12
c102t19d12
c124t18d12
c126t19d12
c101t18d12
c103t19d12
c163t18d12
c166t19d12
c96t16d30
c98t17d30
c120t16d30
c122t17d30
c97t16d30
c99t17d30
```

```
  c157t16d30
  c160t17d30
  c100t18d30
  c102t19d30
  c124t18d30
  c126t19d30
  c101t18d30
  c103t19d30
  c163t18d30
  c166t19d30
  c96t16d48
  c98t17d48
  c120t16d48
  c122t17d48
  c97t16d48
  c99t17d48
  c157t16d48
  c160t17d48
  c100t18d48
  c102t19d48
  c124t18d48
  c126t19d48
  c101t18d48
  c103t19d48
  c163t18d48
  c166t19d48
  c96t16d66
  c98t17d66
  c120t16d66
  c122t17d66
  c97t16d66
  c99t17d66
  c157t16d66
  c160t17d66
  c100t18d66
  c102t19d66
  c124t18d66
  c126t19d66
  c101t18d66
  c103t19d66
  c163t18d66
  c166t19d66
  END
  VOLUME_GROUP: asu1-8 (d7)
  STRIPE 8m
  VOLUME 1
  c96t16d13
  c98t17d13
  c120t16d13
  c122t17d13
  c97t16d13
  c99t17d13
  c157t16d13
  c160t17d13
  c100t18d13
  c102t19d13
  c124t18d13
  c126t19d13
  c101t18d13
  c103t19d13
  c163t18d13
  c166t19d13
  c96t16d31
```

```
c98t17d31
c120t16d31
c122t17d31
c97t16d31
c99t17d31
c157t16d31
c160t17d31
c100t18d31
c102t19d31
c124t18d31
c126t19d31
c101t18d31
c103t19d31
c163t18d31
c166t19d31
c96t16d49
c98t17d49
c120t16d49
c122t17d49
c97t16d49
c99t17d49
c157t16d49
c160t17d49
c100t18d49
c102t19d49
c124t18d49
c126t19d49
c101t18d49
c103t19d49
c163t18d49
c166t19d49
c96t16d67
c98t17d67
c120t16d67
c122t17d67
c97t16d67
c99t17d67
c157t16d67
c160t17d67
c100t18d67
c102t19d67
c124t18d67
c126t19d67
c101t18d67
c103t19d67
c163t18d67
c166t19d67
END
VOLUME_GROUP: asu2-1 (d8)
STRIPE 8m
VOLUME 1
c96t16d0
c98t17d0
c120t16d0
c122t17d0
c97t16d0
c99t17d0
c157t16d0
c160t17d0
c100t18d0
c102t19d0
c124t18d0
c126t19d0
```

```
c101t18d0
c103t19d0
c163t18d0
c166t19d0
c96t16d18
c98t17d18
c120t16d18
c122t17d18
c97t16d18
c99t17d18
c157t16d18
c160t17d18
c100t18d18
c102t19d18
c124t18d18
c126t19d18
c101t18d18
c103t19d18
c163t18d18
c166t19d18
c96t16d36
c98t17d36
c120t16d36
c122t17d36
c97t16d36
c99t17d36
c157t16d36
c160t17d36
c100t18d36
c102t19d36
c124t18d36
c126t19d36
c101t18d36
c103t19d36
c163t18d36
c166t19d36
c96t16d54
c98t17d54
c120t16d54
c122t17d54
c97t16d54
c99t17d54
c157t16d54
c160t17d54
c100t18d54
c102t19d54
c124t18d54
c126t19d54
c101t18d54
c103t19d54
c163t18d54
c166t19d54
END
VOLUME_GROUP: asu2-2 (d9)
STRIPE 8m
VOLUME 1
c96t16d1
c98t17d1
c120t16d1
c122t17d1
c97t16d1
c99t17d1
c157t16d1
```

```
c160t17d1
c100t18d1
c102t19d1
c124t18d1
c126t19d1
c101t18d1
c103t19d1
c163t18d1
c166t19d1
c96t16d19
c98t17d19
c120t16d19
c122t17d19
c97t16d19
c99t17d19
c157t16d19
c160t17d19
c100t18d19
c102t19d19
c124t18d19
c126t19d19
c101t18d19
c103t19d19
c163t18d19
c166t19d19
c96t16d37
c98t17d37
c120t16d37
c122t17d37
c97t16d37
c99t17d37
c157t16d37
c160t17d37
c100t18d37
c102t19d37
c124t18d37
c126t19d37
c101t18d37
c103t19d37
c163t18d37
c166t19d37
c96t16d55
c98t17d55
c120t16d55
c122t17d55
c97t16d55
c99t17d55
c157t16d55
c160t17d55
c100t18d55
c102t19d55
c124t18d55
c126t19d55
c101t18d55
c103t19d55
c163t18d55
c166t19d55
END
VOLUME_GROUP: asu2-3 (d10)
STRIPE 8m
VOLUME 1
c96t16d2
c98t17d2
```

