SPC BENCHMARK 1™

FULL DISCLOSURE REPORT

FUJITSU LIMITED

FUJITSU STORAGE SYSTEMS
ETERNUS6000 MODEL 1100

SPC-1 V1.10

Submitted for Review: February 27, 2006
Submission Identifier: A00045
Accepted: April 28, 2006

First Edition – February 2006

Trademarks

Table of Contents

AUDIT CERTIFICATION

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

February 27, 2006

The SPC Benchmark 1™ results listed below for the Fujitsu Storage Systems ETERNUS6000 Model 1100 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 ETERNUS6000 Model 1100	
Metric	**Reported Result**
SPC-1 IOPS™	108,745.34
SPC-1 Price-Performance	$12.21/SPC-1 IOPS™
Total ASU Capacity	11,377.366 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$1,327,787

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

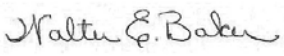
- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified using information supplied by Fujitsu Limited:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and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

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

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
- There were no differences between the Tested Storage Configuration (TSC) used for the benchmark and 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.

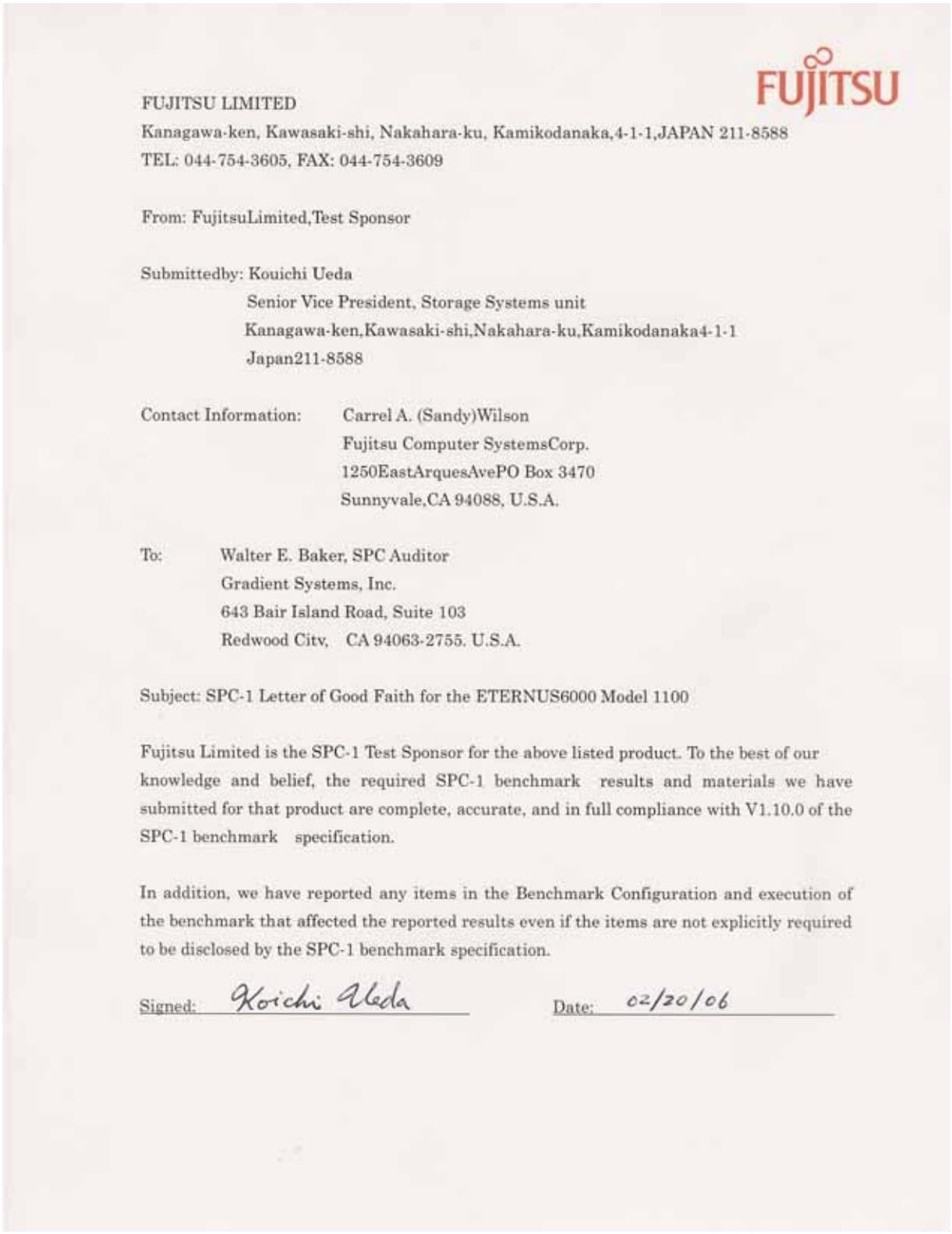
Respectfully,



Walter E. Baker
SPC Auditor

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

LETTER OF GOOD FAITH



FUJITSU

FUJITSU LIMITED
Kanagawa-ken, Kawasaki-shi, Nakahara-ku, Kamikodanaka,4-1-1,JAPAN 211-8588
TEL: 044-754-3605, FAX: 044-754-3609

From: FujitsuLimited,Test Sponsor

Submittedby: Kouichi Ueda
Senior Vice President, Storage Systems unit
Kanagawa-ken,Kawasaki-shi,Nakahara-ku,Kamikodanaka4-1-1
Japan211-8588

Contact Information: Carrel A. (Sandy)Wilson
Fujitsu Computer SystemsCorp.
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 ETERNUS6000 Model 1100

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: Koichi Ueda Date: 02/20/06

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
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu Computer Systems Corp. Kun Katsumata Kun_Katsumata@us.fujitsu.com 1250 East Arques Ave. PO Box 3470 Sunnyvale, CA 94088-3470 Phone (408) 746-6415
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	February 27, 2006
Date the FDR was submitted to the SPC	February 27, 2006
Date the TSC is available for shipment to customers	May 31, 2006
Date the TSC completed audit certification	February 27, 2006

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS6000 Model 1100	
Metric	**Reported Result**
SPC-1 IOPS™	108,745.34
SPC-1 Price-Performance	$12.21/SPC-1 IOPS™
Total ASU Capacity	11,377.366 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$1,327,787

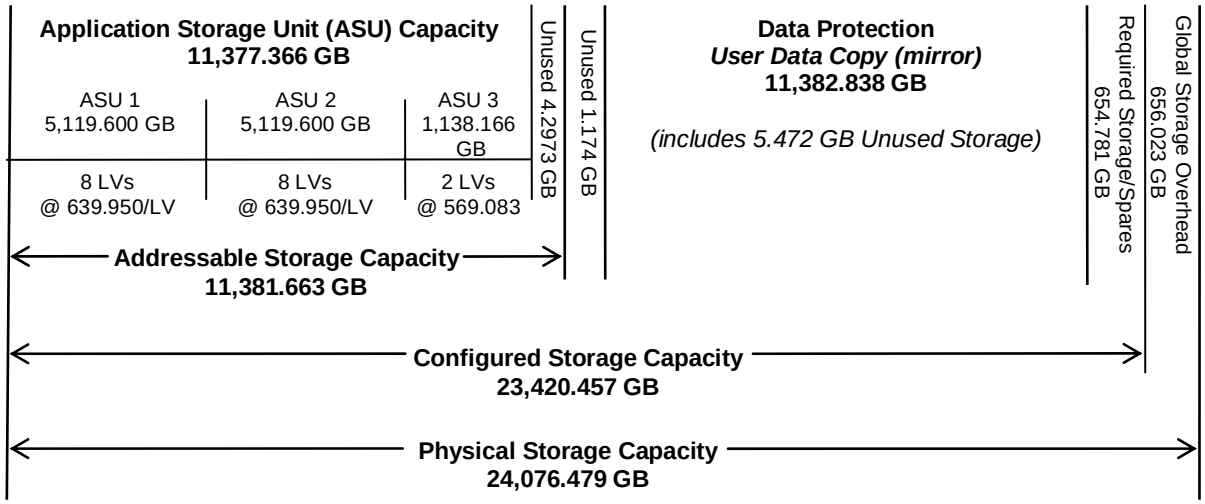
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

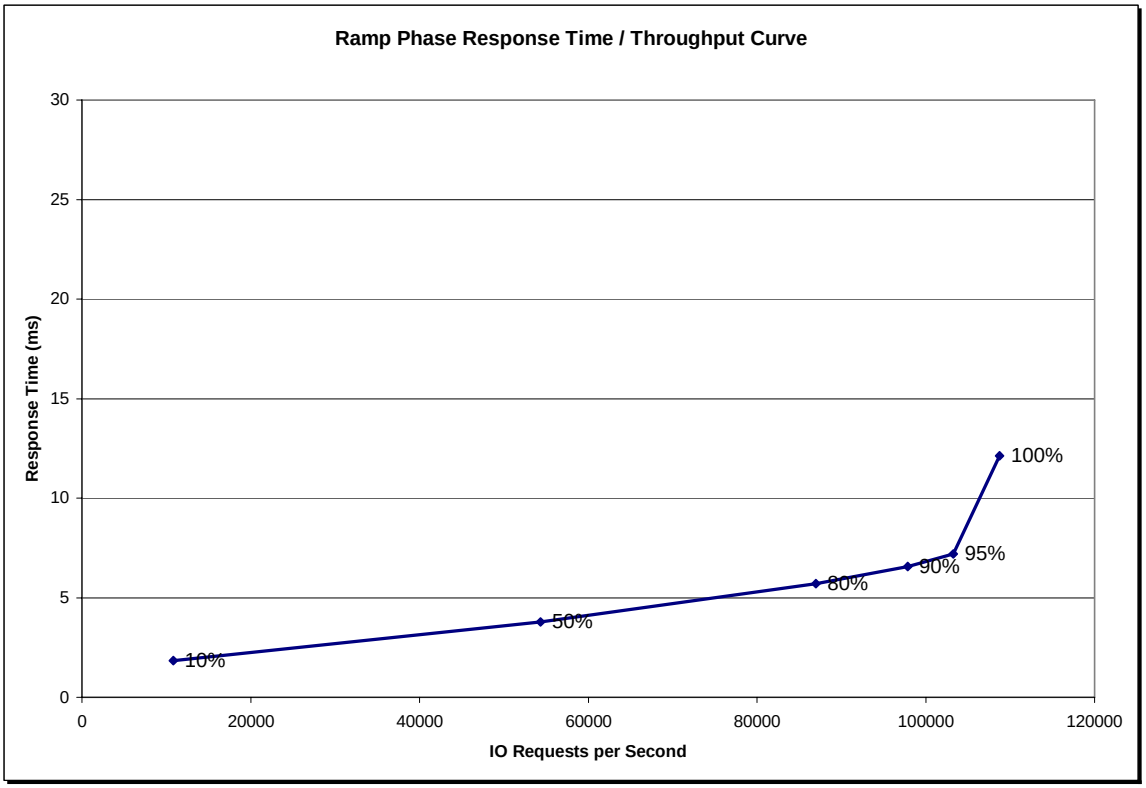
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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	10,850.59	54,328.07	86,993.69	97,849.79	103,272.14	108,745.34
Average Response Time (ms):						
All ASUs	1.85	3.79	5.70	6.56	7.20	12.13
ASU-1	2.35	4.46	6.57	7.55	8.26	14.16
ASU-2	1.79	3.70	5.86	6.87	7.53	10.07
ASU-3	0.81	2.41	3.78	4.34	4.79	8.73
Reads	3.54	6.03	8.77	10.12	11.04	16.43
Writes	0.74	2.33	3.69	4.24	4.69	9.33

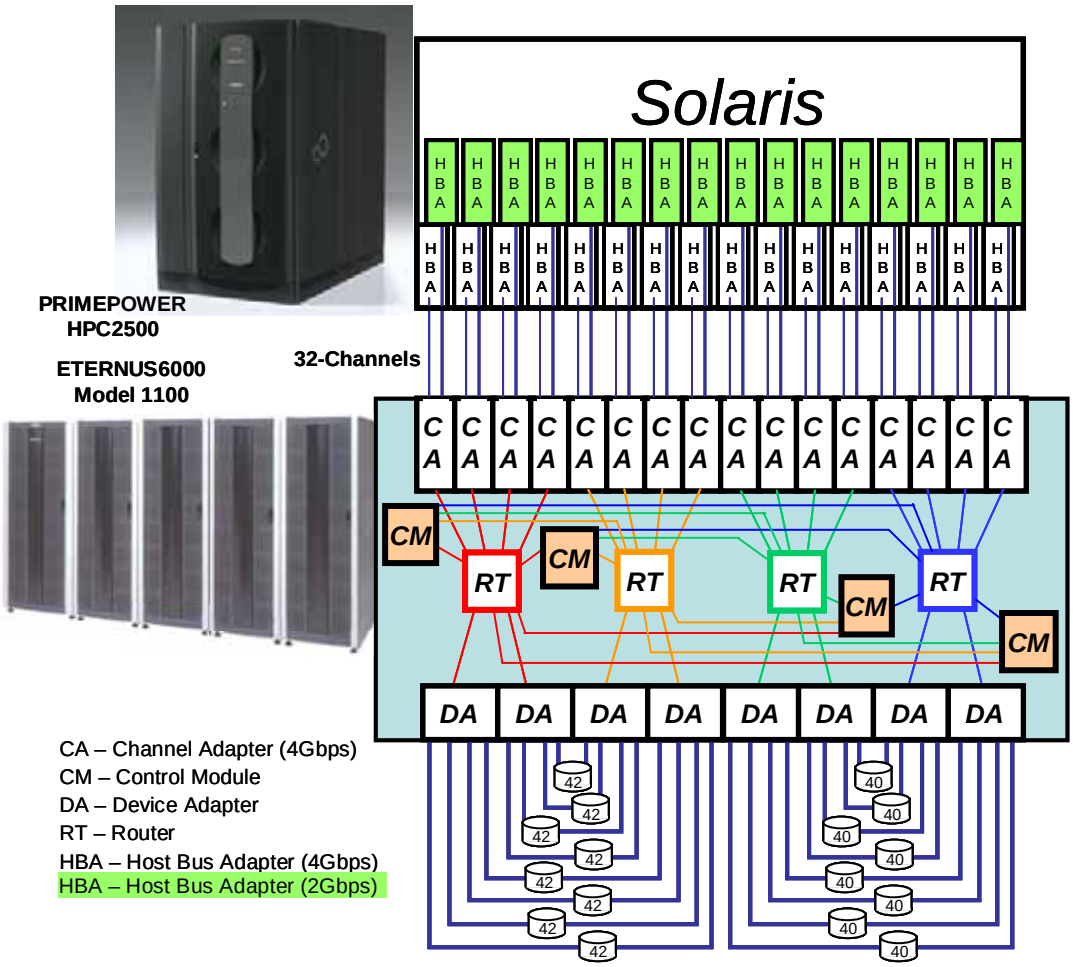
Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Item	Product Id	Description	Qty	Unit $	Extd $
1	E6B0S01AU	ETERNUS6000 Model 1100 Base Unit (with door) including Controller Enclosure, 4x Controllers (CM), 4x Interface Units (RT), 8x Drive Interface (DA), 4x power supplie units, 6x battery units, 24x drive enclosures (DE), 8x 36GB System disk drives, 1x Base 1800mm (36U) rack, 2x Expansion 1800mm (36U) rack, 8x power distribution (200VAC), rack mount kit, ETERNUSmgr & drivers slots for up to 360 disk drives	1	$452,110	$452,110
2	E600CR3U	ETERNUS6000 Expansion Rack (with door) including Expansion 1800mm (36U) rack 2x power distribution (200 VAC)	2	$8,000	$16,000
3	E600CE21U	Drive Enclosure (4x DE) with slots for up to 60 disk drives	6	$31,000	$186,000
4	E600CM45	Additional cache memory (4x 8GB)	1	$130,500	$130,500
5	E600CM47	Additional cache memory (4x 16GB)	1	$163,800	$163,800
6	E600CH14	Fibre Channel Host Interface (dual port) x2	8	$12,800	$102,400
7	E600CC2L	36GB/15krpm Disk Drives RAID(4+4)	80	$8,000	$640,000
8	E600CA2L	36GB/15krpm Disk Drive (Hot Spare)	16	$1,000	$16,000
9	CBL-MLLB15	Fibre Channel Cable	32	$181	$5,792
10	LP10000	Emulex LP10000 HBA (per quote from Micro2nds)	16	$850	$13,600
11	LP11000-M4	Emulex 4Gb PCI-X Single HBA (per quote from InfoX)	16	$861	$13,776
12		Enhanced Plus ETERNUS6000 Model 1100 System Phone 24x7, On-site 24x7, maintenance service with 4 hour response - 2 year Warranty Included with 4 hour response - 1 year Extended Service	1	$145,128	$145,128
		Total Product List Price			$1,712,602
		Product Discount		30%	
		Net Product Price			$1,198,821
		Total Service List Price			$145,128
		Service Discount		30%	
		Net Service Price			$101,590
		Outside Quoted Product Price			$27,376
		Total Sell Price, including 3 years Service			$1,327,787

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

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

Benchmark Configuration/Tested Storage Configuration Diagram



Host System:	Tested Storage Configuration (TSC):
UID=HS-1 Fujitsu PRIMEPOWER 2500	16 – Emulex LP10000 Fibre Channel HBAs (2 Gbps) 16 – Emulex LP11000 Fibre Channel HBAs (4 Gbps)
128 - SPARC64 V (1.3 GHz) CPUs, each with: 128 KB L1 instruction cache, 128 KB L1 data cache, and 2 MB L2 cache	***UID=SC-1:*** Fujitsu ETERNUS6000 Model 1100
512 GB main memory	4 – Controller Modules (CM) each with 24 GB cache 16 – Channel Adapter (CA) Modules 8 – Device Adapter (DA) Modules 4 – Router (RT) Modules 32 – Front side fibre channels (4 Gbps each) 32 – Drive side fibre channel switched FC-AL loops (2 Gbps each)
Solaris 9	
PCI	
WG	
	48 – Drive enclosure modules, each with dual switched FC-AL interfaces 15 hot swap drive slots
	664 – 36 GB 15K RPM disk drives

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

CONFIGURATION INFORMATION

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

Clause 9.2.4.4.1

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 14 *(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 14 *(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 61 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 64 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 102.

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 57 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)	11,377.366
Addressable Storage Capacity	Gigabytes (GB)	11,381.663
Configured Storage Capacity	Gigabytes (GB)	23,420.457
Physical Storage Capacity	Gigabytes (GB)	24,076.479
Data Protection (Mirroring)	Gigabytes (GB)	11,381.663
Required Storage/Spares	Gigabytes (GB)	654.781
Global Storage Overhead	Gigabytes (GB)	656.023
Total Unused Storage	Gigabytes (GB)	10.943

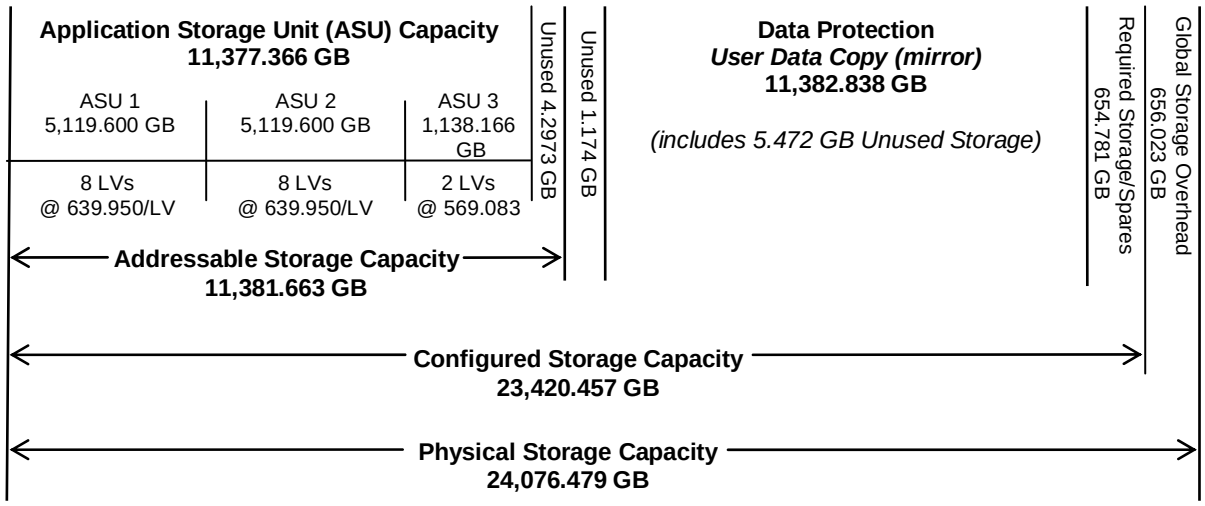
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	99.96%	48.58%	47.26%
Required for Data Protection (Mirroring)		48.60%	47.27%
Addressable Storage Capacity		48.60%	47.27%
Required Storage		2.80%	2.72%
Configured Storage Capacity			97.28%
Global Storage Overhead			2.72%
Unused Storage:			
Addressable	0.038%		
Configured		0.010%	
Physical			0.000%

The Physical Storage Capacity consisted of 24,076.479 GB distributed over 664 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 656.023 GB (2.72%) of Physical Storage Capacity. There was 2.349 GB (0.01%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 99.96% of the Addressable Storage Capacity resulting in 4.297 GB (0.038%) 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 (5,119.600 GB)	**ASU-2 (5,119.600 GB)**	**ASU-3 (1,138.166 GB)**
8 Logical Volumes 640.218 GB per Logical Volume 639.950 (GB used per Logical Volume)	8 Logical Volumes 640.218 GB per Logical Volume 639.950 (GB used per Logical Volume)	2 Logical Volumes 569.083 GB per Logical Volume (569.083 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 80 RAID Group Assignments are RAID0+1(4+4) sets, each divided into 18 Logical Volumes, for a total of 1440 LVs. These are grouped into thirty-two separate sets of LUNs, using Host Affinity grouping, each with 45 LUNs.

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

G08-5-1 Configuration using 640 drives in 80 groups with high activity portions in the middle of the drives.

Drive Slot:	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	DA-Lp
DE:																
00	HS	RG-66	RG-60	RG-54	RG-48	RG-42	RG-36	RG-30	RG-24	RG-18	RG-12	RG-6	RG-0	SY	SY	DA0-0
01	HS													SY	SY	DA0-1
02	HS													SY	SY	DA0-2
03	HS													SY	SY	DA0-3
04	HS	RG-77	RG-72	RG-66	RG-60	RG-54	RG-48	RG-42	RG-36	RG-30	RG-24	RG-18	RG-12	RG-6	RG-0	DA1-0
05	HS															DA1-1
06	HS															DA1-2
07	HS															DA1-3
08	HS	RG-78		RG-67	RG-61	RG-55	RG-49	RG-43	RG-37	RG-31	RG-25	RG-19	RG-13	RG-7	RG-1	DA2-0
09	HS															DA2-1
0a	HS															DA2-2
0b	HS															DA2-3
0c	HS	RG-79	RG-73													DA3-0
0d	HS															DA3-1
0e	HS															DA3-2
0f	HS															DA3-3
10	RG-79	RG-78		RG-68	RG-62	RG-56	RG-50	RG-44	RG-38	RG-32	RG-26	RG-20	RG-14	RG-8	RG-2	DA0-0
11																DA0-1
12																DA0-2
13																DA0-3
14			RG-74													DA1-0
15																DA1-1
16																DA1-2
17																DA1-3
18				RG-69	RG-63	RG-57	RG-51	RG-45	RG-39	RG-33	RG-27	RG-21	RG-15	RG-9	RG-3	DA2-0
19																DA2-1
1a																DA2-2
1b																DA2-3
1c																DA3-0
1d																DA3-1
1e																DA3-2
1f			RG-75													DA3-3
20				RG-70	RG-64	RG-58	RG-52	RG-46	RG-40	RG-34	RG-28	RG-22	RG-16	RG-10	RG-4	DA0-0
21																DA0-1
22																DA0-2
23																DA0-3
24																DA1-0
25																DA1-1
26																DA1-2
27			RG-76													DA1-3
28				RG-71	RG-65	RG-59	RG-53	RG-47	RG-41	RG-35	RG-29	RG-23	RG-17	RG-11	RG-5	DA2-0
29																DA2-1
2a																DA2-2
2b																DA2-3
2c																DA3-0
2d			RG-77													DA3-1
2e																DA3-2
2f																DA3-3

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 4+4 arrangements. Please see Appendix (Tested Storage Configuration Creation) for further details on preparing the configuration.

There are eight (8) of the drives reserved exclusively for system use, and sixteen (16) Hot Spare drives have been included in the configuration. There are fifty-six (56) empty drive slots in this configuration, as well.

The LUNs, seen through the thirty-two 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 80 LUNs are used for ASU1 and another eight for ASU2, while two Volumes, also each with 80 LUNs are used for ASU3. The sizes are reflected in the ASU Logical Volume Mapping chart.

Two optional facilities in the ETERNUS6000 (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 64 were active, with the other 64 set off-line, during this benchmark run.

The Host Interface Units (CAs) on the ETERNUS6000 are capable of operating at 1Gbps, 2Gbps, and 4Gbps. During this benchmark test, all the host interface channels were set to operate at 2Gbps, using a mix of 16 LP10000 and 16 LP11000 HBAs. Each of the 16 CAs have two ports (P0 & P1), with all of the P0 ports directly connected to the LP11000 HBAs, and all of the P1 ports directly connected to the LP10000 HBAs.

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 58 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 103.

Sustainability Test Results File

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

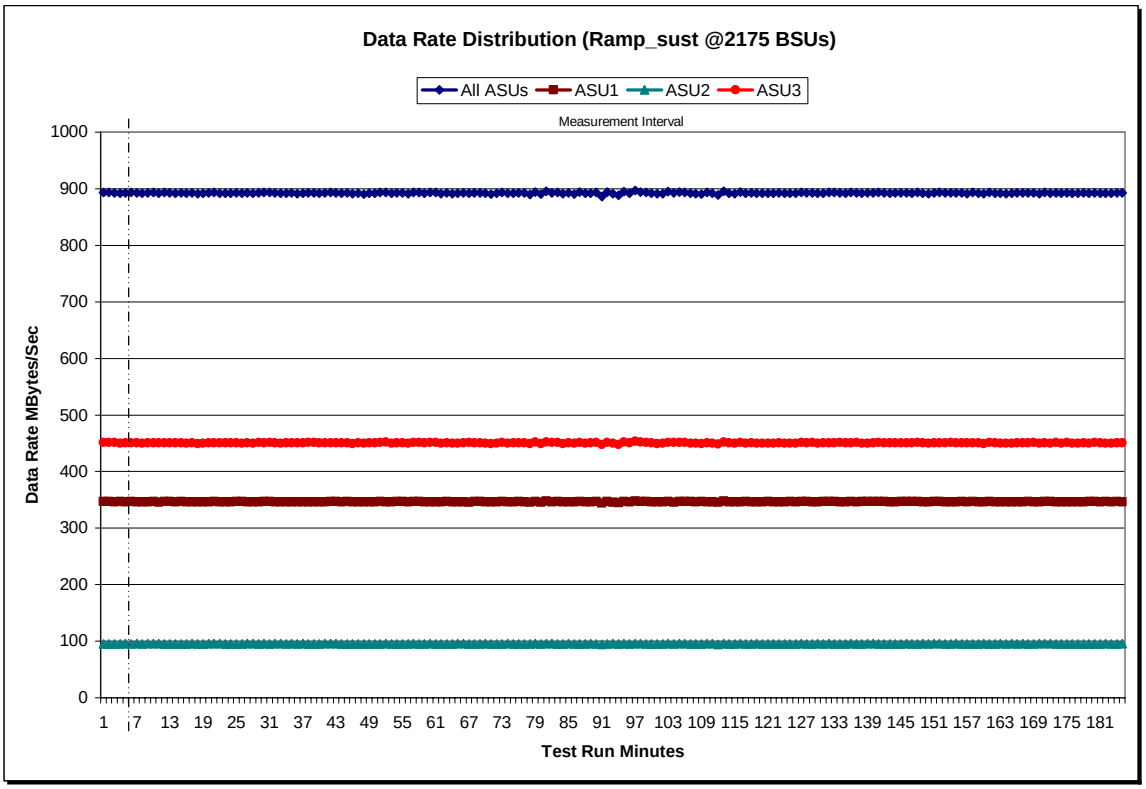
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	10:00:18	10:05:18	0-4	0:05:00
Measurement Interval	10:05:18	13:05:18	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	893.24	347.08	95.04	451.13	63	891.61	346.46	95.17	449.98	126	893.67	346.84	95.56	451.27
1	893.52	346.95	95.34	451.23	64	892.25	346.49	95.56	450.20	127	892.60	346.76	95.24	450.59
2	892.71	346.23	95.15	451.33	65	892.53	346.39	95.50	450.64	128	892.90	346.20	95.25	451.46
3	891.89	346.81	95.18	449.90	66	891.92	345.81	94.98	451.13	129	891.85	346.29	95.48	450.09
4	893.04	346.51	95.54	450.99	67	893.00	346.94	95.22	450.84	130	892.36	346.67	95.06	450.63
5	893.27	347.24	95.30	450.73	68	892.43	346.65	95.22	450.56	131	893.34	346.96	95.53	450.85
6	892.50	346.57	95.59	450.33	69	891.89	346.62	95.57	449.70	132	893.12	347.06	95.38	450.68
7	891.77	346.39	95.28	450.10	70	890.89	346.07	95.30	449.52	133	892.75	346.57	95.09	451.09
8	892.98	346.64	95.42	450.92	71	891.97	346.58	95.27	450.12	134	892.15	346.22	95.34	450.59
9	893.43	347.25	95.50	450.67	72	893.76	347.08	95.23	451.45	135	893.20	346.89	95.50	450.81
10	891.73	345.90	95.42	450.41	73	892.00	346.33	95.40	450.26	136	893.02	346.03	95.30	451.69
11	893.15	346.80	95.35	451.01	74	892.30	346.31	95.20	450.78	137	892.25	346.91	95.24	450.10
12	892.69	346.91	95.06	450.71	75	893.03	346.90	95.19	450.94	138	892.81	347.11	95.43	450.27
13	891.90	346.15	95.31	450.44	76	892.71	346.44	95.29	450.98	139	892.99	346.99	95.46	450.55
14	892.80	346.77	95.35	450.69	77	889.93	345.81	95.18	448.93	140	893.19	346.69	95.27	451.23
15	891.95	346.51	95.31	450.13	78	894.13	346.69	95.54	451.89	141	892.38	346.70	95.06	450.61
16	892.65	346.55	95.46	450.64	79	890.27	345.67	95.00	449.60	142	892.34	346.35	95.26	450.73
17	891.40	346.59	95.32	449.49	80	895.56	347.84	95.53	452.20	143	892.82	346.57	95.22	451.03
18	891.84	346.37	95.38	450.09	81	892.85	346.19	95.43	451.22	144	892.80	346.74	95.20	450.85
19	892.88	346.39	95.77	450.72	82	893.25	346.93	95.17	451.15	145	892.97	346.91	95.44	450.61
20	893.51	347.09	95.42	450.99	83	891.04	346.28	95.29	449.47	146	892.22	346.66	95.17	450.38
21	892.30	346.02	95.56	450.72	84	892.97	346.37	95.62	450.98	147	893.51	346.88	95.28	451.35
22	892.31	346.51	95.08	450.72	85	890.78	346.00	94.89	449.89	148	892.36	346.56	95.41	450.40
23	892.04	346.33	95.31	450.41	86	893.87	346.84	95.26	451.76	149	891.50	346.30	95.09	450.10
24	892.39	346.79	95.18	450.43	87	891.78	346.64	95.27	449.86	150	893.01	346.91	95.49	450.61
25	892.02	346.80	95.04	450.18	88	892.27	346.32	95.46	450.50	151	893.42	346.97	95.42	451.04
26	892.67	346.52	95.41	450.74	89	893.32	346.66	95.16	451.51	152	892.89	346.60	95.33	450.96
27	891.92	345.99	95.83	450.10	90	886.45	344.40	94.61	447.45	153	892.78	346.39	95.08	451.31
28	892.82	346.19	95.24	451.39	91	893.83	346.84	95.37	451.61	154	892.48	346.34	95.44	450.70
29	893.60	347.09	95.78	450.73	92	891.59	345.86	95.49	450.24	155	893.03	346.92	95.25	450.86
30	893.27	346.84	95.13	451.29	93	888.32	345.05	95.18	448.09	156	891.51	346.06	95.11	450.34
31	892.95	346.48	95.61	450.86	94	894.71	347.34	95.44	451.93	157	893.14	347.02	95.22	450.90
32	892.00	346.15	95.53	450.32	95	892.34	346.55	95.13	450.66	158	892.24	346.13	95.22	450.89
33	892.05	346.32	95.32	450.41	96	896.91	347.77	95.61	453.54	159	891.08	346.44	95.54	449.10
34	892.56	346.36	95.44	450.77	97	894.37	346.94	95.58	451.86	160	893.30	346.81	95.22	451.26
35	891.50	346.08	94.89	450.52	98	893.64	347.04	95.38	451.22	161	892.33	346.51	95.23	450.59
36	892.02	345.99	95.40	450.63	99	892.08	346.09	95.30	450.69	162	891.94	346.16	95.53	450.26
37	892.54	346.41	95.04	451.10	100	891.41	346.45	95.38	449.58	163	891.19	346.39	95.08	449.72
38	892.95	346.55	95.23	451.17	101	891.51	346.12	95.14	450.25	164	891.81	346.27	95.54	450.00
39	892.36	346.33	95.14	450.88	102	894.55	347.04	95.88	451.63	165	892.89	346.65	95.39	450.85
40	892.63	346.14	95.69	450.81	103	892.43	345.85	95.33	451.25	166	892.94	346.36	95.55	451.03
41	893.39	347.01	95.65	450.73	104	894.07	347.07	95.72	451.29	167	892.92	346.66	95.35	450.91
42	892.70	346.76	95.50	450.45	105	893.52	346.90	95.45	451.18	168	892.61	346.01	95.37	451.22
43	892.26	346.27	95.37	450.61	106	891.83	346.71	95.15	449.97	169	891.59	346.55	95.42	449.62
44	892.80	346.70	95.33	450.76	107	891.55	346.47	95.25	449.83	170	893.10	346.86	95.43	450.82
45	891.49	346.63	95.28	449.58	108	890.91	346.81	95.21	448.90	171	892.36	346.79	95.48	450.10
46	892.20	346.36	95.13	450.71	109	893.17	346.55	95.81	450.82	172	892.67	346.43	95.16	451.08
47	890.88	346.13	94.95	449.80	110	891.69	346.17	95.49	450.04	173	891.99	346.61	95.07	450.32
48	892.04	346.10	95.15	450.79	111	888.99	345.55	94.64	448.80	174	892.85	346.64	95.06	451.16
49	892.26	346.56	95.29	450.42	112	895.72	347.80	95.50	452.42	175	892.14	346.58	95.37	450.19
50	893.38	346.71	95.21	451.46	113	892.06	346.21	95.29	450.56	176	891.76	346.44	95.31	450.02
51	893.78	346.51	95.48	451.78	114	891.23	346.15	95.36	449.72	177	892.57	346.44	95.14	450.99
52	892.01	346.55	95.29	450.17	115	894.03	346.65	95.64	451.74	178	891.82	346.97	95.15	449.70
53	892.56	347.10	95.01	450.44	116	891.71	346.69	94.91	450.11	179	892.93	346.84	95.04	451.05
54	892.98	347.16	95.38	450.43	117	892.44	346.59	95.35	450.50	180	891.86	346.38	95.15	450.34
55	891.51	346.31	95.30	449.90	118	892.25	346.47	95.55	450.23	181	892.30	346.65	95.59	450.06
56	893.60	346.89	95.63	451.08	119	891.70	346.39	95.06	450.25	182	891.95	346.40	95.24	450.31
57	893.26	346.65	95.18	451.42	120	891.92	346.76	95.35	449.81	183	892.65	346.79	95.08	450.78
58	892.05	346.11	95.15	450.79	121	891.67	346.42	95.18	450.08	184	892.78	346.39	95.52	450.87
59	893.34	346.28	95.60	451.47	122	892.40	346.61	95.26	450.52					
60	893.11	346.56	95.39	451.16	123	891.70	346.40	95.08	450.22					
61	891.32	346.42	95.04	449.86	124	892.03	346.89	95.30	449.84					
62	892.71	347.15	94.86	450.70	125	891.80	346.58	95.11	450.10					