```
  c120t16d2
  c122t17d2
  c97t16d2
  c99t17d2
  c157t16d2
  c160t17d2
  c100t18d2
  c102t19d2
  c124t18d2
  c126t19d2
  c101t18d2
  c103t19d2
  c163t18d2
  c166t19d2
  c96t16d20
  c98t17d20
  c120t16d20
  c122t17d20
  c97t16d20
  c99t17d20
  c157t16d20
  c160t17d20
  c100t18d20
  c102t19d20
  c124t18d20
  c126t19d20
  c101t18d20
  c103t19d20
  c163t18d20
  c166t19d20
  c96t16d38
  c98t17d38
  c120t16d38
  c122t17d38
  c97t16d38
  c99t17d38
  c157t16d38
  c160t17d38
  c100t18d38
  c102t19d38
  c124t18d38
  c126t19d38
  c101t18d38
  c103t19d38
  c163t18d38
  c166t19d38
  c96t16d56
  c98t17d56
  c120t16d56
  c122t17d56
  c97t16d56
  c99t17d56
  c157t16d56
  c160t17d56
  c100t18d56
  c102t19d56
  c124t18d56
  c126t19d56
  c101t18d56
  c103t19d56
  c163t18d56
  c166t19d56
  END
```

```
VOLUME_GROUP: asu2-4 (d11)
STRIPE 8m
VOLUME 1
c96t16d3
c98t17d3
c120t16d3
c122t17d3
c97t16d3
c99t17d3
c157t16d3
c160t17d3
c100t18d3
c102t19d3
c124t18d3
c126t19d3
c101t18d3
c103t19d3
c163t18d3
c166t19d3
c96t16d21
c98t17d21
c120t16d21
c122t17d21
c97t16d21
c99t17d21
c157t16d21
c160t17d21
c100t18d21
c102t19d21
c124t18d21
c126t19d21
c101t18d21
c103t19d21
c163t18d21
c166t19d21
c96t16d39
c98t17d39
c120t16d39
c122t17d39
c97t16d39
c99t17d39
c157t16d39
c160t17d39
c100t18d39
c102t19d39
c124t18d39
c126t19d39
c101t18d39
c103t19d39
c163t18d39
c166t19d39
c96t16d57
c98t17d57
c120t16d57
c122t17d57
c97t16d57
c99t17d57
c157t16d57
c160t17d57
c100t18d57
c102t19d57
c124t18d57
c126t19d57
```

```
c101t18d57
c103t19d57
c163t18d57
c166t19d57
END
VOLUME_GROUP: asu2-5 (d12)
STRIPE 8m
VOLUME 1
c96t16d14
c98t17d14
c120t16d14
c122t17d14
c97t16d14
c99t17d14
c157t16d14
c160t17d14
c100t18d14
c102t19d14
c124t18d14
c126t19d14
c101t18d14
c103t19d14
c163t18d14
c166t19d14
c96t16d32
c98t17d32
c120t16d32
c122t17d32
c97t16d32
c99t17d32
c157t16d32
c160t17d32
c100t18d32
c102t19d32
c124t18d32
c126t19d32
c101t18d32
c103t19d32
c163t18d32
c166t19d32
c96t16d50
c98t17d50
c120t16d50
c122t17d50
c97t16d50
c99t17d50
c157t16d50
c160t17d50
c100t18d50
c102t19d50
c124t18d50
c126t19d50
c101t18d50
c103t19d50
c163t18d50
c166t19d50
c96t16d68
c98t17d68
c120t16d68
c122t17d68
c97t16d68
c99t17d68
c157t16d68
```