Sustainability – Data Rate Distribution Graph

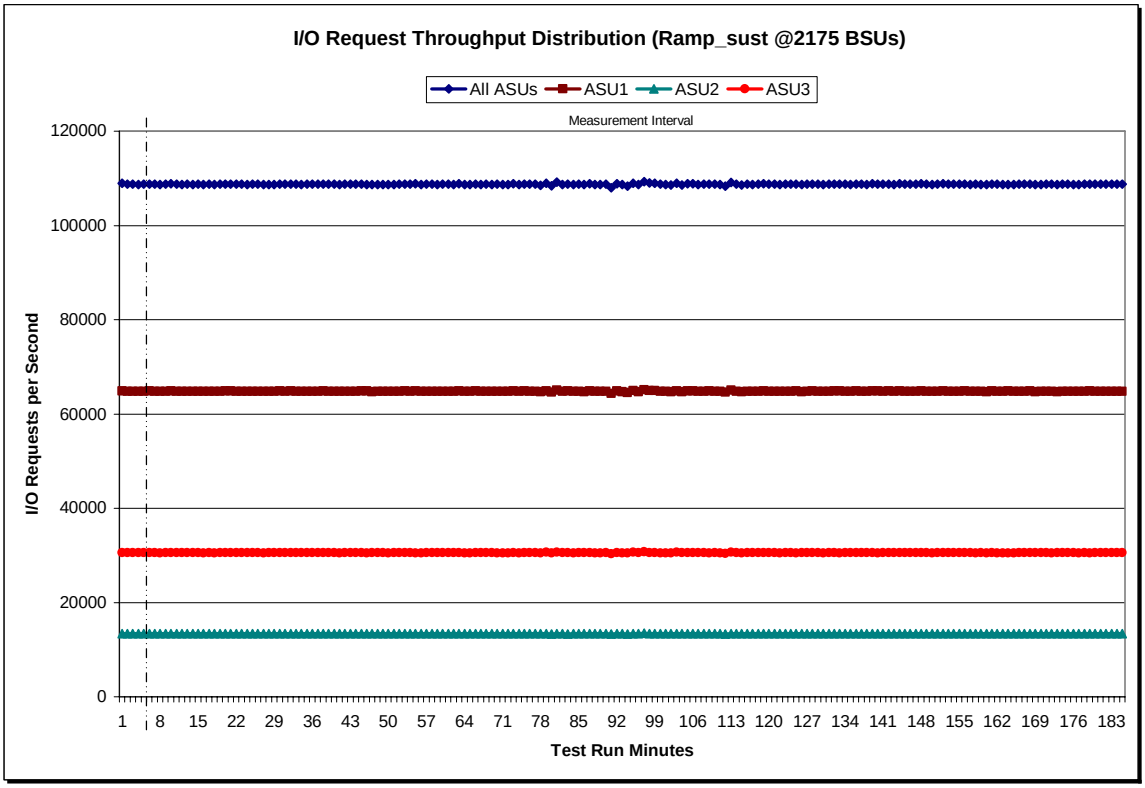


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	10:00:18	10:05:18	0-4	0:05:00
Measurement Interval	10:05:18	13:05:18	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	108,914.37	64,911.03	13,385.53	30,617.80	63	108,686.90	64,780.78	13,377.47	30,528.65	126	108,785.60	64,824.48	13,364.80	30,596.32
1	108,744.90	64,798.62	13,374.52	30,571.77	64	108,720.10	64,802.05	13,382.30	30,535.75	127	108,775.93	64,846.87	13,381.83	30,547.23
2	108,779.27	64,795.28	13,367.45	30,616.53	65	108,794.38	64,848.80	13,385.30	30,560.28	128	108,757.60	64,807.30	13,377.33	30,572.97
3	108,711.55	64,797.63	13,370.05	30,543.87	66	108,706.55	64,758.67	13,354.13	30,593.75	129	108,695.67	64,774.63	13,385.55	30,535.48
4	108,755.83	64,803.98	13,397.00	30,554.85	67	108,745.10	64,809.48	13,358.22	30,577.40	130	108,725.87	64,772.30	13,369.42	30,584.15
5	108,807.73	64,884.17	13,351.05	30,572.52	68	108,701.33	64,781.17	13,349.25	30,570.92	131	108,807.73	64,863.62	13,384.18	30,559.93
6	108,785.23	64,836.27	13,391.45	30,557.52	69	108,770.58	64,826.98	13,409.47	30,534.13	132	108,758.40	64,856.82	13,379.42	30,522.17
7	108,668.67	64,786.12	13,351.88	30,530.67	70	108,696.65	64,798.18	13,361.65	30,536.82	133	108,753.88	64,793.92	13,376.15	30,583.82
8	108,772.43	64,819.53	13,365.90	30,587.00	71	108,706.85	64,824.07	13,362.85	30,519.93	134	108,721.67	64,793.98	13,365.82	30,561.87
9	108,836.68	64,881.98	13,386.10	30,568.60	72	108,838.13	64,868.82	13,370.23	30,599.08	135	108,797.75	64,859.42	13,382.67	30,555.67
10	108,759.18	64,812.37	13,384.02	30,562.80	73	108,701.48	64,770.97	13,392.08	30,538.43	136	108,744.85	64,782.43	13,378.20	30,584.22
11	108,719.52	64,776.70	13,376.28	30,566.53	74	108,761.85	64,851.42	13,358.83	30,551.60	137	108,724.32	64,804.53	13,369.33	30,550.45
12	108,775.63	64,830.38	13,393.58	30,551.67	75	108,737.28	64,824.57	13,357.83	30,554.88	138	108,829.40	64,860.98	13,400.32	30,568.10
13	108,673.57	64,759.58	13,350.93	30,563.05	76	108,759.93	64,797.45	13,378.65	30,583.83	139	108,772.58	64,852.05	13,384.80	30,535.73
14	108,797.25	64,832.93	13,399.33	30,564.98	77	108,527.37	64,687.45	13,350.23	30,489.68	140	108,796.12	64,834.07	13,377.62	30,584.43
15	108,690.73	64,785.90	13,370.93	30,533.90	78	108,926.85	64,904.10	13,392.30	30,630.45	141	108,770.63	64,850.03	13,357.23	30,563.37
16	108,727.40	64,782.88	13,382.70	30,561.82	79	108,397.50	64,619.87	13,303.90	30,473.73	142	108,693.15	64,784.40	13,367.90	30,540.85
17	108,711.15	64,785.98	13,392.48	30,532.68	80	109,172.57	65,069.85	13,418.05	30,684.67	143	108,841.08	64,869.73	13,381.35	30,590.00
18	108,769.60	64,829.85	13,387.53	30,552.22	81	108,675.00	64,752.32	13,356.95	30,565.73	144	108,755.72	64,818.50	13,349.30	30,587.92
19	108,785.20	64,856.22	13,388.20	30,540.78	82	108,754.90	64,840.05	13,347.22	30,567.63	145	108,779.73	64,812.08	13,395.25	30,572.40
20	108,789.02	64,863.58	13,376.82	30,548.62	83	108,702.43	64,792.13	13,378.62	30,531.68	146	108,773.92	64,830.67	13,374.53	30,568.72
21	108,774.83	64,823.02	13,397.07	30,554.75	84	108,774.08	64,817.97	13,365.00	30,591.12	147	108,835.97	64,871.88	13,371.37	30,592.72
22	108,763.53	64,834.13	13,365.38	30,564.02	85	108,648.63	64,746.57	13,352.83	30,549.23	148	108,756.05	64,830.45	13,374.22	30,551.38
23	108,717.35	64,773.62	13,385.33	30,558.40	86	108,850.13	64,866.68	13,358.33	30,625.12	149	108,711.88	64,813.95	13,375.37	30,522.57
24	108,764.20	64,826.95	13,380.53	30,556.72	87	108,671.92	64,766.78	13,367.05	30,538.08	150	108,778.67	64,811.20	13,373.38	30,594.08
25	108,751.48	64,817.15	13,369.53	30,564.80	88	108,666.42	64,766.37	13,369.73	30,530.32	151	108,838.87	64,873.87	13,378.80	30,586.20
26	108,705.77	64,819.57	13,373.93	30,512.27	89	108,751.00	64,829.83	13,362.73	30,558.43	152	108,749.03	64,785.30	13,391.47	30,572.27
27	108,724.75	64,782.80	13,390.62	30,551.33	90	108,014.88	64,368.72	13,293.15	30,353.02	153	108,739.22	64,762.85	13,362.47	30,613.90
28	108,714.43	64,790.57	13,366.53	30,557.33	91	108,846.62	64,850.47	13,382.30	30,613.85	154	108,749.83	64,773.15	13,386.80	30,589.88
29	108,797.30	64,847.98	13,403.90	30,545.42	92	108,657.90	64,739.13	13,388.73	30,530.03	155	108,809.87	64,841.78	13,374.82	30,593.27
30	108,790.47	64,806.57	13,401.97	30,581.93	93	108,325.53	64,533.02	13,336.98	30,455.53	156	108,691.63	64,787.98	13,353.02	30,550.63
31	108,807.78	64,850.82	13,381.22	30,575.75	94	108,971.22	64,940.32	13,399.52	30,631.38	157	108,727.93	64,823.95	13,367.83	30,536.15
32	108,771.40	64,817.90	13,385.85	30,567.65	95	108,711.23	64,751.55	13,396.13	30,563.55	158	108,696.13	64,787.48	13,365.53	30,543.12
33	108,696.92	64,772.42	13,366.15	30,558.35	96	109,278.67	65,102.58	13,439.95	30,736.13	159	108,652.47	64,748.97	13,387.48	30,516.02
34	108,784.27	64,834.88	13,387.45	30,561.93	97	108,988.37	64,962.70	13,412.50	30,613.17	160	108,804.78	64,858.50	13,377.03	30,569.25
35	108,761.73	64,826.35	13,348.27	30,587.12	98	108,947.12	64,925.18	13,420.20	30,601.73	161	108,729.93	64,798.75	13,398.00	30,533.18
36	108,778.43	64,818.18	13,378.30	30,581.95	99	108,727.45	64,802.22	13,387.48	30,537.75	162	108,658.25	64,763.35	13,364.90	30,530.00
37	108,777.05	64,838.98	13,351.13	30,586.93	100	108,722.78	64,805.10	13,383.65	30,534.03	163	108,724.68	64,851.38	13,360.07	30,513.23
38	108,742.42	64,800.13	13,370.23	30,572.05	101	108,567.37	64,728.80	13,354.97	30,483.60	164	108,691.42	64,765.47	13,386.98	30,538.97
39	108,727.95	64,798.25	13,388.93	30,540.77	102	108,976.40	64,917.52	13,422.02	30,636.87	165	108,769.95	64,818.63	13,376.70	30,574.62
40	108,697.32	64,788.65	13,391.72	30,516.95	103	108,624.82	64,720.95	13,354.37	30,549.50	166	108,744.38	64,769.87	13,404.22	30,570.30
41	108,762.65	64,826.98	13,382.60	30,553.07	104	108,884.97	64,888.15	13,423.13	30,573.68	167	108,789.37	64,852.40	13,369.67	30,567.30
42	108,769.68	64,820.25	13,391.47	30,557.97	105	108,827.58	64,855.62	13,387.87	30,584.10	168	108,706.78	64,740.55	13,394.12	30,572.12
43	108,757.68	64,815.42	13,365.97	30,576.30	106	108,704.15	64,800.43	13,358.87	30,544.85	169	108,687.12	64,796.78	13,349.92	30,540.42
44	108,775.28	64,839.75	13,374.80	30,560.73	107	108,733.93	64,805.65	13,364.92	30,563.37	170	108,759.83	64,827.40	13,380.55	30,551.88
45	108,710.82	64,842.10	13,356.82	30,511.90	108	108,734.75	64,848.90	13,374.12	30,511.73	171	108,768.40	64,832.23	13,397.63	30,538.53
46	108,664.43	64,726.82	13,370.55	30,567.07	109	108,806.27	64,813.63	13,419.37	30,573.27	172	108,705.18	64,742.05	13,378.57	30,584.57
47	108,709.77	64,780.18	13,375.48	30,554.10	110	108,654.52	64,756.98	13,371.87	30,525.67	173	108,748.67	64,820.33	13,371.85	30,556.48
48	108,723.15	64,793.38	13,362.37	30,567.40	111	108,358.52	64,595.83	13,314.97	30,447.72	174	108,746.58	64,813.00	13,373.02	30,560.57
49	108,693.33	64,789.77	13,370.25	30,533.32	112	109,149.87	65,055.20	13,432.62	30,662.05	175	108,698.72	64,787.47	13,368.60	30,542.65
50	108,713.25	64,763.13	13,372.73	30,577.38	113	108,729.45	64,784.30	13,383.50	30,561.65	176	108,714.25	64,815.73	13,360.95	30,537.57
51	108,793.40	64,795.35	13,405.13	30,592.92	114	108,622.93	64,738.93	13,355.73	30,528.27	177	108,801.77	64,805.68	13,393.78	30,602.30
52	108,760.55	64,842.48	13,376.90	30,541.17	115	108,788.98	64,832.43	13,376.23	30,580.32	178	108,772.57	64,860.47	13,377.42	30,534.68
53	108,741.93	64,819.17	13,357.22	30,565.55	116	108,720.58	64,805.03	13,351.47	30,564.08	179	108,762.43	64,833.10	13,351.58	30,577.75
54	108,821.30	64,868.20	13,419.95	30,533.15	117	108,760.38	64,823.08	13,388.42	30,548.88	180	108,744.68	64,830.18	13,367.12	30,547.38
55	108,719.32	64,812.30	13,381.05	30,525.97	118	108,818.58	64,865.00	13,402.18	30,551.40	181	108,736.15	64,793.82	13,386.73	30,555.60
56	108,786.83	64,829.37	13,389.25	30,568.22	119	108,748.38	64,802.33	13,386.17	30,559.88	182	108,736.45	64,824.37	13,357.18	30,554.90
57	108,796.40	64,816.57	13,387.60	30,592.23	120	108,746.03	64,806.32	13,396.75	30,542.97	183	108,780.78	64,804.53	13,381.25	30,595.00
58	108,696.93	64,789.47	13,360.37	30,547.10	121	108,684.80	64,810.98	13,371.30	30,502.52	184	108,742.72	64,786.35	13,392.15	30,564.22
59	108,778.12	64,794.68	13,388.65	30,594.78	122	108,770.60	64,824.52	13,392.30	30,553.78	Average	108,747.95	64,811.97	13,376.97	30,559.01
60	108,808.78	64,828.05	13,408.88	30,571.85	123	108,737.08	64,796.58	13,391.88	30,548.62					
61	108,695.73	64,772.85	13,376.58	30,546.30	124	108,803.70	64,886.80	13,383.73	30,533.17					
62	108,838.23	64,901.73	13,365.18	30,571.32	125	108,678.05	64,747.62	13,375.77	30,554.67					

Sustainability – I/O Request Throughput Distribution Graph

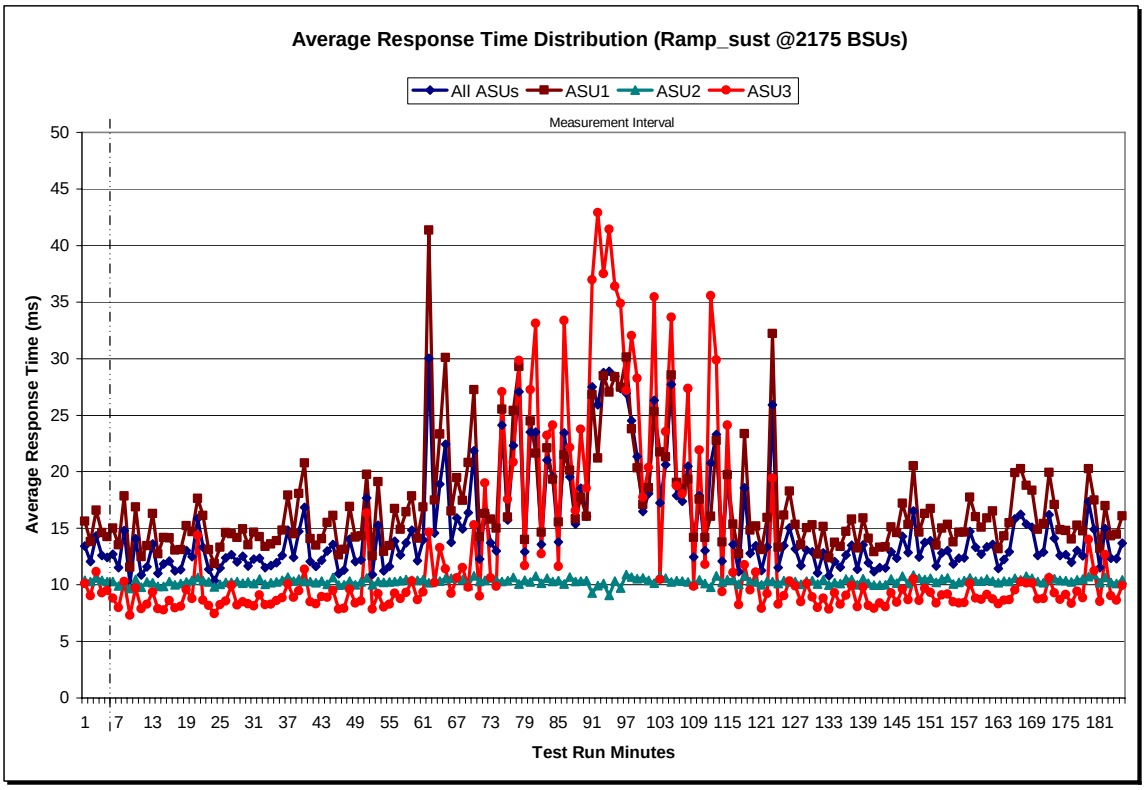


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	10:00:18	10:05:18	0-4	0:05:00
Measurement Interval	10:05:18	13:05:18	5-184	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	13.43	15.63	10.41	10.11	63	18.89	23.31	10.34	13.27	126	13.18	15.34	10.29	9.89
1	12.04	13.82	10.31	9.03	64	22.44	30.09	10.55	11.41	127	11.69	13.54	10.03	8.48
2	14.34	16.60	10.62	11.17	65	13.75	16.52	10.57	9.25	128	13.08	15.03	10.35	10.13
3	12.61	14.63	10.39	9.29	66	15.90	19.48	10.62	10.63	129	12.91	15.30	10.38	8.94
4	12.42	14.25	10.30	9.50	67	14.93	17.45	10.49	11.53	130	11.06	12.70	10.09	7.99
5	12.70	15.02	10.29	8.81	68	16.37	20.80	9.92	9.80	131	12.81	15.17	10.45	8.83
6	11.53	13.54	9.89	7.99	69	21.86	27.25	10.80	15.28	132	10.82	12.39	9.96	7.86
7	14.80	17.86	10.27	10.29	70	12.28	14.24	10.28	8.99	133	12.07	13.77	10.20	9.28
8	10.12	11.54	9.69	7.30	71	16.34	16.31	10.41	19.00	134	11.55	13.39	10.10	8.29
9	14.09	16.89	10.46	9.73	72	13.70	15.79	10.62	10.61	135	12.62	14.73	10.50	9.06
10	10.86	12.48	9.79	7.89	73	13.01	15.03	10.42	9.87	136	13.48	15.78	10.46	9.94
11	11.60	13.45	10.25	8.28	74	24.10	25.54	10.31	27.08	137	11.39	13.24	10.02	8.06
12	13.60	16.31	10.17	9.34	75	15.73	15.98	10.35	17.56	138	13.54	15.92	10.56	9.80
13	11.02	12.74	9.86	7.90	76	22.32	25.42	10.64	20.86	139	11.97	14.13	10.14	8.18
14	11.85	14.18	9.85	7.77	77	27.08	29.29	10.06	29.84	140	11.16	12.92	9.98	7.93
15	12.11	14.14	10.30	8.61	78	12.92	14.02	10.40	11.70	141	11.53	13.32	9.99	8.40
16	11.24	13.06	10.00	7.95	79	23.52	24.48	10.27	27.25	142	11.47	13.37	10.01	8.07
17	11.33	13.11	10.10	8.10	80	23.52	21.63	10.75	33.11	143	12.92	15.13	10.50	9.30
18	13.02	15.21	10.26	9.58	81	13.57	14.67	10.15	12.75	144	12.34	14.62	10.17	8.46
19	12.50	14.68	10.42	8.79	82	21.01	22.12	10.57	23.23	145	14.28	17.20	10.76	9.62
20	15.87	17.65	10.64	14.38	83	19.56	19.33	10.29	24.11	146	12.83	15.35	10.13	8.68
21	13.31	16.12	10.36	8.64	84	13.80	15.54	10.35	11.61	147	16.52	20.51	10.87	10.53
22	11.36	13.10	10.27	8.16	85	23.42	21.47	10.09	33.39	148	12.45	14.65	10.59	8.59
23	10.38	11.86	9.84	7.46	86	19.53	20.12	10.69	22.14	149	13.74	16.32	10.49	9.70
24	11.50	13.32	10.05	8.25	87	15.36	15.84	10.29	16.55	150	13.88	16.72	10.57	9.32
25	12.37	14.60	10.23	8.57	88	18.54	17.76	10.35	23.77	151	11.65	13.49	10.23	8.38
26	12.68	14.49	10.23	9.92	89	16.05	16.06	10.38	18.53	152	12.80	15.01	10.52	9.10
27	12.02	14.17	10.31	8.22	90	27.50	26.80	9.30	36.96	153	13.03	15.35	10.62	9.19
28	12.54	14.94	10.14	8.49	91	25.93	21.22	9.94	42.90	154	11.83	13.78	10.08	8.49
29	11.67	13.54	10.25	8.32	92	28.75	28.47	10.10	37.53	155	12.34	14.64	10.21	8.39
30	12.26	14.66	10.11	8.12	93	28.87	27.03	9.06	41.44	156	12.38	14.65	10.35	8.43
31	12.35	14.25	10.52	9.12	94	28.42	28.40	10.34	36.39	157	14.74	17.76	10.64	10.12
32	11.53	13.39	10.05	8.23	95	27.38	27.48	9.73	34.90	158	13.31	16.03	10.32	8.83
33	11.69	13.60	10.20	8.29	96	26.94	30.12	10.92	27.19	159	12.71	15.09	10.32	8.71
34	11.95	13.88	10.27	8.60	97	24.50	23.81	10.67	32.05	160	13.36	15.93	10.53	9.14
35	12.61	14.83	10.39	8.86	98	21.35	20.33	10.55	28.27	161	13.58	16.53	10.34	8.76
36	14.83	17.93	10.71	10.07	99	16.48	17.09	10.63	17.76	162	11.44	13.18	10.19	8.30
37	12.42	14.52	10.32	8.90	100	18.07	18.56	10.39	20.38	163	12.23	14.31	10.33	8.63
38	14.73	18.08	10.51	9.47	101	26.30	25.31	10.16	35.46	164	12.94	15.49	10.30	8.68
39	16.83	20.76	10.30	11.38	102	17.23	21.74	10.76	10.49	165	15.85	19.91	10.60	9.54
40	12.05	14.09	10.30	8.50	103	20.62	21.32	10.57	23.55	166	16.24	20.26	10.43	10.27
41	11.63	13.49	10.17	8.33	104	27.73	28.54	10.25	33.67	167	15.38	18.79	10.77	10.16
42	12.17	14.06	10.35	8.96	105	17.88	19.03	10.35	18.74	168	15.09	18.36	10.58	10.13
43	12.98	15.51	10.06	8.90	106	17.38	18.52	10.32	18.05	169	12.61	14.90	10.31	8.74
44	13.58	16.11	10.65	9.49	107	20.47	19.32	10.28	27.36	170	12.90	15.39	10.18	8.78
45	10.96	12.63	9.98	7.85	108	12.47	14.19	10.07	9.86	171	16.18	19.94	10.70	10.61
46	11.29	13.15	10.02	7.91	109	17.90	17.55	10.44	21.92	172	14.10	17.11	10.55	9.27
47	14.04	16.90	10.33	9.60	110	13.02	14.19	10.11	11.81	173	12.59	14.88	10.40	8.70
48	12.07	14.22	10.01	8.40	111	20.76	16.05	9.77	35.56	174	12.67	14.80	10.36	9.15
49	12.20	14.31	10.27	8.56	112	23.28	22.75	10.80	29.87	175	11.98	14.04	10.28	8.36
50	17.68	19.76	10.62	16.36	113	12.11	13.78	10.21	9.40	176	13.04	15.28	10.45	9.42
51	10.92	12.56	10.01	7.85	114	19.81	19.72	10.47	24.10	177	12.58	14.77	10.50	8.84
52	15.25	19.11	10.31	9.20	115	13.57	15.39	10.43	11.10	178	17.34	20.27	10.74	14.00
53	11.24	12.96	10.22	8.04	116	11.15	12.75	10.03	8.24	179	14.91	17.49	10.89	11.22
54	11.61	13.47	10.25	8.26	117	18.57	23.38	10.76	11.78	180	11.52	13.20	10.17	8.54
55	13.84	16.74	10.31	9.23	118	12.79	14.84	10.29	9.53	181	14.99	16.99	10.64	12.66
56	12.62	14.91	10.35	8.77	119	13.45	15.20	10.25	11.14	182	12.34	14.33	10.21	9.04
57	13.71	16.45	10.48	9.31	120	11.26	13.10	10.01	7.90	183	12.30	14.48	10.13	8.65
58	14.82	17.84	10.41	10.35	121	13.37	15.95	10.32	9.20	184	13.67	16.11	10.43	9.94
59	12.12	14.10	10.42	8.67	122	25.92	32.21	10.29	19.45	Average	15.08	17.07	10.31	12.97
60	13.98	16.89	10.48	9.35	123	11.52	13.34	10.12	8.27					
61	30.01	41.34	10.17	14.66	124	13.45	16.16	10.38	9.04					
62	14.57	17.50	10.33	10.20	125	15.06	18.27	10.26	10.33					

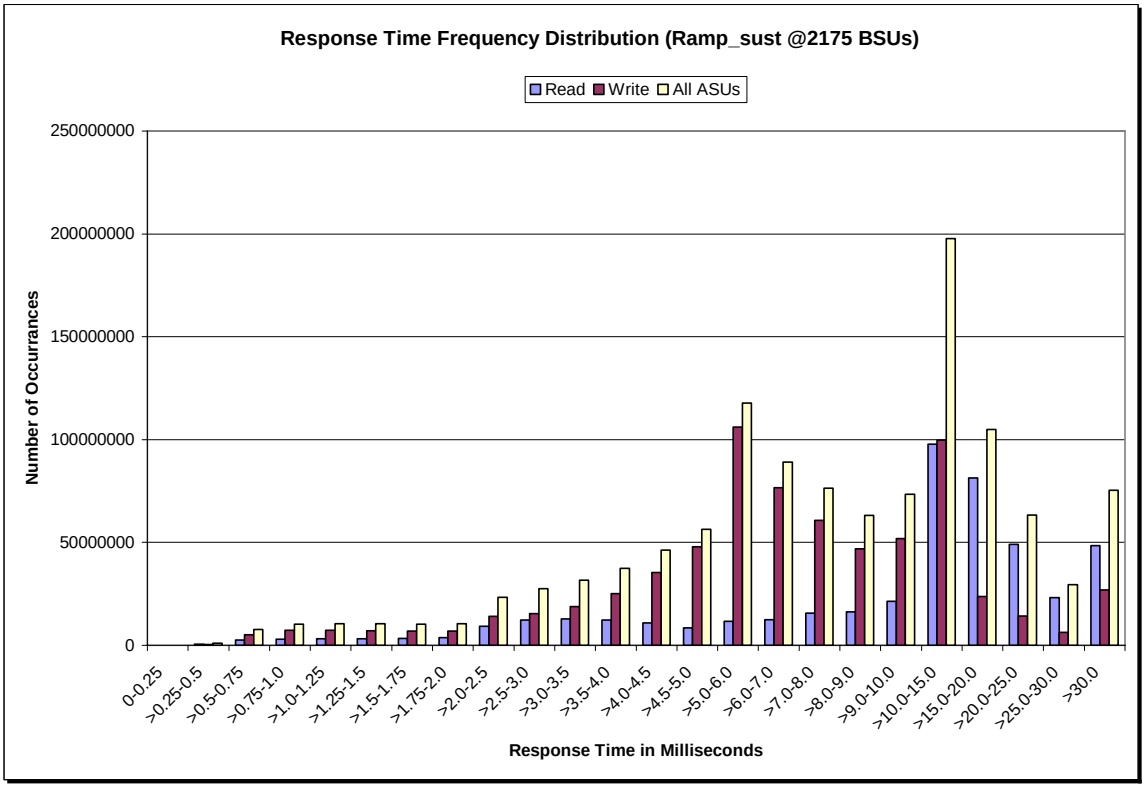
Sustainability – Average Response Time (ms) Distribution Graph



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	2	622,122	2,499,268	3,037,888	3,178,600	3,218,554	3,343,102	3,664,080
Write	-	349,384	5,211,278	7,259,346	7,393,161	7,180,551	6,992,986	6,908,967
All ASUs	2	971,506	7,710,546	10,297,234	10,571,761	10,399,105	10,336,088	10,573,047
ASU1	1	659,807	4,543,570	5,715,350	5,760,625	5,635,146	5,614,771	5,793,103
ASU2	1	202,489	1,301,552	1,639,088	1,668,441	1,639,642	1,641,012	1,711,065
ASU3	-	109,210	1,865,424	2,942,796	3,142,695	3,124,317	3,080,305	3,068,879
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	9,384,454	12,180,333	12,865,921	12,241,167	10,818,765	8,443,473	11,750,349	12,466,858
Write	14,044,202	15,393,629	18,773,522	25,150,985	35,452,347	47,936,379	106,067,398	76,674,149
All ASUs	23,428,656	27,573,962	31,639,443	37,392,152	46,271,112	56,379,852	117,817,747	89,141,007
ASU1	13,191,979	15,852,220	17,893,823	20,315,509	23,874,734	27,602,718	55,491,615	43,984,449
ASU2	3,968,172	4,844,015	5,381,017	5,889,973	6,609,446	7,269,712	13,616,913	9,801,249
ASU3	6,268,505	6,877,727	8,364,603	11,186,670	15,786,932	21,507,422	48,709,219	35,355,309
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	15,686,343	16,281,359	21,444,358	97,852,409	81,339,737	49,148,694	23,231,497	48,506,975
Write	60,736,868	46,827,183	51,918,363	99,817,061	23,665,318	14,168,188	6,359,427	26,989,689
All ASUs	76,423,211	63,108,542	73,362,721	197,669,470	105,005,055	63,316,882	29,590,924	75,496,664
ASU1	40,573,576	34,021,533	39,824,576	122,469,585	79,182,160	48,293,866	22,938,058	60,735,763
ASU2	8,744,166	7,687,215	9,258,645	22,464,970	11,883,759	7,472,367	3,702,579	6,073,658
ASU3	27,105,469	21,399,794	24,279,500	52,734,915	13,939,136	7,550,649	2,950,287	8,687,243

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	0.007	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.002	0.001	0.002	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 – 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 103.

IOPS Test Results File

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

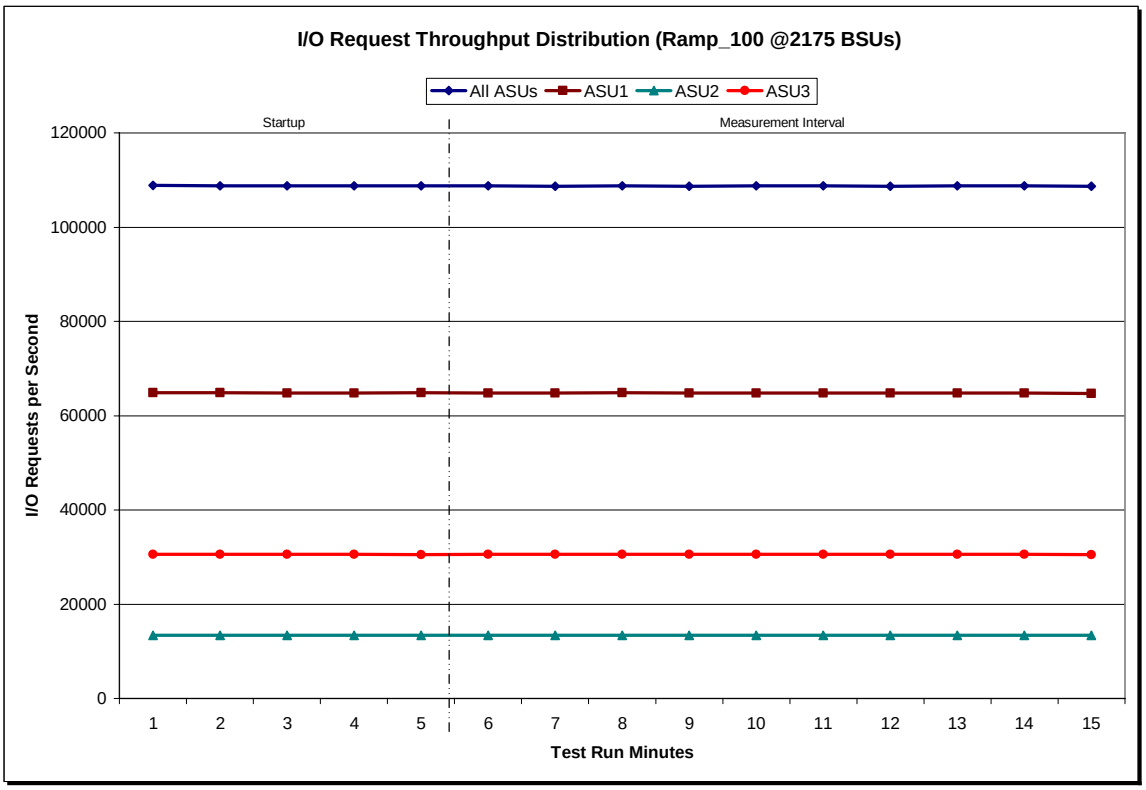
IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:08:16	13:13:17	0-4	0:05:01
Measurement Interval	13:13:17	13:23:17	5-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	108,840.92	64,850.03	13,410.17	30,580.72
1	108,794.35	64,864.57	13,379.90	30,549.88
2	108,756.78	64,827.18	13,363.88	30,565.72
3	108,728.75	64,794.08	13,377.75	30,556.92
4	108,764.57	64,848.77	13,381.30	30,534.50
5	108,808.33	64,817.12	13,379.83	30,611.38
6	108,715.80	64,792.30	13,352.35	30,571.15
7	108,807.55	64,872.18	13,366.35	30,569.02
8	108,712.68	64,772.52	13,354.62	30,585.55
9	108,734.15	64,765.83	13,381.57	30,586.75
10	108,742.17	64,806.05	13,381.83	30,554.28
11	108,706.92	64,768.85	13,360.18	30,577.88
12	108,768.33	64,817.63	13,373.55	30,577.15
13	108,767.50	64,798.93	13,403.48	30,565.08
14	108,690.00	64,747.82	13,402.75	30,539.43
Average	108,745.34	64,795.92	13,375.65	30,573.77

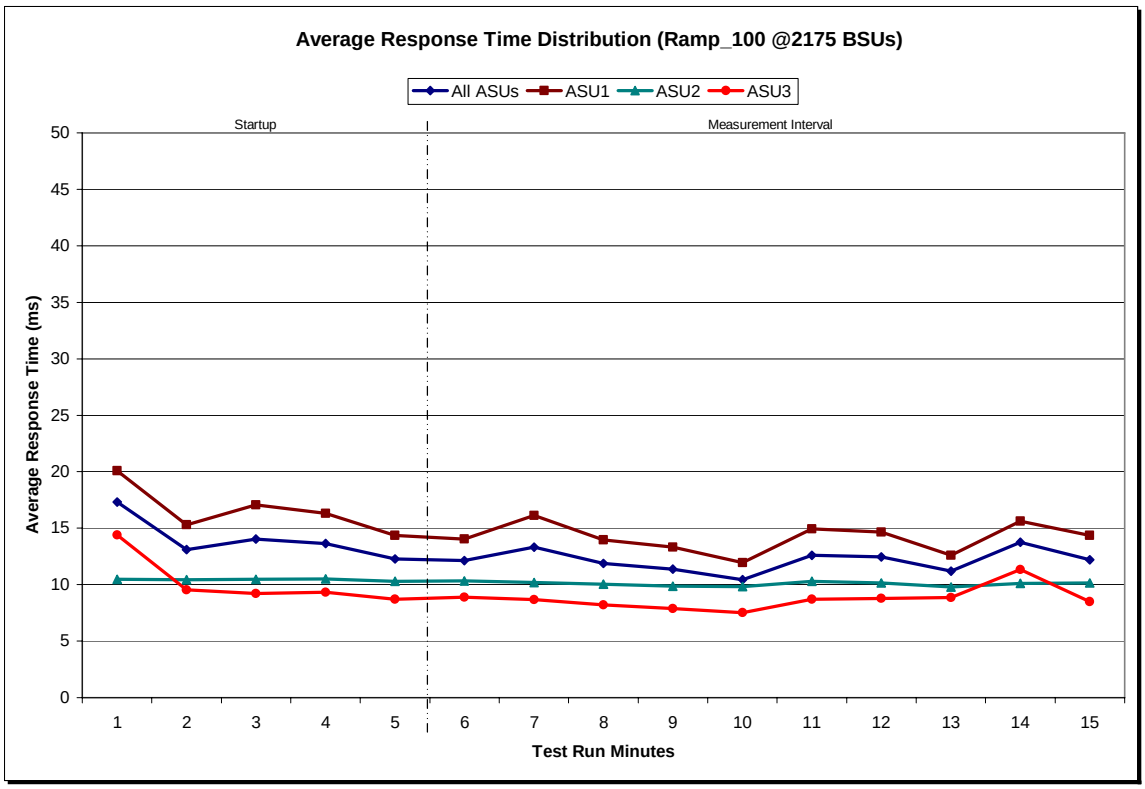
IOPS Test Run – I/O Request Throughput Distribution Graph



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

2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:08:16	13:13:17	0-4	0:05:01
Measurement Interval	13:13:17	13:23:17	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	17.30	20.08	10.46	14.40
1	13.09	15.31	10.44	9.53
2	14.04	17.05	10.49	9.20
3	13.63	16.30	10.53	9.32
4	12.27	14.36	10.28	8.71
5	12.13	14.03	10.33	8.90
6	13.31	16.14	10.19	8.68
7	11.87	13.97	10.04	8.21
8	11.37	13.33	9.88	7.87
9	10.44	11.95	9.83	7.51
10	12.61	14.93	10.28	8.72
11	12.44	14.64	10.15	8.78
12	11.21	12.62	9.78	8.85
13	13.75	15.64	10.10	11.34
14	12.20	14.37	10.16	8.48
Average	12.13	14.16	10.07	8.73

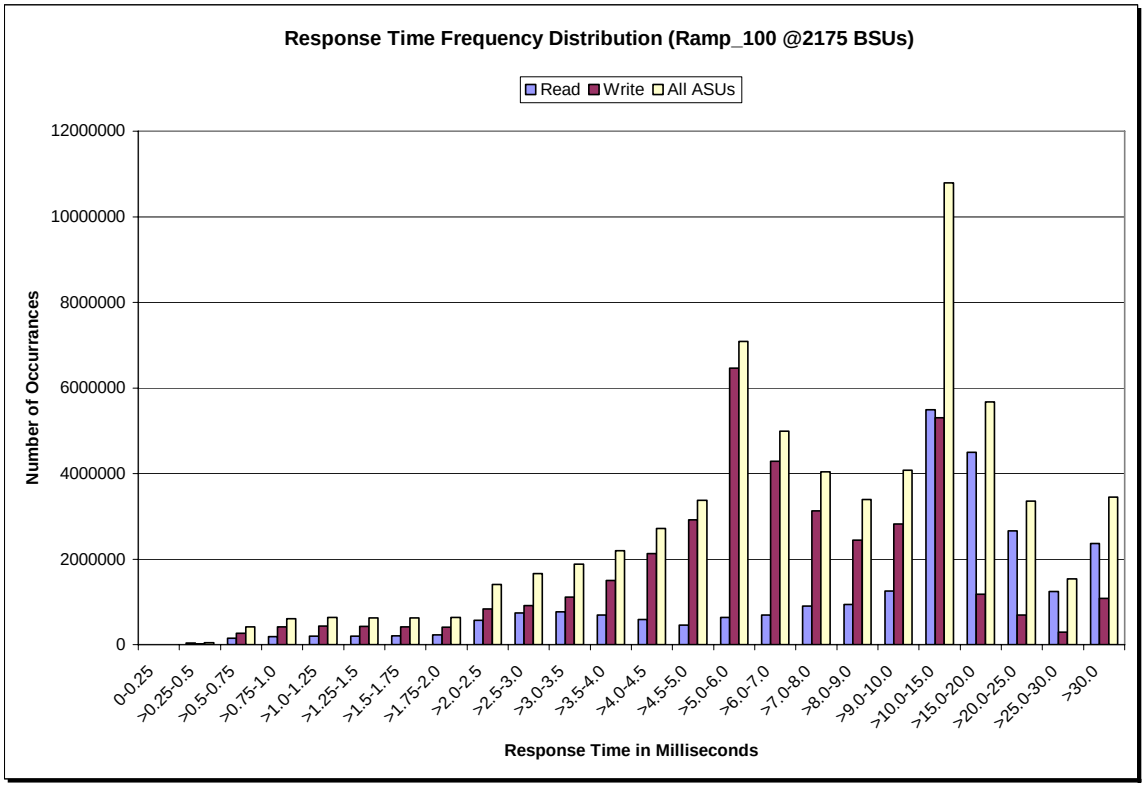
IOPS Test Run – Average Response Time (ms) Distribution Graph



IOPS Test Run – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	0	35,495	151,114	189,513	198,796	200,855	206,664	225,513
Write	0	16,126	269,722	419,559	440,135	430,480	419,408	413,213
All ASUs	0	51,621	420,836	609,072	638,931	631,335	626,072	638,726
ASU1	0	35,881	253,052	342,768	352,130	345,977	342,588	352,382
ASU2	0	10,866	72,439	97,977	100,512	99,052	98,708	102,335
ASU3	0	4,874	95,345	168,327	186,289	186,306	184,776	184,009
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	573,261	745,028	769,649	697,921	591,292	455,075	634,523	697,661
Write	837,575	914,189	1,113,406	1,499,814	2,129,223	2,916,327	6,457,315	4,285,970
All ASUs	1,410,836	1,659,217	1,883,055	2,197,735	2,720,515	3,371,402	7,091,838	4,983,631
ASU1	800,075	962,625	1,069,960	1,193,267	1,394,008	1,638,875	3,314,324	2,446,079
ASU2	236,179	287,998	315,621	338,027	377,802	423,304	802,773	534,746
ASU3	374,582	408,594	497,474	666,441	948,705	1,309,223	2,974,741	2,002,806
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	905,080	945,262	1,254,694	5,490,834	4,491,064	2,659,859	1,241,554	2,369,169
Write	3,128,497	2,443,410	2,821,181	5,306,004	1,179,169	693,434	295,284	1,084,432
All ASUs	4,033,577	3,388,672	4,075,875	10,796,838	5,670,233	3,353,293	1,536,838	3,453,601
ASU1	2,167,630	1,862,027	2,248,404	6,792,448	4,335,560	2,591,628	1,207,036	2,826,279
ASU2	452,449	403,239	499,754	1,205,305	644,554	398,431	197,982	325,138
ASU3	1,413,498	1,123,406	1,327,717	2,799,085	690,119	363,234	131,820	302,184

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
65,243,749	61,790,148	3,453,601

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	0.2809	0.0700	0.2100	0.0180	0.0700	0.0350	0.2812
COV	0.002	0.000	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 103.