```
c160t17d68
c100t18d68
c102t19d68
c124t18d68
c126t19d68
c101t18d68
c103t19d68
c163t18d68
c166t19d68
END
VOLUME_GROUP: asu2-6 (d13)
STRIPE 8m
VOLUME 1
c96t16d15
c98t17d15
c120t16d15
c122t17d15
c97t16d15
c99t17d15
c157t16d15
c160t17d15
c100t18d15
c102t19d15
c124t18d15
c126t19d15
c101t18d15
c103t19d15
c163t18d15
c166t19d15
c96t16d33
c98t17d33
c120t16d33
c122t17d33
c97t16d33
c99t17d33
c157t16d33
c160t17d33
c100t18d33
c102t19d33
c124t18d33
c126t19d33
c101t18d33
c103t19d33
c163t18d33
c166t19d33
c96t16d51
c98t17d51
c120t16d51
c122t17d51
c97t16d51
c99t17d51
c157t16d51
c160t17d51
c100t18d51
c102t19d51
c124t18d51
c126t19d51
c101t18d51
c103t19d51
c163t18d51
c166t19d51
c96t16d69
c98t17d69
```

```
c120t16d69
c122t17d69
c97t16d69
c99t17d69
c157t16d69
c160t17d69
c100t18d69
c102t19d69
c124t18d69
c126t19d69
c101t18d69
c103t19d69
c163t18d69
c166t19d69
END
VOLUME_GROUP: asu2-7 (d14)
STRIPE 8m
VOLUME 1
c96t16d16
c98t17d16
c120t16d16
c122t17d16
c97t16d16
c99t17d16
c157t16d16
c160t17d16
c100t18d16
c102t19d16
c124t18d16
c126t19d16
c101t18d16
c103t19d16
c163t18d16
c166t19d16
c96t16d34
c98t17d34
c120t16d34
c122t17d34
c97t16d34
c99t17d34
c157t16d34
c160t17d34
c100t18d34
c102t19d34
c124t18d34
c126t19d34
c101t18d34
c103t19d34
c163t18d34
c166t19d34
c96t16d52
c98t17d52
c120t16d52
c122t17d52
c97t16d52
c99t17d52
c157t16d52
c160t17d52
c100t18d52
c102t19d52
c124t18d52
c126t19d52
c101t18d52
```

```
c103t19d52
c163t18d52
c166t19d52
c96t16d70
c98t17d70
c120t16d70
c122t17d70
c97t16d70
c99t17d70
c157t16d70
c160t17d70
c100t18d70
c102t19d70
c124t18d70
c126t19d70
c101t18d70
c103t19d70
c163t18d70
c166t19d70
END
VOLUME_GROUP: asu2-8 (d15)
STRIPE 8m
VOLUME 1
c96t16d17
c98t17d17
c120t16d17
c122t17d17
c97t16d17
c99t17d17
c157t16d17
c160t17d17
c100t18d17
c102t19d17
c124t18d17
c126t19d17
c101t18d17
c103t19d17
c163t18d17
c166t19d17
c96t16d35
c98t17d35
c120t16d35
c122t17d35
c97t16d35
c99t17d35
c157t16d35
c160t17d35
c100t18d35
c102t19d35
c124t18d35
c126t19d35
c101t18d35
c103t19d35
c163t18d35
c166t19d35
c96t16d53
c98t17d53
c120t16d53
c122t17d53
c97t16d53
c99t17d53
c157t16d53
c160t17d53
```

```
c100t18d53
c102t19d53
c124t18d53
c126t19d53
c101t18d53
c103t19d53
c163t18d53
c166t19d53
c96t16d71
c98t17d71
c120t16d71
c122t17d71
c97t16d71
c99t17d71
c157t16d71
c160t17d71
c100t18d71
c102t19d71
c124t18d71
c126t19d71
c101t18d71
c103t19d71
c163t18d71
c166t19d71
END
VOLUME_GROUP: asu3-1 (d16)
STRIPE 8m
VOLUME 1
c96t16d8
c98t17d8
c120t16d8
c122t17d8
c97t16d8
c99t17d8
c157t16d8
c160t17d8
c100t18d8
c102t19d8
c124t18d8
c126t19d8
c101t18d8
c103t19d8
c163t18d8
c166t19d8
c96t16d26
c98t17d26
c120t16d26
c122t17d26
c97t16d26
c99t17d26
c157t16d26
c160t17d26
c100t18d26
c102t19d26
c124t18d26
c126t19d26
c101t18d26
c103t19d26
c163t18d26
c166t19d26
c96t16d44
c98t17d44
c120t16d44
```

```
c122t17d44
c97t16d44
c99t17d44
c157t16d44
c160t17d44
c100t18d44
c102t19d44
c124t18d44
c126t19d44
c101t18d44
c103t19d44
c163t18d44
c166t19d44
c96t16d62
c98t17d62
c120t16d62
c122t17d62
c97t16d62
c99t17d62
c157t16d62
c160t17d62
c100t18d62
c102t19d62
c124t18d62
c126t19d62
c101t18d62
c103t19d62
c163t18d62
c166t19d62
END
VOLUME_GROUP: asu3-2 (d17)
STRIPE 8m
VOLUME 1
c96t16d9
c98t17d9
c120t16d9
c122t17d9
c97t16d9
c99t17d9
c157t16d9
c160t17d9
c100t18d9
c102t19d9
c124t18d9
c126t19d9
c101t18d9
c103t19d9
c163t18d9
c166t19d9
c96t16d27
c98t17d27
c120t16d27
c122t17d27
c97t16d27
c99t17d27
c157t16d27
c160t17d27
c100t18d27
c102t19d27
c124t18d27
c126t19d27
c101t18d27
c103t19d27
```

```
  c163t18d27
  c166t19d27
  c96t16d45
  c98t17d45
  c120t16d45
  c122t17d45
  c97t16d45
  c99t17d45
  c157t16d45
  c160t17d45
  c100t18d45
  c102t19d45
  c124t18d45
  c126t19d45
  c101t18d45
  c103t19d45
  c163t18d45
  c166t19d45
  c96t16d63
  c98t17d63
  c120t16d63
  c122t17d63
  c97t16d63
  c99t17d63
  c157t16d63
  c160t17d63
  c100t18d63
  c102t19d63
  c124t18d63
  c126t19d63
  c101t18d63
  c103t19d63
  c163t18d63
  c166t19d63
  END
```

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

The SPC-1 Workload Generator command and parameter file used in this benchmark is listed below.

```
javaparms="-Xmx1024m -Xms1024m -Xss512k"
sd=asu1_1,lun=/dev/md/rdsk/d0,size=383.647g
sd=asu1_2,lun=/dev/md/rdsk/d1,size=383.647g
sd=asu1_3,lun=/dev/md/rdsk/d2,size=383.647g
sd=asu1_4,lun=/dev/md/rdsk/d3,size=383.647g
sd=asu1_5,lun=/dev/md/rdsk/d4,size=383.647g
sd=asu1_6,lun=/dev/md/rdsk/d5,size=383.647g
sd=asu1_7,lun=/dev/md/rdsk/d6,size=383.647g
sd=asu1_8,lun=/dev/md/rdsk/d7,size=383.647g
sd=asu2_1,lun=/dev/md/rdsk/d8,size=383.647g
sd=asu2_2,lun=/dev/md/rdsk/d9,size=383.647g
sd=asu2_3,lun=/dev/md/rdsk/d10,size=383.647g
sd=asu2_4,lun=/dev/md/rdsk/d11,size=383.647g
sd=asu2_5,lun=/dev/md/rdsk/d12,size=383.647g
sd=asu2_6,lun=/dev/md/rdsk/d13,size=383.647g
sd=asu2_7,lun=/dev/md/rdsk/d14,size=383.647g
sd=asu2_8,lun=/dev/md/rdsk/d15,size=383.647g
sd=asu3_1,lun=/dev/md/rdsk/d16,size=340.913g
sd=asu3_2,lun=/dev/md/rdsk/d17,size=340.913g
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

Commands executed from the Command Line Interface

The following command was used to execute the Metrics Test, Repeatability Test, and Persistence Test Run 1 in an uninterrupted sequence as required by the SPC-1 benchmark specification.

```
./run_fdr_060818.sh
```

The following command was used to execute Persistence Test Run 2:

```
./run_fdr_all_060818.sh
```

The content of the two scripts are listed below.

run_fdr_060818.sh

```
#metric
java -Xms1024m -Xmx1024m -Xss512k metrics -b 1200 -s 300
#repeat-1
java -Xms1024m -Xmx1024m -Xss512k repeat1 -b 1200 -s 300
#repeat-2
java -Xms1024m -Xmx1024m -Xss512k repeat2 -b 1200 -s 300
#persist1
java -Xmx1024m -Xms1024m -Xss512k persist1 -b 1200

mv persistence1 persist1_060818_1200
mv metrics metrics_060808_1200
mv repeatability1 repeat1_060818_1200
mv repeatability2 repeat2_060818_1200
#mv SPCOut SPCOut_060818_1200
```

run_fdr_all_060818.sh

```
#persist-2
java -Xmx1024m -Xms1024m -Xss512k persist2
#
mv persistence2 persist2_060818_1200
mv SPCOut SPCOut_060818_1200
```

APPENDIX F: THIRD-PARTY QUOTATIONS

Emulex HBAs

Info X
Technology Solutions

QUOTE

1 Veterans Place
Whippany, NJ 07981
(973) 386-1411, Fax: (973) 386-0783
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Toll Free: (800) 463-9998 - Chris Kowalik Ext. 130