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 - 2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:08:16	13:13:17	0-4	0:05:01
Measurement Interval	13:13:17	13:23:17	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	108,840.92	64,850.03	13,410.17	30,580.72
1	108,794.35	64,864.57	13,379.90	30,549.88
2	108,756.78	64,827.18	13,363.88	30,565.72
3	108,728.75	64,794.08	13,377.75	30,556.92
4	108,764.57	64,848.77	13,381.30	30,534.50
5	108,808.33	64,817.12	13,379.83	30,611.38
6	108,715.80	64,792.30	13,352.35	30,571.15
7	108,807.55	64,872.18	13,366.35	30,569.02
8	108,712.68	64,772.52	13,354.62	30,585.55
9	108,734.15	64,765.83	13,381.57	30,586.75
10	108,742.17	64,806.05	13,381.83	30,554.28
11	108,706.92	64,768.85	13,360.18	30,577.88
12	108,768.33	64,817.63	13,373.55	30,577.15
13	108,767.50	64,798.93	13,403.48	30,565.08
14	108,690.00	64,747.82	13,402.75	30,539.43
Average	108,745.34	64,795.92	13,375.65	30,573.77

95% Load Level - 2066 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:25:18	13:30:19	0-4	0:05:01
Measurement Interval	13:30:19	13:40:19	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	103,443.88	61,644.87	12,715.68	29,083.33
1	103,300.68	61,556.82	12,705.77	29,038.10
2	103,372.22	61,559.88	12,732.88	29,079.45
3	103,288.10	61,570.28	12,717.23	29,000.58
4	103,323.50	61,560.52	12,713.40	29,049.58
5	103,304.25	61,566.33	12,716.18	29,021.73
6	103,214.93	61,513.80	12,687.50	29,013.63
7	103,278.58	61,509.13	12,715.72	29,053.73
8	103,281.33	61,567.42	12,705.38	29,008.53
9	103,249.92	61,574.93	12,685.73	28,989.25
10	103,319.85	61,562.13	12,720.93	29,036.78
11	103,225.73	61,509.50	12,685.53	29,030.70
12	103,254.98	61,519.55	12,683.10	29,052.33
13	103,328.42	61,606.73	12,697.93	29,023.75
14	103,263.42	61,484.12	12,709.00	29,070.30
Average	103,272.14	61,541.37	12,700.70	29,030.08

90% Load Level - 1957 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:42:19	13:47:20	0-4	0:05:01
Measurement Interval	13:47:20	13:57:20	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	97,884.00	58,296.72	12,048.92	27,538.37
1	97,872.75	58,337.40	12,041.00	27,494.35
2	97,822.65	58,262.02	12,037.30	27,523.33
3	97,880.43	58,354.60	12,023.95	27,501.88
4	97,857.85	58,308.18	12,040.25	27,509.42
5	97,855.28	58,329.55	12,042.55	27,483.18
6	97,810.32	58,328.43	12,016.65	27,465.23
7	97,860.93	58,286.87	12,054.73	27,519.33
8	97,846.12	58,298.93	12,027.60	27,519.58
9	97,835.53	58,282.83	12,041.78	27,510.92
10	97,826.92	58,315.95	12,030.78	27,480.18
11	97,834.08	58,297.77	12,032.60	27,503.72
12	97,873.15	58,321.92	12,041.67	27,509.57
13	97,838.03	58,316.82	12,022.07	27,499.15
14	97,917.53	58,346.33	12,053.30	27,517.90
Average	97,849.79	58,312.54	12,036.37	27,500.88

80% Load Level - 1740 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:58:55	14:03:56	0-4	0:05:01
Measurement Interval	14:03:56	14:13:56	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	87,024.83	51,849.20	10,710.63	24,465.00
1	87,032.68	51,884.78	10,721.15	24,426.75
2	86,951.87	51,828.07	10,689.05	24,434.75
3	86,991.72	51,822.28	10,727.72	24,441.72
4	87,056.83	51,912.58	10,695.00	24,449.25
5	86,936.55	51,809.78	10,690.77	24,436.00
6	87,026.88	51,856.85	10,693.02	24,477.02
7	86,984.37	51,851.20	10,679.60	24,453.57
8	87,008.08	51,850.27	10,711.97	24,445.85
9	87,040.82	51,844.78	10,715.92	24,480.12
10	87,005.27	51,863.42	10,707.00	24,434.85
11	86,907.80	51,808.38	10,675.17	24,424.25
12	87,025.72	51,874.87	10,695.82	24,455.03
13	86,988.72	51,813.62	10,706.90	24,468.20
14	87,012.72	51,819.75	10,718.60	24,474.37
Average	86,993.69	51,839.29	10,699.48	24,454.93

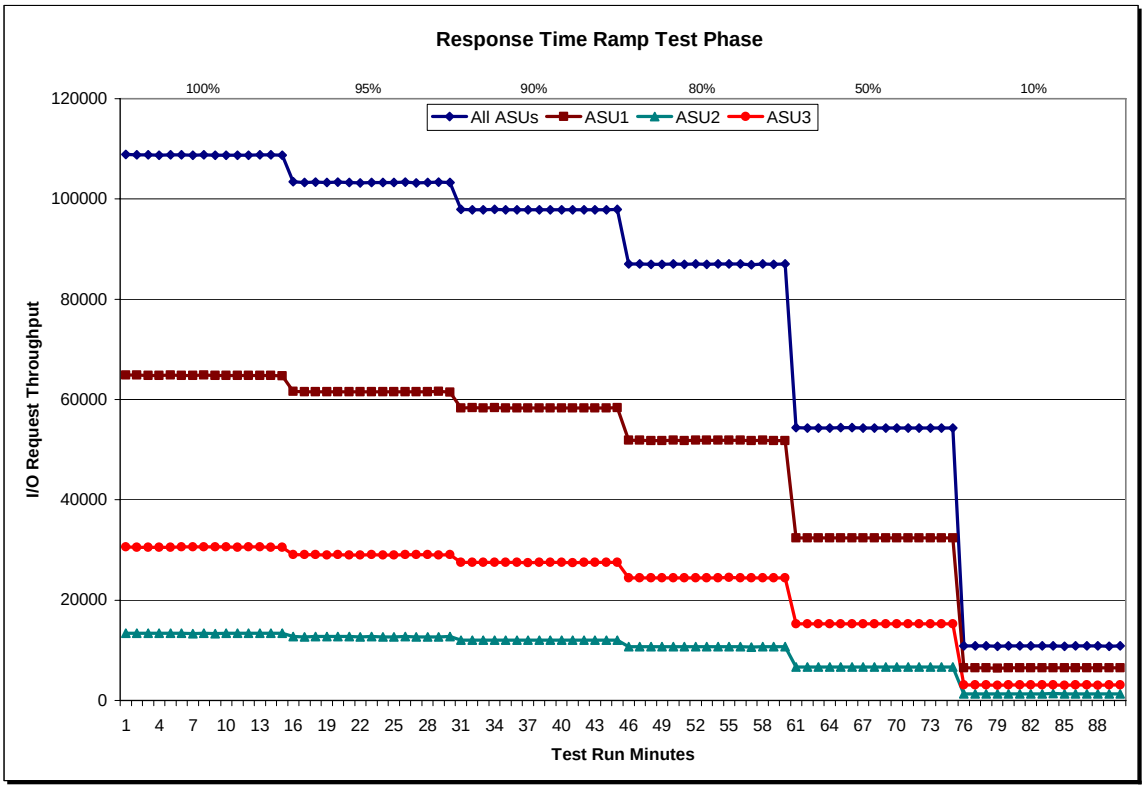
50% Load Level - 1087 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:15:30	14:20:31	0-4	0:05:01
Measurement Interval	14:20:31	14:30:31	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	54,365.25	32,410.37	6,689.45	15,265.43
1	54,337.60	32,390.23	6,670.07	15,277.30
2	54,317.62	32,389.25	6,685.32	15,243.05
3	54,336.42	32,426.12	6,672.95	15,237.35
4	54,372.17	32,398.97	6,688.65	15,284.55
5	54,358.60	32,423.73	6,676.60	15,258.27
6	54,333.65	32,391.42	6,679.32	15,262.92
7	54,336.22	32,386.65	6,689.95	15,259.62
8	54,331.38	32,377.35	6,682.15	15,271.88
9	54,301.97	32,360.58	6,695.47	15,245.92
10	54,349.35	32,393.98	6,691.42	15,263.95
11	54,307.37	32,356.03	6,688.68	15,262.65
12	54,331.68	32,365.57	6,691.05	15,275.07
13	54,310.23	32,359.88	6,686.73	15,263.62
14	54,320.20	32,373.07	6,676.42	15,270.72
Average	54,328.07	32,378.83	6,685.78	15,263.46

10% Load Level - 217 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:31:28	14:36:29	0-4	0:05:01
Measurement Interval	14:36:29	14:46:29	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	10,879.87	6,484.25	1,333.55	3,062.07
1	10,864.90	6,483.93	1,324.32	3,056.65
2	10,854.45	6,472.28	1,335.40	3,046.77
3	10,831.08	6,452.83	1,339.35	3,038.90
4	10,874.60	6,487.28	1,334.33	3,052.98
5	10,847.83	6,476.85	1,325.35	3,045.63
6	10,845.32	6,459.47	1,331.33	3,054.52
7	10,843.75	6,465.30	1,333.48	3,044.97
8	10,883.32	6,485.27	1,339.83	3,058.22
9	10,833.28	6,455.22	1,334.65	3,043.42
10	10,857.43	6,477.97	1,331.62	3,047.85
11	10,846.38	6,457.42	1,332.97	3,056.00
12	10,841.48	6,466.27	1,333.23	3,041.98
13	10,834.85	6,461.92	1,326.43	3,046.50
14	10,872.23	6,486.05	1,338.43	3,047.75
Average	10,850.59	6,469.17	1,332.73	3,048.68

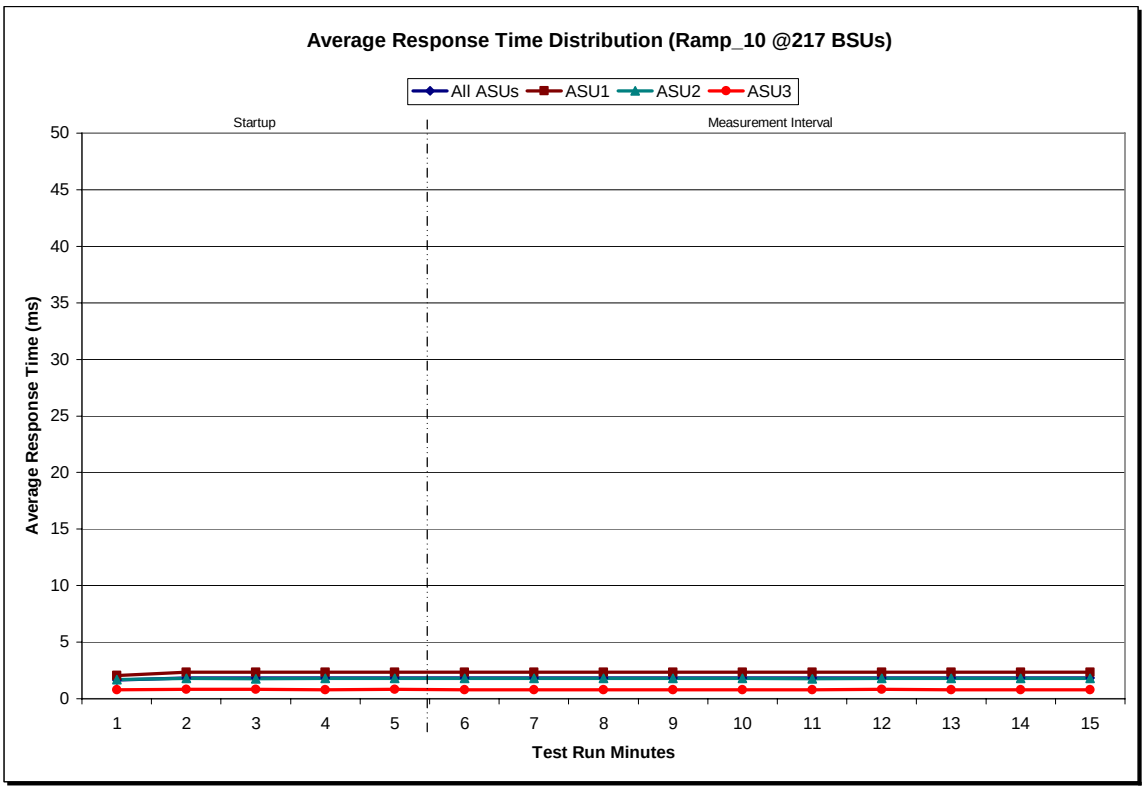
Response Time Ramp Distribution (IOPS) Graph



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

217 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:31:28	14:36:29	0-4	0:05:01
Measurement Interval	14:36:29	14:46:29	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.65	2.05	1.69	0.80
1	1.84	2.34	1.78	0.81
2	1.85	2.35	1.78	0.81
3	1.84	2.34	1.79	0.81
4	1.84	2.34	1.78	0.81
5	1.85	2.34	1.80	0.81
6	1.84	2.34	1.79	0.81
7	1.84	2.34	1.79	0.81
8	1.85	2.34	1.79	0.81
9	1.85	2.35	1.80	0.81
10	1.84	2.34	1.78	0.81
11	1.85	2.35	1.79	0.81
12	1.85	2.35	1.79	0.81
13	1.85	2.35	1.80	0.81
14	1.85	2.35	1.78	0.81
Average	1.85	2.35	1.79	0.81

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	0.2811	0.0698	0.2102	0.0180	0.0699	0.0349	0.2810
COV	0.006	0.003	0.005	0.002	0.008	0.005	0.005	0.002

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 103.

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	***108,010.84***	***1.88***
Repeatability Test Phase 1	108,744.85	1.85
Repeatability Test Phase 2	108,749.59	1.85

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

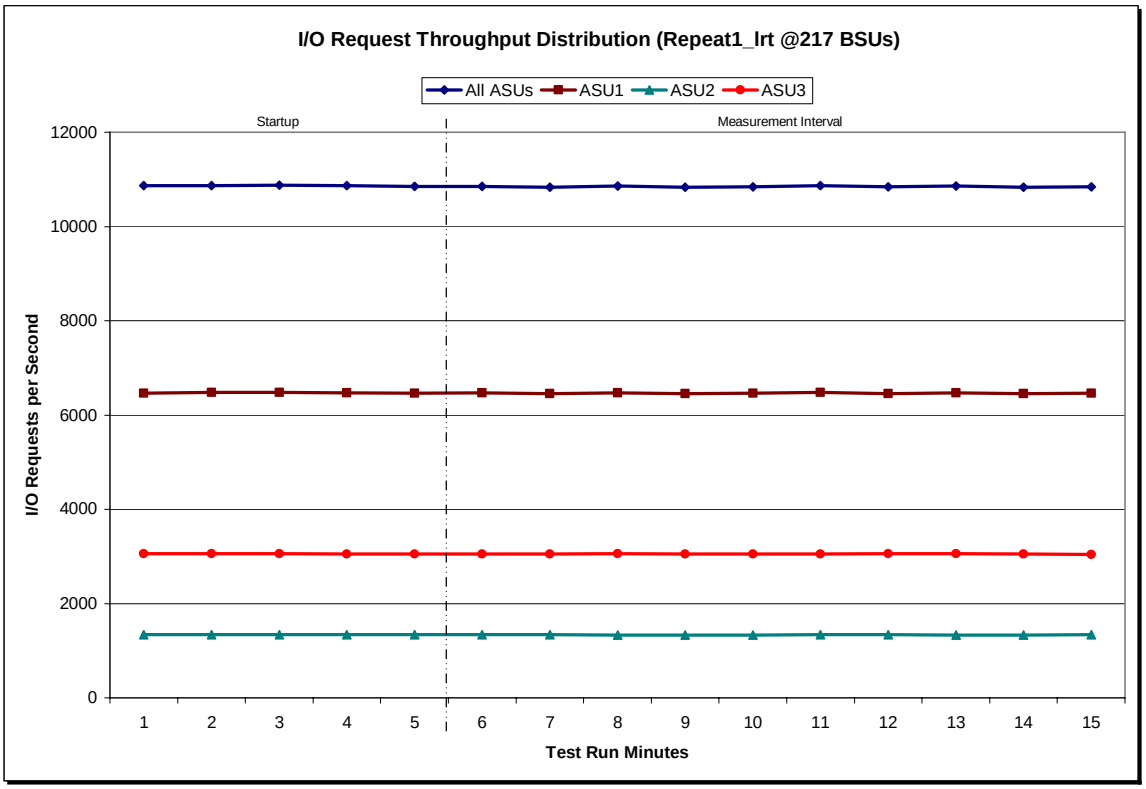
Repeatability Test Phase 1, Test Run 1 (LRT)
Repeatability Test Phase 1, Test Run 2 (IOPS)
Repeatability Test Phase 2, Test Run 1 (LRT)
Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

217 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:48:21	14:53:21	0-4	0:05:00
Measurement Interval	14:53:21	15:03:21	5-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	10,864.17	6,465.78	1,337.85	3,060.53
1	10,871.77	6,476.97	1,339.50	3,055.30
2	10,879.37	6,478.88	1,341.28	3,059.20
3	10,867.27	6,472.97	1,342.43	3,051.87
4	10,851.30	6,466.35	1,337.00	3,047.95
5	10,854.53	6,467.48	1,337.87	3,049.18
6	10,830.67	6,449.78	1,334.78	3,046.10
7	10,861.42	6,466.88	1,332.92	3,061.62
8	10,835.03	6,454.82	1,328.40	3,051.82
9	10,844.20	6,463.00	1,333.40	3,047.80
10	10,864.18	6,478.25	1,337.98	3,047.95
11	10,845.22	6,454.87	1,336.07	3,054.28
12	10,861.60	6,472.97	1,331.62	3,057.02
13	10,835.78	6,455.87	1,333.23	3,046.68
14	10,840.97	6,460.83	1,335.52	3,044.62
Average	10,847.36	6,462.48	1,334.18	3,050.71

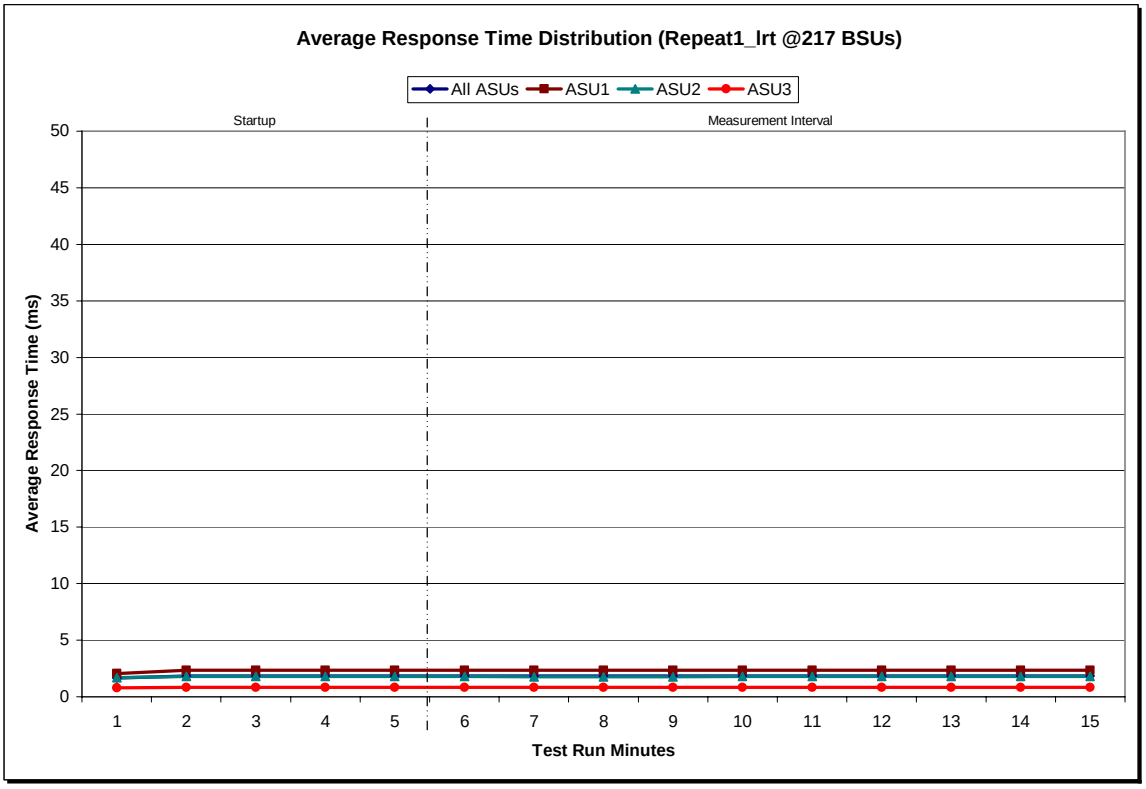
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

217 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:48:21	14:53:21	0-4	0:05:00
Measurement Interval	14:53:21	15:03:21	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.65	2.05	1.70	0.81
1	1.85	2.35	1.80	0.82
2	1.85	2.35	1.79	0.82
3	1.85	2.35	1.79	0.82
4	1.85	2.35	1.79	0.82
5	1.84	2.34	1.79	0.81
6	1.84	2.34	1.78	0.81
7	1.85	2.35	1.78	0.82
8	1.84	2.35	1.77	0.81
9	1.85	2.35	1.79	0.81
10	1.85	2.34	1.80	0.82
11	1.85	2.35	1.80	0.81
12	1.85	2.35	1.79	0.82
13	1.85	2.35	1.80	0.81
14	1.85	2.34	1.80	0.81
Average	1.85	2.35	1.79	0.81

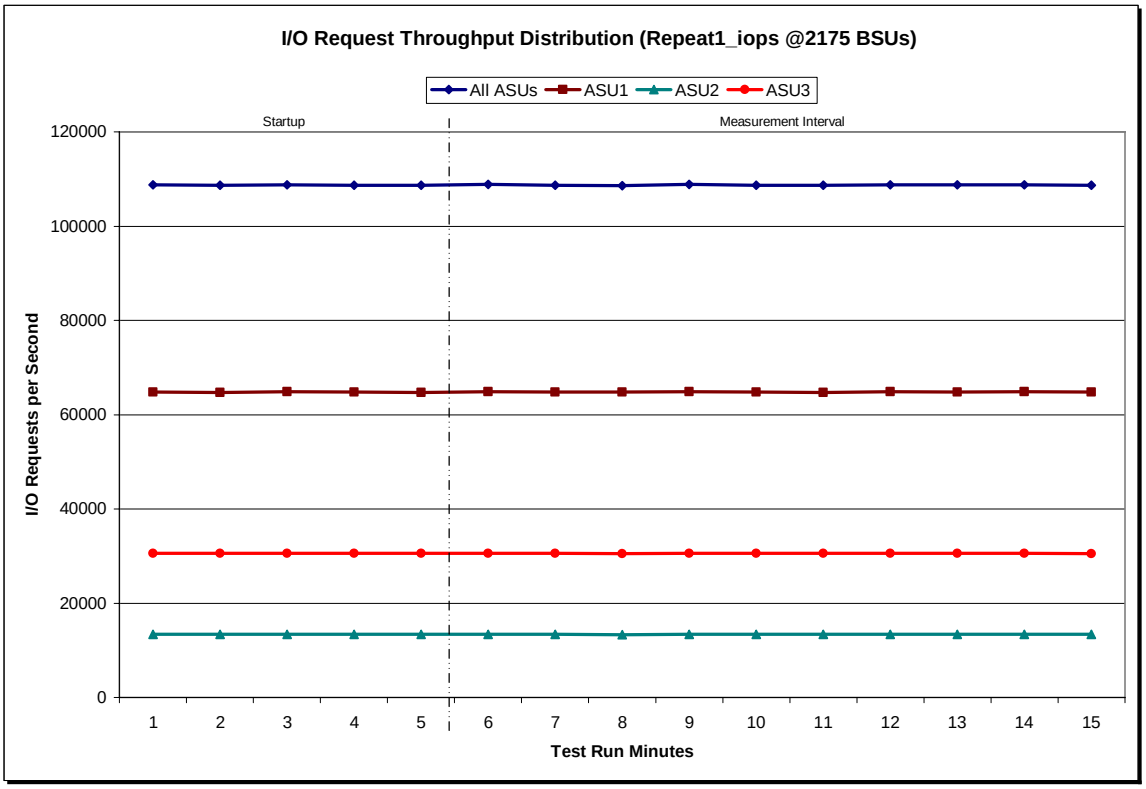
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:05:17	15:10:18	0-4	0:05:01
Measurement Interval	15:10:18	15:20:18	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	108,775.97	64,805.63	13,376.20	30,594.13
1	108,685.78	64,746.30	13,375.78	30,563.70
2	108,779.17	64,871.97	13,349.95	30,557.25
3	108,703.50	64,761.32	13,379.23	30,562.95
4	108,650.73	64,738.52	13,361.95	30,550.27
5	108,819.22	64,862.40	13,374.83	30,581.98
6	108,711.22	64,795.68	13,365.97	30,549.57
7	108,591.13	64,767.60	13,325.80	30,497.73
8	108,856.47	64,872.75	13,394.20	30,589.52
9	108,725.20	64,779.62	13,374.93	30,570.65
10	108,687.62	64,740.78	13,392.70	30,554.13
11	108,802.27	64,856.25	13,383.67	30,562.35
12	108,764.58	64,789.22	13,379.12	30,596.25
13	108,773.07	64,861.42	13,367.53	30,544.12
14	108,717.70	64,800.57	13,378.25	30,538.88
Average	108,744.85	64,812.63	13,373.70	30,558.52

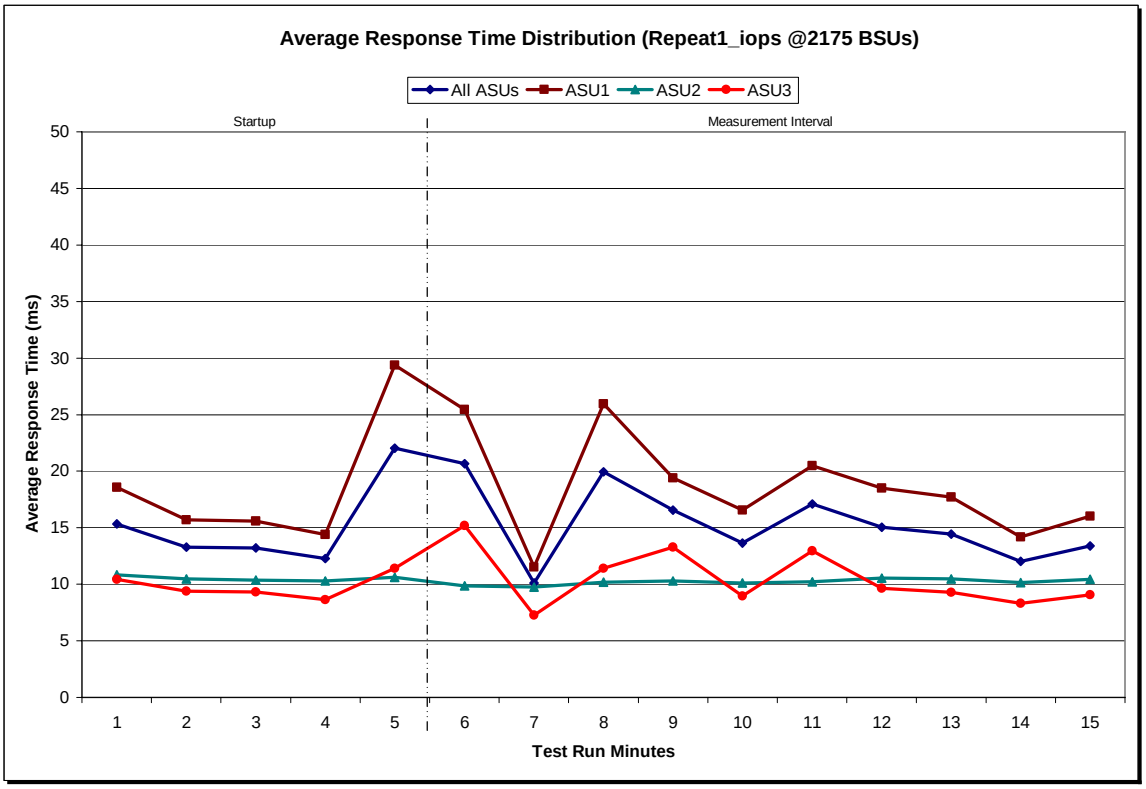
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:05:17	15:10:18	0-4	0:05:01
Measurement Interval	15:10:18	15:20:18	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	15.35	18.59	10.84	10.45
1	13.29	15.70	10.49	9.41
2	13.19	15.59	10.38	9.32
3	12.29	14.41	10.31	8.65
4	22.02	29.37	10.61	11.42
5	20.65	25.45	9.86	15.19
6	10.10	11.50	9.77	7.27
7	19.93	25.95	10.17	11.41
8	16.56	19.40	10.28	13.28
9	13.63	16.56	10.13	8.95
10	17.09	20.47	10.22	12.96
11	15.03	18.49	10.54	9.65
12	14.45	17.71	10.46	9.30
13	12.03	14.17	10.15	8.31
14	13.38	16.02	10.45	9.06
Average	15.28	18.57	10.20	10.54

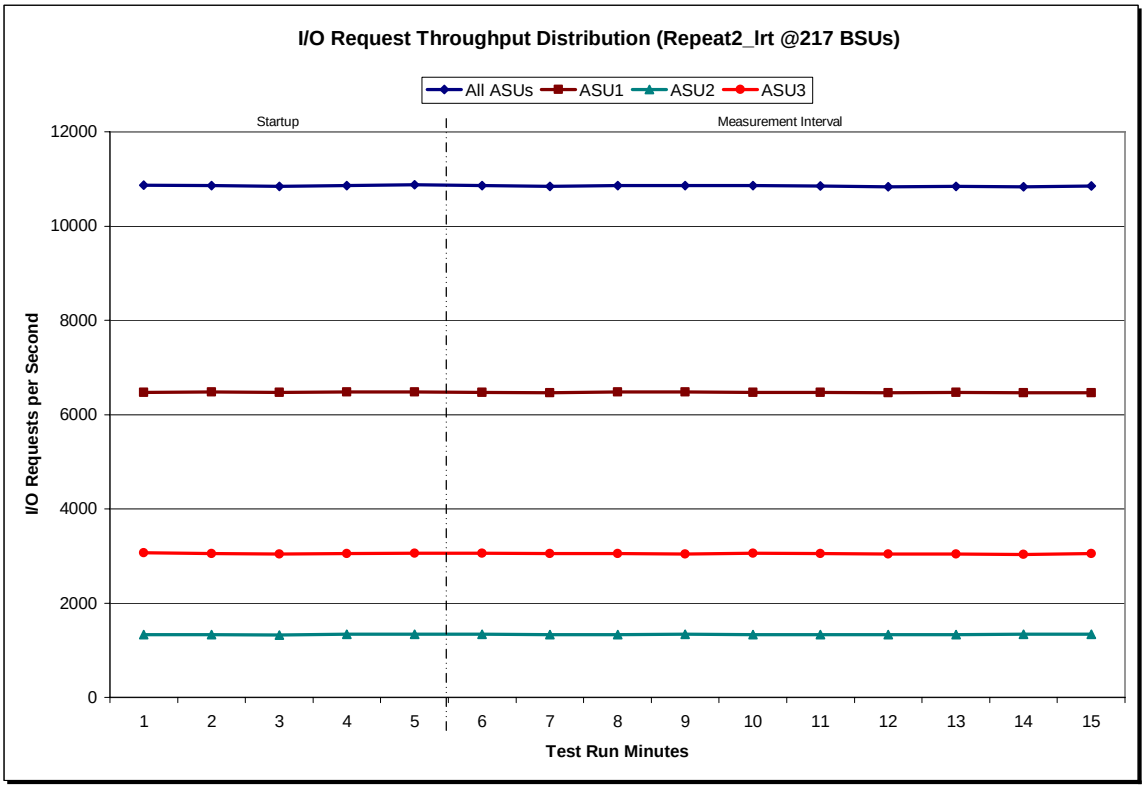
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

217 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:21:53	15:26:53	0-4	0:05:00
Measurement Interval	15:26:53	15:36:53	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	10,870.03	6,474.88	1,331.35	3,063.80
1	10,859.28	6,482.48	1,328.03	3,048.77
2	10,842.28	6,473.67	1,325.67	3,042.95
3	10,863.87	6,477.05	1,336.12	3,050.70
4	10,875.12	6,482.75	1,336.53	3,055.83
5	10,859.93	6,467.45	1,335.73	3,056.75
6	10,845.62	6,461.87	1,332.58	3,051.17
7	10,858.77	6,476.88	1,334.43	3,047.45
8	10,857.83	6,479.92	1,337.65	3,040.27
9	10,862.53	6,473.78	1,332.50	3,056.25
10	10,852.92	6,471.52	1,334.10	3,047.30
11	10,834.45	6,466.20	1,330.83	3,037.42
12	10,842.18	6,466.88	1,334.50	3,040.80
13	10,836.12	6,461.13	1,338.50	3,036.48
14	10,847.70	6,465.63	1,336.67	3,045.40
Average	10,849.81	6,469.13	1,334.75	3,045.93

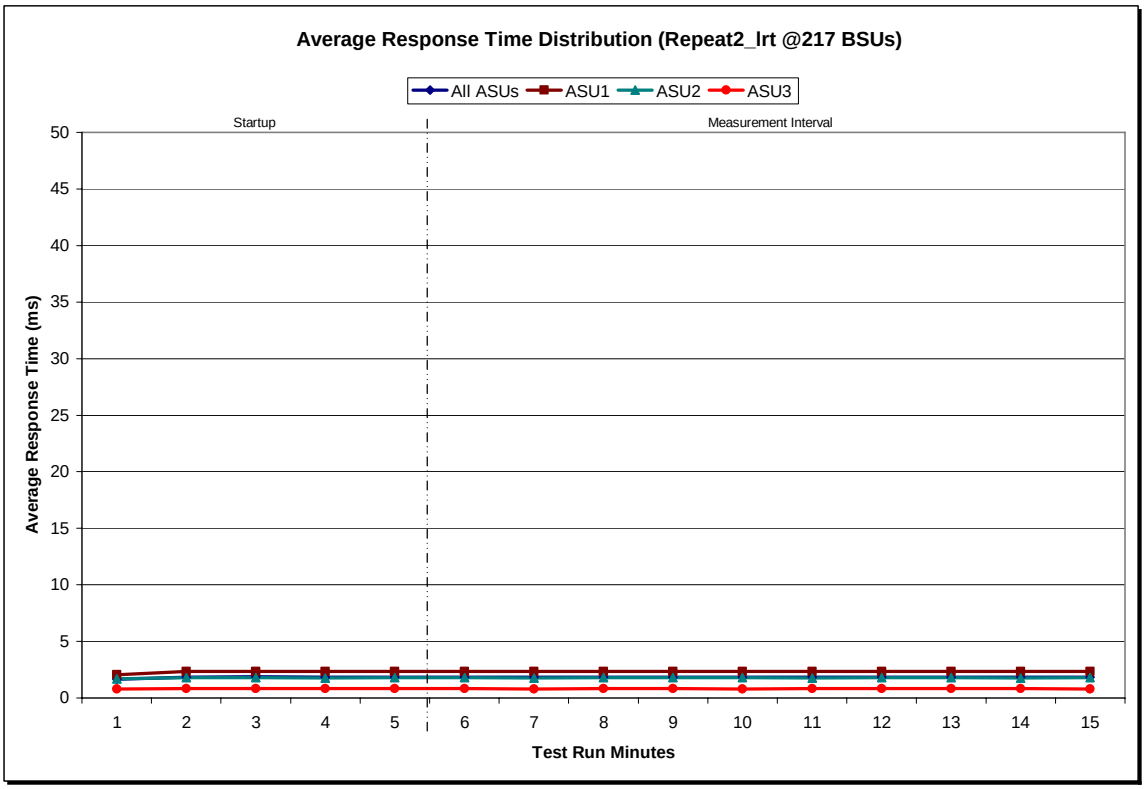
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

217 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:21:53	15:26:53	0-4	0:05:00
Measurement Interval	15:26:53	15:36:53	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1.65	2.05	1.70	0.80
1	1.85	2.35	1.78	0.81
2	1.85	2.36	1.80	0.82
3	1.85	2.35	1.78	0.81
4	1.85	2.35	1.80	0.81
5	1.84	2.34	1.78	0.81
6	1.84	2.34	1.78	0.81
7	1.85	2.35	1.80	0.81
8	1.85	2.35	1.79	0.81
9	1.85	2.35	1.82	0.81
10	1.85	2.35	1.78	0.81
11	1.85	2.35	1.79	0.81
12	1.85	2.35	1.81	0.81
13	1.85	2.35	1.77	0.81
14	1.85	2.36	1.79	0.81
Average	1.85	2.35	1.79	0.81

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

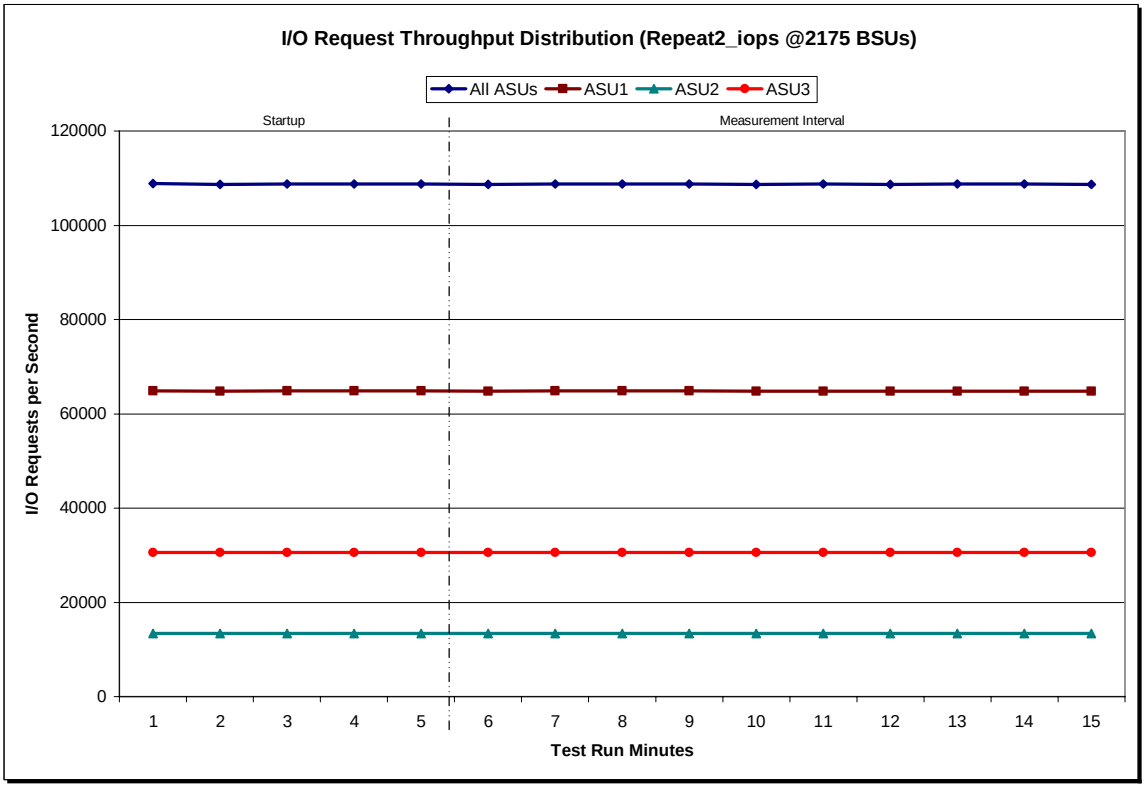


Repeatability 2 IOPS – I/O Request Throughput Distribution Data

2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:38:46	15:43:47	0-4	0:05:01
Measurement Interval	15:43:47	15:53:47	5-14	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	108,837.50	64,862.08	13,373.02	30,602.40
1	108,704.48	64,779.62	13,383.40	30,541.47
2	108,783.30	64,855.08	13,381.23	30,546.98
3	108,799.47	64,850.90	13,379.83	30,568.73
4	108,803.78	64,871.00	13,375.27	30,557.52
5	108,715.82	64,778.03	13,376.12	30,561.67
6	108,786.42	64,841.52	13,375.23	30,569.67
7	108,802.58	64,840.35	13,383.43	30,578.80
8	108,774.23	64,857.05	13,373.33	30,543.85
9	108,713.72	64,753.93	13,396.25	30,563.53
10	108,745.48	64,783.75	13,392.60	30,569.13
11	108,720.03	64,769.28	13,377.48	30,573.27
12	108,780.77	64,816.45	13,374.82	30,589.50
13	108,736.63	64,786.43	13,396.08	30,554.12
14	108,720.20	64,794.17	13,375.73	30,550.30
Average	108,749.59	64,802.10	13,382.11	30,565.38