ORDER NUMBER: 0114209
ORDER DATE: 8/23/2006

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Sunnyvale, CA 94085-3470US

SHIP TO:

Fujitsu Computer Systems
Account Payable-MS 141
1250 E Arques Avenue
Sunnyvale, CA 94085-3470US

CONFIRM TO: Karen Carlson*

CUSTOMER P.O.	SHIP VIA	F.O.B.	TERMS
			Net 30

ITEM NUMBER	UNIT	ORDERED	SHIPPED	BACK ORDE	PRICE	AMOUNT
LP11000-E	EACH	16	0	0	826.56	13,224.96
EMC 4Gb PCI-X 2.0 Single Port						
EMC adapter, in stock, retail $ 1695.00						
3yr warranty, 24x7 support, advanced replacement						
LP11000-M4	EACH	16	0	0	779.00	12,464.00
Emulex 4Gb PCI-X Single 3.3V Signaling, 5V Tolerant						
Generic adapter, in stock, retail $ 1695.00						
3yr warranty, 24x7 support, advanced replacement						
LP11002-E	EACH	16	0	0	1,066.24	17,059.84
EMC 4Gb PCI-X Dual 3.3V Sign / 5V Tol						
EMC adapter, in stock, retail $ 2795.00						
3yr warranty, 24x7 support, advanced replacement						
LP11002-M4	EACH	16	0	0	1,328.00	21,248.00
Emulex 4Gb PCI-X Dual 3.3V Sign / 5V Tol						
Generic adapter, in stock, retail $ 2795.00						
3yr warranty, 24x7 support, advanced replacement						
LPE11000-E	EACH	16	0	0	826.56	13,224.96
EMC 4Gb x4 PCI-Express Single Port						
EMC adapter, in stock, retail $ 1695.00						
3yr warranty, 24x7 support, advanced replacement						
LPE11000-M4	EACH	16	0	0	779.00	12,464.00
Emulex 4Gb PCI-Express Single 3.3V Signaling, 5V Tolerant						
Generic adapter, in stock, retail $ 1695.00						
3yr warranty, 24x7 support, advanced replacement						
LPE11002-E	EACH	16	0	0	1,066.24	17,059.84
EMC 4Gb PCI-Express Dual 3.3V Sign / 5V Tol						
EMC adapter, in stock, retail $ 2795.00						
3yr warranty, 24x7 support, advanced replacement						
LPE11002-M4	EACH	16	0	0	1,327.00	21,232.00
Emulex 4Gb PCI-Express Dual 3.3V Sign / 5V Tol						
Generic adapter, in stock, retail $ 2795.00						
3yr warranty, 24x7 support, advanced replacement						

Emulex HBAs *(cont.)*

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QUOTE

ORDER NUMBER: 0114209
ORDER DATE: 8/23/2006

CUSTOMER NO: FUJTS

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Fujitsu Computer Systems
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1250 E Arques Avenue
Sunnyvale, CA 94085-3470US

SHIP TO:

Fujitsu Computer Systems
Account Payable-MS 141
1250 E Arques Avenue
Sunnyvale, CA 94085-3470US

CONFIRM TO: Karen Carlson*

CUSTOMER P.O.	SHIP VIA	F.O.B.	TERMS
			Net 30

ITEM NUMBER	UNIT	ORDERED	SHIPPED	BACK ORDE	PRICE	AMOUNT

Advanced Replacements on all defective HBA products.
24x7x365 Support from our Certified Fibre Channel Engineers.
3 Year Manufacturer Warranty on all Fibre Channel HBAs.

Net Order:	127,977.60
Less Discount:	0.00
Shipping & Handling:	0.00
Sales Tax:	0.00
Order Total:	**127,977.60**

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Terms and Conditions:
Shipping and Handling are not included on this Quote. Please ask your sales representative for a freight quote based on the desired shipping method.
Customer is responsible for all applicable taxes and duties.
Prices are in US currency and are subject to change without notice.
Returns will only be accepted after a valid RMA number has been issued. All non-defective returns must be completed within 30 days from the original purchase date. Open items will only be accepted on a case by case basis and are subject to a 15% restocking fee and are not allowed after 30 days from the original purchase date.
Customer is responsible for all freight costs associated with returns or exchanges.
Past Due invoices will incur a 1% monthly finance charge. In addition, any collection costs associated with past due invoices will be the responsibility of the customer.

Accepted

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