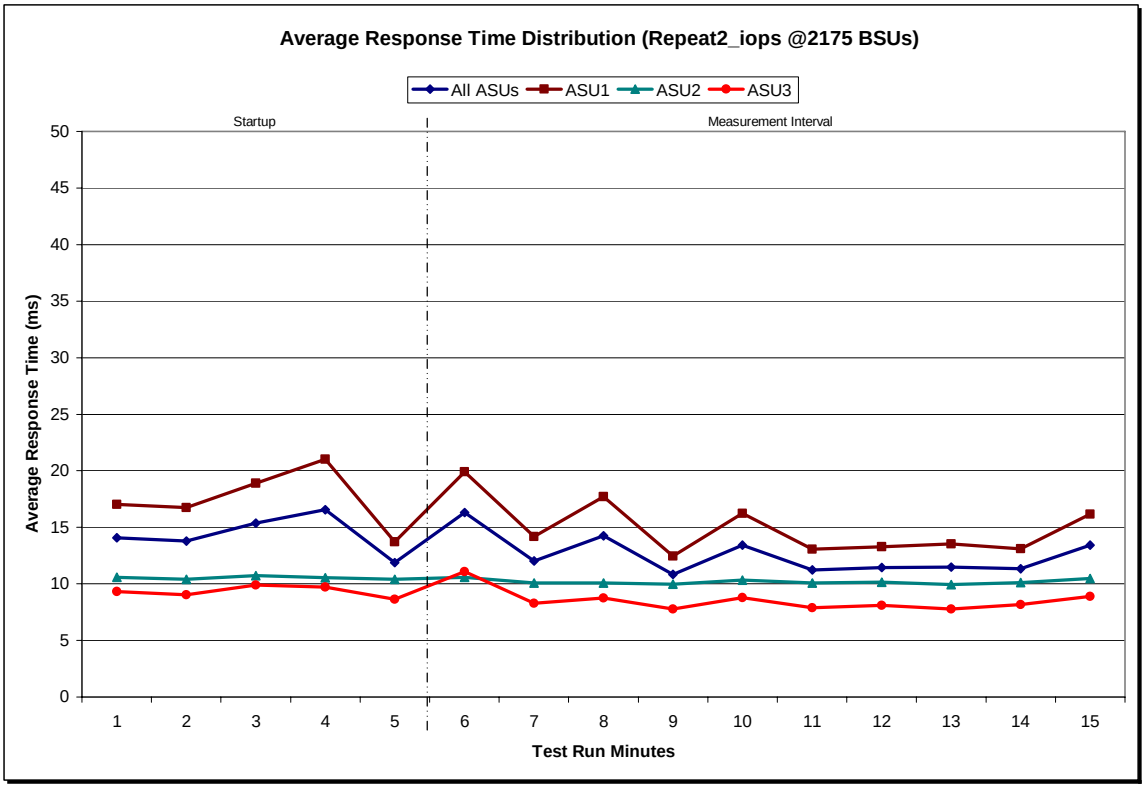
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

2175 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:38:46	15:43:47	0-4	0:05:01
Measurement Interval	15:43:47	15:53:47	5-14	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	14.07	17.02	10.57	9.34
1	13.79	16.74	10.41	9.02
2	15.37	18.90	10.73	9.90
3	16.55	21.01	10.54	9.73
4	11.89	13.72	10.40	8.65
5	16.29	19.92	10.60	11.10
6	12.03	14.20	10.08	8.28
7	14.24	17.70	10.06	8.74
8	10.84	12.46	9.99	7.78
9	13.41	16.24	10.33	8.77
10	11.25	13.08	10.07	7.88
11	11.44	13.29	10.14	8.09
12	11.47	13.52	9.95	7.78
13	11.35	13.12	10.11	8.15
14	13.42	16.16	10.47	8.89
Average	12.57	14.97	10.18	8.55

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	0.0349	0.2808	0.0701	0.2100	0.0180	0.0701	0.0349	0.2812
COV	0.008	0.002	0.005	0.001	0.006	0.005	0.004	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.*

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	*0.0350*	*0.2810*	*0.0700*	*0.2100*	*0.0180*	*0.0700*	*0.0350*	*0.2810*
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.002	0.001	0.001	0.001	0.005	0.001	0.002	0.001

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	*0.0350*	*0.2810*	*0.0700*	*0.2100*	*0.0180*	*0.0700*	*0.0350*	*0.2810*
MIM	0.0351	0.2810	0.0700	0.2101	0.0180	0.0699	0.0351	0.2807
COV	0.003	0.002	0.006	0.003	0.010	0.003	0.006	0.002

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	*0.0350*	*0.2810*	*0.0700*	*0.2100*	*0.0180*	*0.0700*	*0.0350*	*0.2810*
MIM	0.0350	0.2809	0.0700	0.2099	0.0180	0.0700	0.0350	0.2811
COV	0.001	0.001	0.001	0.001	0.004	0.001	0.001	0.000

Data Persistence Test

Clause 6

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

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

The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 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 103.

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	57,544,736
Total Number of Logical Blocks Verified	50,995,232
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 ETERNUS6000 Model 1100, as documented in this Full Disclosure Report will be available on May 31, 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 ETERNUS6000 Model 1100.

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.

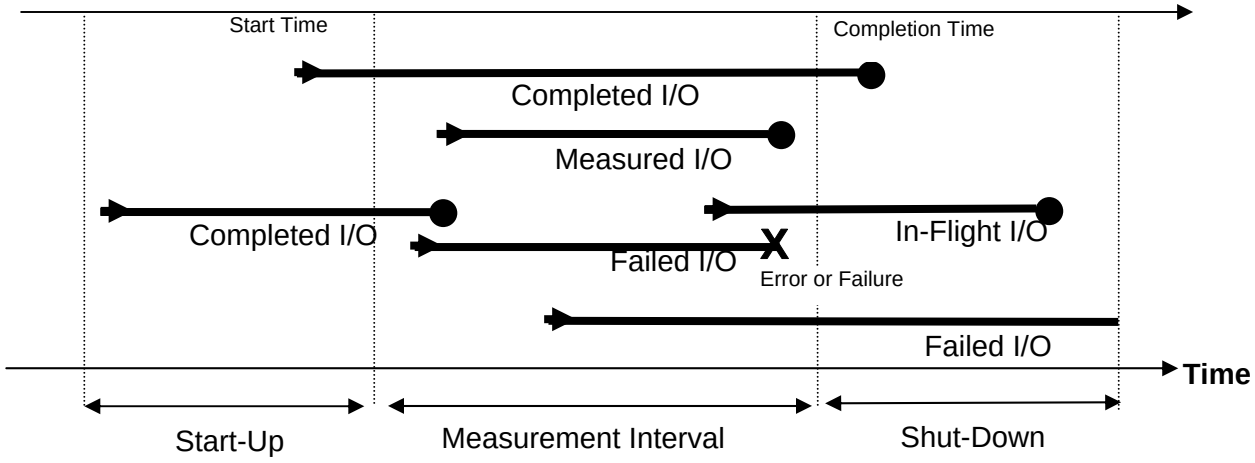
Test: A collection of Test Phases and or Test Runs sharing a common objective.

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

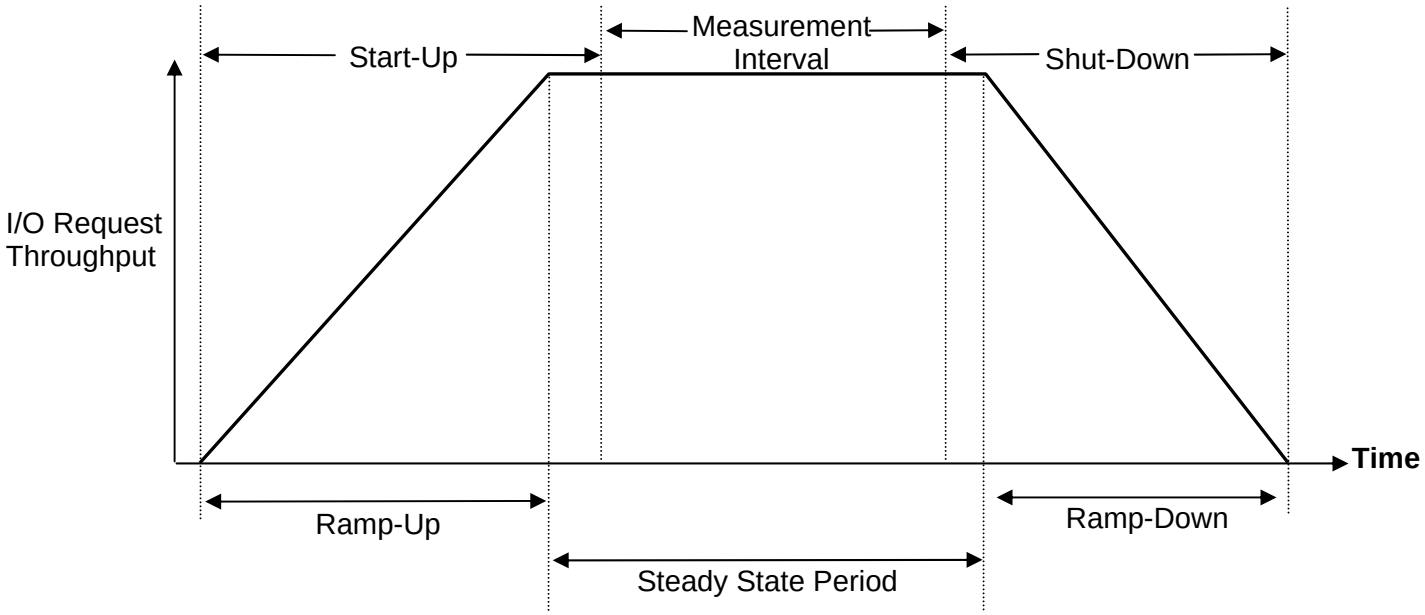
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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 ETERNUS6000 Model 1100 Storage System:

```
   # 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.
   automap=1;
```

```
# 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=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=45;

# 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;
```

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 ETERNUS6000 Model 1100.

```
# 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;
   name="sd" parent="lpfc" target=16 lun=23;
   name="sd" parent="lpfc" target=16 lun=24;
   name="sd" parent="lpfc" target=16 lun=25;
   name="sd" parent="lpfc" target=16 lun=26;
   name="sd" parent="lpfc" target=16 lun=27;
   name="sd" parent="lpfc" target=16 lun=28;
   name="sd" parent="lpfc" target=16 lun=29;
   name="sd" parent="lpfc" target=16 lun=30;
   name="sd" parent="lpfc" target=16 lun=31;
   name="sd" parent="lpfc" target=16 lun=32;
   name="sd" parent="lpfc" target=16 lun=33;
   name="sd" parent="lpfc" target=16 lun=34;
   name="sd" parent="lpfc" target=16 lun=35;
   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;
```

```
   name="sd" parent="lpfc" target=16 lun=41;
   name="sd" parent="lpfc" target=16 lun=42;
   name="sd" parent="lpfc" target=16 lun=43;
   name="sd" parent="lpfc" target=16 lun=44;
   name="sd" parent="lpfc" target=16 lun=45;
   name="sd" parent="lpfc" target=16 lun=46;
   name="sd" parent="lpfc" target=16 lun=47;
   name="sd" parent="lpfc" target=16 lun=48;
   name="sd" parent="lpfc" target=16 lun=49;
   name="sd" parent="lpfc" target=17 lun=0;
   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=17 lun=4;
   name="sd" parent="lpfc" target=17 lun=5;
   name="sd" parent="lpfc" target=17 lun=6;
   name="sd" parent="lpfc" target=17 lun=7;
   name="sd" parent="lpfc" target=17 lun=8;
   name="sd" parent="lpfc" target=17 lun=9;
   name="sd" parent="lpfc" target=17 lun=10;
   name="sd" parent="lpfc" target=17 lun=11;
   name="sd" parent="lpfc" target=17 lun=12;
   name="sd" parent="lpfc" target=17 lun=13;
   name="sd" parent="lpfc" target=17 lun=14;
   name="sd" parent="lpfc" target=17 lun=15;
   name="sd" parent="lpfc" target=17 lun=16;
   name="sd" parent="lpfc" target=17 lun=17;
   name="sd" parent="lpfc" target=17 lun=18;
   name="sd" parent="lpfc" target=17 lun=19;
   name="sd" parent="lpfc" target=17 lun=20;
   name="sd" parent="lpfc" target=17 lun=21;
   name="sd" parent="lpfc" target=17 lun=22;
   name="sd" parent="lpfc" target=17 lun=23;
   name="sd" parent="lpfc" target=17 lun=24;
   name="sd" parent="lpfc" target=17 lun=25;
   name="sd" parent="lpfc" target=17 lun=26;
   name="sd" parent="lpfc" target=17 lun=27;
   name="sd" parent="lpfc" target=17 lun=28;
   name="sd" parent="lpfc" target=17 lun=29;
   name="sd" parent="lpfc" target=17 lun=30;
   name="sd" parent="lpfc" target=17 lun=31;
   name="sd" parent="lpfc" target=17 lun=32;
   name="sd" parent="lpfc" target=17 lun=33;
   name="sd" parent="lpfc" target=17 lun=34;
   name="sd" parent="lpfc" target=17 lun=35;
   name="sd" parent="lpfc" target=17 lun=36;
   name="sd" parent="lpfc" target=17 lun=37;
   name="sd" parent="lpfc" target=17 lun=38;
   name="sd" parent="lpfc" target=17 lun=39;
   name="sd" parent="lpfc" target=17 lun=40;
   name="sd" parent="lpfc" target=17 lun=41;
   name="sd" parent="lpfc" target=17 lun=42;
   name="sd" parent="lpfc" target=17 lun=43;
   name="sd" parent="lpfc" target=17 lun=44;
   name="sd" parent="lpfc" target=17 lun=45;
   name="sd" parent="lpfc" target=17 lun=46;
   name="sd" parent="lpfc" target=17 lun=47;
   name="sd" parent="lpfc" target=17 lun=48;
   name="sd" parent="lpfc" target=17 lun=49;
   name="sd" parent="lpfc" target=18 lun=0;
   name="sd" parent="lpfc" target=18 lun=1;
   name="sd" parent="lpfc" target=18 lun=2;
   name="sd" parent="lpfc" target=18 lun=3;
```

```
   name="sd" parent="lpfc" target=18 lun=4;
   name="sd" parent="lpfc" target=18 lun=5;
   name="sd" parent="lpfc" target=18 lun=6;
   name="sd" parent="lpfc" target=18 lun=7;
   name="sd" parent="lpfc" target=18 lun=8;
   name="sd" parent="lpfc" target=18 lun=9;
   name="sd" parent="lpfc" target=18 lun=10;
   name="sd" parent="lpfc" target=18 lun=11;
   name="sd" parent="lpfc" target=18 lun=12;
   name="sd" parent="lpfc" target=18 lun=13;
   name="sd" parent="lpfc" target=18 lun=14;
   name="sd" parent="lpfc" target=18 lun=15;
   name="sd" parent="lpfc" target=18 lun=16;
   name="sd" parent="lpfc" target=18 lun=17;
   name="sd" parent="lpfc" target=18 lun=18;
   name="sd" parent="lpfc" target=18 lun=19;
   name="sd" parent="lpfc" target=18 lun=20;
   name="sd" parent="lpfc" target=18 lun=21;
   name="sd" parent="lpfc" target=18 lun=22;
   name="sd" parent="lpfc" target=18 lun=23;
   name="sd" parent="lpfc" target=18 lun=24;
   name="sd" parent="lpfc" target=18 lun=25;
   name="sd" parent="lpfc" target=18 lun=26;
   name="sd" parent="lpfc" target=18 lun=27;
   name="sd" parent="lpfc" target=18 lun=28;
   name="sd" parent="lpfc" target=18 lun=29;
   name="sd" parent="lpfc" target=18 lun=30;
   name="sd" parent="lpfc" target=18 lun=31;
   name="sd" parent="lpfc" target=18 lun=32;
   name="sd" parent="lpfc" target=18 lun=33;
   name="sd" parent="lpfc" target=18 lun=34;
   name="sd" parent="lpfc" target=18 lun=35;
   name="sd" parent="lpfc" target=18 lun=36;
   name="sd" parent="lpfc" target=18 lun=37;
   name="sd" parent="lpfc" target=18 lun=38;
   name="sd" parent="lpfc" target=18 lun=39;
   name="sd" parent="lpfc" target=18 lun=40;
   name="sd" parent="lpfc" target=18 lun=41;
   name="sd" parent="lpfc" target=18 lun=42;
   name="sd" parent="lpfc" target=18 lun=43;
   name="sd" parent="lpfc" target=18 lun=44;
   name="sd" parent="lpfc" target=18 lun=45;
   name="sd" parent="lpfc" target=18 lun=46;
   name="sd" parent="lpfc" target=18 lun=47;
   name="sd" parent="lpfc" target=18 lun=48;
   name="sd" parent="lpfc" target=18 lun=49;
   name="sd" parent="lpfc" target=19 lun=0;
   name="sd" parent="lpfc" target=19 lun=1;
   name="sd" parent="lpfc" target=19 lun=2;
   name="sd" parent="lpfc" target=19 lun=3;
   name="sd" parent="lpfc" target=19 lun=4;
   name="sd" parent="lpfc" target=19 lun=5;
   name="sd" parent="lpfc" target=19 lun=6;
   name="sd" parent="lpfc" target=19 lun=7;
   name="sd" parent="lpfc" target=19 lun=8;
   name="sd" parent="lpfc" target=19 lun=9;
   name="sd" parent="lpfc" target=19 lun=10;
   name="sd" parent="lpfc" target=19 lun=11;
   name="sd" parent="lpfc" target=19 lun=12;
   name="sd" parent="lpfc" target=19 lun=13;
   name="sd" parent="lpfc" target=19 lun=14;
   name="sd" parent="lpfc" target=19 lun=15;
   name="sd" parent="lpfc" target=19 lun=16;
```

```
name="sd" parent="lpfc" target=19 lun=17;
name="sd" parent="lpfc" target=19 lun=18;
name="sd" parent="lpfc" target=19 lun=19;
name="sd" parent="lpfc" target=19 lun=20;
name="sd" parent="lpfc" target=19 lun=21;
name="sd" parent="lpfc" target=19 lun=22;
name="sd" parent="lpfc" target=19 lun=23;
name="sd" parent="lpfc" target=19 lun=24;
name="sd" parent="lpfc" target=19 lun=25;
name="sd" parent="lpfc" target=19 lun=26;
name="sd" parent="lpfc" target=19 lun=27;
name="sd" parent="lpfc" target=19 lun=28;
name="sd" parent="lpfc" target=19 lun=29;
name="sd" parent="lpfc" target=19 lun=30;
name="sd" parent="lpfc" target=19 lun=31;
name="sd" parent="lpfc" target=19 lun=32;
name="sd" parent="lpfc" target=19 lun=33;
name="sd" parent="lpfc" target=19 lun=34;
name="sd" parent="lpfc" target=19 lun=35;
name="sd" parent="lpfc" target=19 lun=36;
name="sd" parent="lpfc" target=19 lun=37;
name="sd" parent="lpfc" target=19 lun=38;
name="sd" parent="lpfc" target=19 lun=39;
name="sd" parent="lpfc" target=19 lun=40;
name="sd" parent="lpfc" target=19 lun=41;
name="sd" parent="lpfc" target=19 lun=42;
name="sd" parent="lpfc" target=19 lun=43;
name="sd" parent="lpfc" target=19 lun=44;
name="sd" parent="lpfc" target=19 lun=45;
name="sd" parent="lpfc" target=19 lun=46;
name="sd" parent="lpfc" target=19 lun=47;
name="sd" parent="lpfc" target=19 lun=48;
name="sd" parent="lpfc" target=19 lun=49;
# End lpfc auto-generated configuration -- do NOT alter or delete this line
```

Configuring the ETERNUS6000 Storage Array

The following entries in **sd.conf** were defined to enable the Emulex HBAs for accessing the LUNs defined in the ETERNUS6000 Model 1100.

The ETERNUS6000 Storage Array is configured using an interactive on-line tool called ETERNUSmgr. When an ETERNUS6000 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 sheets for the TSC may be accessed via the following URLs:

SPC-2 E6k Design Sheets

SPC-2 E6k 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/eternus6000mgr_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 directly connected from thirty-two HBAs to Channel Adapter ports, 32 CA port connections in all. Each port was 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 direct connection from the server HBA port to the storage CA port, the default selection of FC-AL Connection, Loop-Id (Manual), 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 2Gbps 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 45 Logical Volumes as LUNs 0-44 on each of the Channel Adapter ports. There are 1440 Logical Volumes in the defined configuration, 18 on each of the 80 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 ETERNUS6000 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 ETERNUS6000 Model 1100.

1. makesol

The **makesol** script is used to create the Solaris Volume Manager (SVM) logical volumes based on a configuration description file, **Test_E6000M1110_G08-5-1_svmake.txt**. This script is called by:

./makesol Test_E6000M1110_G08-5-1_svmake.txt

2. **Test_E6000M1110_G08-5-1_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 script is called 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_E6000M1110_G08-5-1_svmake.txt

```
DELETE_ALL
VOLUME_GROUP: asu1-1 (d0)
STRIPE 8m
VOLUME 1
c104t16d4
c120t16d4
c96t16d4
c112t16d4
c106t17d4
c122t17d4
c98t17d4
c114t17d4
c108t18d4
c124t18d4
c100t18d4
c116t18d4
c110t19d4
c126t19d4
c102t19d4
c118t19d4
c104t16d13
c120t16d13
c96t16d13
c112t16d13
c106t17d13
c122t17d13
c98t17d13
c114t17d13
c108t18d13
c124t18d13
c100t18d13
c116t18d13
c110t19d13
c126t19d13
c102t19d13
c118t19d13
c104t16d22
c120t16d22
c96t16d22
c112t16d22
c106t17d22
c122t17d22
c98t17d22
c114t17d22
c108t18d22
c124t18d22
c100t18d22
c116t18d22
c110t19d22
c126t19d22
c102t19d22
c118t19d22
c104t16d31
c120t16d31
```

```
c96t16d31
c112t16d31
c106t17d31
c122t17d31
c98t17d31
c114t17d31
c108t18d31
c124t18d31
c100t18d31
c116t18d31
c110t19d31
c126t19d31
c102t19d31
c118t19d31
c104t16d40
c120t16d40
c96t16d40
c112t16d40
c106t17d40
c122t17d40
c98t17d40
c114t17d40
c108t18d40
c124t18d40
c100t18d40
c116t18d40
c110t19d40
c126t19d40
c102t19d40
c118t19d40
END
VOLUME_GROUP: asu1-2 (d1)
STRIPE 8m
VOLUME 1
c104t16d5
c120t16d5
c96t16d5
c112t16d5
c106t17d5
c122t17d5
c98t17d5
c114t17d5
c108t18d5
c124t18d5
c100t18d5
c116t18d5
c110t19d5
c126t19d5
c102t19d5
c118t19d5
c104t16d14
c120t16d14
c96t16d14
c112t16d14
c106t17d14
c122t17d14
c98t17d14
c114t17d14
c108t18d14
c124t18d14
c100t18d14
c116t18d14
c110t19d14
```

```
c126t19d14
c102t19d14
c118t19d14
c104t16d23
c120t16d23
c96t16d23
c112t16d23
c106t17d23
c122t17d23
c98t17d23
c114t17d23
c108t18d23
c124t18d23
c100t18d23
c116t18d23
c110t19d23
c126t19d23
c102t19d23
c118t19d23
c104t16d32
c120t16d32
c96t16d32
c112t16d32
c106t17d32
c122t17d32
c98t17d32
c114t17d32
c108t18d32
c124t18d32
c100t18d32
c116t18d32
c110t19d32
c126t19d32
c102t19d32
c118t19d32
c104t16d41
c120t16d41
c96t16d41
c112t16d41
c106t17d41
c122t17d41
c98t17d41
c114t17d41
c108t18d41
c124t18d41
c100t18d41
c116t18d41
c110t19d41
c126t19d41
c102t19d41
c118t19d41
END
VOLUME_GROUP: asu1-3 (d2)
STRIPE 8m
VOLUME 1
c104t16d6
c120t16d6
c96t16d6
c112t16d6
c106t17d6
c122t17d6
c98t17d6
c114t17d6
```

```
c108t18d6
c124t18d6
c100t18d6
c116t18d6
c110t19d6
c126t19d6
c102t19d6
c118t19d6
c104t16d15
c120t16d15
c96t16d15
c112t16d15
c106t17d15
c122t17d15
c98t17d15
c114t17d15
c108t18d15
c124t18d15
c100t18d15
c116t18d15
c110t19d15
c126t19d15
c102t19d15
c118t19d15
c104t16d24
c120t16d24
c96t16d24
c112t16d24
c106t17d24
c122t17d24
c98t17d24
c114t17d24
c108t18d24
c124t18d24
c100t18d24
c116t18d24
c110t19d24
c126t19d24
c102t19d24
c118t19d24
c104t16d33
c120t16d33
c96t16d33
c112t16d33
c106t17d33
c122t17d33
c98t17d33
c114t17d33
c108t18d33
c124t18d33
c100t18d33
c116t18d33
c110t19d33
c126t19d33
c102t19d33
c118t19d33
c104t16d42
c120t16d42
c96t16d42
c112t16d42
c106t17d42
c122t17d42
c98t17d42
```

```
c114t17d42
c108t18d42
c124t18d42
c100t18d42
c116t18d42
c110t19d42
c126t19d42
c102t19d42
c118t19d42
END
VOLUME_GROUP: asu1-4 (d3)
STRIPE 8m
VOLUME 1
c104t16d7
c120t16d7
c96t16d7
c112t16d7
c106t17d7
c122t17d7
c98t17d7
c114t17d7
c108t18d7
c124t18d7
c100t18d7
c116t18d7
c110t19d7
c126t19d7
c102t19d7
c118t19d7
c104t16d16
c120t16d16
c96t16d16
c112t16d16
c106t17d16
c122t17d16
c98t17d16
c114t17d16
c108t18d16
c124t18d16
c100t18d16
c116t18d16
c110t19d16
c126t19d16
c102t19d16
c118t19d16
c104t16d25
c120t16d25
c96t16d25
c112t16d25
c106t17d25
c122t17d25
c98t17d25
c114t17d25
c108t18d25
c124t18d25
c100t18d25
c116t18d25
c110t19d25
c126t19d25
c102t19d25
c118t19d25
c104t16d34
c120t16d34
```

```
c96t16d34
c112t16d34
c106t17d34
c122t17d34
c98t17d34
c114t17d34
c108t18d34
c124t18d34
c100t18d34
c116t18d34
c110t19d34
c126t19d34
c102t19d34
c118t19d34
c104t16d43
c120t16d43
c96t16d43
c112t16d43
c106t17d43
c122t17d43
c98t17d43
c114t17d43
c108t18d43
c124t18d43
c100t18d43
c116t18d43
c110t19d43
c126t19d43
c102t19d43
c118t19d43
END
VOLUME_GROUP: asu1-5 (d4)
STRIPE 8m
VOLUME 1
c105t16d1
c121t16d1
c97t16d1
c113t16d1
c107t17d1
c123t17d1
c99t17d1
c115t17d1
c109t18d1
c125t18d1
c101t18d1
c117t18d1
c111t19d1
c127t19d1
c103t19d1
c119t19d1
c105t16d10
c121t16d10
c97t16d10
c113t16d10
c107t17d10
c123t17d10
c99t17d10
c115t17d10
c109t18d10
c125t18d10
c101t18d10
c117t18d10
c111t19d10
```

```
c127t19d10
c103t19d10
c119t19d10
c105t16d19
c121t16d19
c97t16d19
c113t16d19
c107t17d19
c123t17d19
c99t17d19
c115t17d19
c109t18d19
c125t18d19
c101t18d19
c117t18d19
c111t19d19
c127t19d19
c103t19d19
c119t19d19
c105t16d28
c121t16d28
c97t16d28
c113t16d28
c107t17d28
c123t17d28
c99t17d28
c115t17d28
c109t18d28
c125t18d28
c101t18d28
c117t18d28
c111t19d28
c127t19d28
c103t19d28
c119t19d28
c105t16d37
c121t16d37
c97t16d37
c113t16d37
c107t17d37
c123t17d37
c99t17d37
c115t17d37
c109t18d37
c125t18d37
c101t18d37
c117t18d37
c111t19d37
c127t19d37
c103t19d37
c119t19d37
END
VOLUME_GROUP: asu1-6 (d5)
STRIPE 8m
VOLUME 1
c105t16d2
c121t16d2
c97t16d2
c113t16d2
c107t17d2
c123t17d2
c99t17d2
c115t17d2
```

```
c109t18d2
c125t18d2
c101t18d2
c117t18d2
c111t19d2
c127t19d2
c103t19d2
c119t19d2
c105t16d11
c121t16d11
c97t16d11
c113t16d11
c107t17d11
c123t17d11
c99t17d11
c115t17d11
c109t18d11
c125t18d11
c101t18d11
c117t18d11
c111t19d11
c127t19d11
c103t19d11
c119t19d11
c105t16d20
c121t16d20
c97t16d20
c113t16d20
c107t17d20
c123t17d20
c99t17d20
c115t17d20
c109t18d20
c125t18d20
c101t18d20
c117t18d20
c111t19d20
c127t19d20
c103t19d20
c119t19d20
c105t16d29
c121t16d29
c97t16d29
c113t16d29
c107t17d29
c123t17d29
c99t17d29
c115t17d29
c109t18d29
c125t18d29
c101t18d29
c117t18d29
c111t19d29
c127t19d29
c103t19d29
c119t19d29
c105t16d38
c121t16d38
c97t16d38
c113t16d38
c107t17d38
c123t17d38
c99t17d38
```

```
c115t17d38
c109t18d38
c125t18d38
c101t18d38
c117t18d38
c111t19d38
c127t19d38
c103t19d38
c119t19d38
END
VOLUME_GROUP: asu1-7 (d6)
STRIPE 8m
VOLUME 1
c105t16d3
c121t16d3
c97t16d3
c113t16d3
c107t17d3
c123t17d3
c99t17d3
c115t17d3
c109t18d3
c125t18d3
c101t18d3
c117t18d3
c111t19d3
c127t19d3
c103t19d3
c119t19d3
c105t16d12
c121t16d12
c97t16d12
c113t16d12
c107t17d12
c123t17d12
c99t17d12
c115t17d12
c109t18d12
c125t18d12
c101t18d12
c117t18d12
c111t19d12
c127t19d12
c103t19d12
c119t19d12
c105t16d21
c121t16d21
c97t16d21
c113t16d21
c107t17d21
c123t17d21
c99t17d21
c115t17d21
c109t18d21
c125t18d21
c101t18d21
c117t18d21
c111t19d21
c127t19d21
c103t19d21
c119t19d21
c105t16d30
c121t16d30
```

```
c97t16d30
c113t16d30
c107t17d30
c123t17d30
c99t17d30
c115t17d30
c109t18d30
c125t18d30
c101t18d30
c117t18d30
c111t19d30
c127t19d30
c103t19d30
c119t19d30
c105t16d39
c121t16d39
c97t16d39
c113t16d39
c107t17d39
c123t17d39
c99t17d39
c115t17d39
c109t18d39
c125t18d39
c101t18d39
c117t18d39
c111t19d39
c127t19d39
c103t19d39
c119t19d39
END
VOLUME_GROUP: asu1-8 (d7)
STRIPE 8m
VOLUME 1
c105t16d4
c121t16d4
c97t16d4
c113t16d4
c107t17d4
c123t17d4
c99t17d4
c115t17d4
c109t18d4
c125t18d4
c101t18d4
c117t18d4
c111t19d4
c127t19d4
c103t19d4
c119t19d4
c105t16d13
c121t16d13
c97t16d13
c113t16d13
c107t17d13
c123t17d13
c99t17d13
c115t17d13
c109t18d13
c125t18d13
c101t18d13
c117t18d13
c111t19d13
```

```
c127t19d13
c103t19d13
c119t19d13
c105t16d22
c121t16d22
c97t16d22
c113t16d22
c107t17d22
c123t17d22
c99t17d22
c115t17d22
c109t18d22
c125t18d22
c101t18d22
c117t18d22
c111t19d22
c127t19d22
c103t19d22
c119t19d22
c105t16d31
c121t16d31
c97t16d31
c113t16d31
c107t17d31
c123t17d31
c99t17d31
c115t17d31
c109t18d31
c125t18d31
c101t18d31
c117t18d31
c111t19d31
c127t19d31
c103t19d31
c119t19d31
c105t16d40
c121t16d40
c97t16d40
c113t16d40
c107t17d40
c123t17d40
c99t17d40
c115t17d40
c109t18d40
c125t18d40
c101t18d40
c117t18d40
c111t19d40
c127t19d40
c103t19d40
c119t19d40
END
VOLUME_GROUP: asu2-1 (d8)
STRIPE 8m
VOLUME 1
c104t16d0
c120t16d0
c96t16d0
c112t16d0
c106t17d0
c122t17d0
c98t17d0
c114t17d0
```

```
c108t18d0
c124t18d0
c100t18d0
c116t18d0
c110t19d0
c126t19d0
c102t19d0
c118t19d0
c104t16d9
c120t16d9
c96t16d9
c112t16d9
c106t17d9
c122t17d9
c98t17d9
c114t17d9
c108t18d9
c124t18d9
c100t18d9
c116t18d9
c110t19d9
c126t19d9
c102t19d9
c118t19d9
c104t16d18
c120t16d18
c96t16d18
c112t16d18
c106t17d18
c122t17d18
c98t17d18
c114t17d18
c108t18d18
c124t18d18
c100t18d18
c116t18d18
c110t19d18
c126t19d18
c102t19d18
c118t19d18
c104t16d27
c120t16d27
c96t16d27
c112t16d27
c106t17d27
c122t17d27
c98t17d27
c114t17d27
c108t18d27
c124t18d27
c100t18d27
c116t18d27
c110t19d27
c126t19d27
c102t19d27
c118t19d27
c104t16d36
c120t16d36
c96t16d36
c112t16d36
c106t17d36
c122t17d36
c98t17d36
```

```
c114t17d36
c108t18d36
c124t18d36
c100t18d36
c116t18d36
c110t19d36
c126t19d36
c102t19d36
c118t19d36
END
VOLUME_GROUP: asu2-2 (d9)
STRIPE 8m
VOLUME 1
c104t16d1
c120t16d1
c96t16d1
c112t16d1
c106t17d1
c122t17d1
c98t17d1
c114t17d1
c108t18d1
c124t18d1
c100t18d1
c116t18d1
c110t19d1
c126t19d1
c102t19d1
c118t19d1
c104t16d10
c120t16d10
c96t16d10
c112t16d10
c106t17d10
c122t17d10
c98t17d10
c114t17d10
c108t18d10
c124t18d10
c100t18d10
c116t18d10
c110t19d10
c126t19d10
c102t19d10
c118t19d10
c104t16d19
c120t16d19
c96t16d19
c112t16d19
c106t17d19
c122t17d19
c98t17d19
c114t17d19
c108t18d19
c124t18d19
c100t18d19
c116t18d19
c110t19d19
c126t19d19
c102t19d19
c118t19d19
c104t16d28
c120t16d28
```

```
c96t16d28
c112t16d28
c106t17d28
c122t17d28
c98t17d28
c114t17d28
c108t18d28
c124t18d28
c100t18d28
c116t18d28
c110t19d28
c126t19d28
c102t19d28
c118t19d28
c104t16d37
c120t16d37
c96t16d37
c112t16d37
c106t17d37
c122t17d37
c98t17d37
c114t17d37
c108t18d37
c124t18d37
c100t18d37
c116t18d37
c110t19d37
c126t19d37
c102t19d37
c118t19d37
END
VOLUME_GROUP: asu2-3 (d10)
STRIPE 8m
VOLUME 1
c104t16d2
c120t16d2
c96t16d2
c112t16d2
c106t17d2
c122t17d2
c98t17d2
c114t17d2
c108t18d2
c124t18d2
c100t18d2
c116t18d2
c110t19d2
c126t19d2
c102t19d2
c118t19d2
c104t16d11
c120t16d11
c96t16d11
c112t16d11
c106t17d11
c122t17d11
c98t17d11
c114t17d11
c108t18d11
c124t18d11
c100t18d11
c116t18d11
c110t19d11
```

```
c126t19d11
c102t19d11
c118t19d11
c104t16d20
c120t16d20
c96t16d20
c112t16d20
c106t17d20
c122t17d20
c98t17d20
c114t17d20
c108t18d20
c124t18d20
c100t18d20
c116t18d20
c110t19d20
c126t19d20
c102t19d20
c118t19d20
c104t16d29
c120t16d29
c96t16d29
c112t16d29
c106t17d29
c122t17d29
c98t17d29
c114t17d29
c108t18d29
c124t18d29
c100t18d29
c116t18d29
c110t19d29
c126t19d29
c102t19d29
c118t19d29
c104t16d38
c120t16d38
c96t16d38
c112t16d38
c106t17d38
c122t17d38
c98t17d38
c114t17d38
c108t18d38
c124t18d38
c100t18d38
c116t18d38
c110t19d38
c126t19d38
c102t19d38
c118t19d38
END
VOLUME_GROUP: asu2-4 (d11)
STRIPE 8m
VOLUME 1
c104t16d3
c120t16d3
c96t16d3
c112t16d3
c106t17d3
c122t17d3
c98t17d3
c114t17d3
```

```
c108t18d3
c124t18d3
c100t18d3
c116t18d3
c110t19d3
c126t19d3
c102t19d3
c118t19d3
c104t16d12
c120t16d12
c96t16d12
c112t16d12
c106t17d12
c122t17d12
c98t17d12
c114t17d12
c108t18d12
c124t18d12
c100t18d12
c116t18d12
c110t19d12
c126t19d12
c102t19d12
c118t19d12
c104t16d21
c120t16d21
c96t16d21
c112t16d21
c106t17d21
c122t17d21
c98t17d21
c114t17d21
c108t18d21
c124t18d21
c100t18d21
c116t18d21
c110t19d21
c126t19d21
c102t19d21
c118t19d21
c104t16d30
c120t16d30
c96t16d30
c112t16d30
c106t17d30
c122t17d30
c98t17d30
c114t17d30
c108t18d30
c124t18d30
c100t18d30
c116t18d30
c110t19d30
c126t19d30
c102t19d30
c118t19d30
c104t16d39
c120t16d39
c96t16d39
c112t16d39
c106t17d39
c122t17d39
c98t17d39
```

```
c114t17d39
c108t18d39
c124t18d39
c100t18d39
c116t18d39
c110t19d39
c126t19d39
c102t19d39
c118t19d39
END
VOLUME_GROUP: asu2-5 (d12)
STRIPE 8m
VOLUME 1
c105t16d5
c121t16d5
c97t16d5
c113t16d5
c107t17d5
c123t17d5
c99t17d5
c115t17d5
c109t18d5
c125t18d5
c101t18d5
c117t18d5
c111t19d5
c127t19d5
c103t19d5
c119t19d5
c105t16d14
c121t16d14
c97t16d14
c113t16d14
c107t17d14
c123t17d14
c99t17d14
c115t17d14
c109t18d14
c125t18d14
c101t18d14
c117t18d14
c111t19d14
c127t19d14
c103t19d14
c119t19d14
c105t16d23
c121t16d23
c97t16d23
c113t16d23
c107t17d23
c123t17d23
c99t17d23
c115t17d23
c109t18d23
c125t18d23
c101t18d23
c117t18d23
c111t19d23
c127t19d23
c103t19d23
c119t19d23
c105t16d32
c121t16d32
```

```
c97t16d32
c113t16d32
c107t17d32
c123t17d32
c99t17d32
c115t17d32
c109t18d32
c125t18d32
c101t18d32
c117t18d32
c111t19d32
c127t19d32
c103t19d32
c119t19d32
c105t16d41
c121t16d41
c97t16d41
c113t16d41
c107t17d41
c123t17d41
c99t17d41
c115t17d41
c109t18d41
c125t18d41
c101t18d41
c117t18d41
c111t19d41
c127t19d41
c103t19d41
c119t19d41
END
VOLUME_GROUP: asu2-6 (d13)
STRIPE 8m
VOLUME 1
c105t16d6
c121t16d6
c97t16d6
c113t16d6
c107t17d6
c123t17d6
c99t17d6
c115t17d6
c109t18d6
c125t18d6
c101t18d6
c117t18d6
c111t19d6
c127t19d6
c103t19d6
c119t19d6
c105t16d15
c121t16d15
c97t16d15
c113t16d15
c107t17d15
c123t17d15
c99t17d15
c115t17d15
c109t18d15
c125t18d15
c101t18d15
c117t18d15
c111t19d15
```

```
c127t19d15
c103t19d15
c119t19d15
c105t16d24
c121t16d24
c97t16d24
c113t16d24
c107t17d24
c123t17d24
c99t17d24
c115t17d24
c109t18d24
c125t18d24
c101t18d24
c117t18d24
c111t19d24
c127t19d24
c103t19d24
c119t19d24
c105t16d33
c121t16d33
c97t16d33
c113t16d33
c107t17d33
c123t17d33
c99t17d33
c115t17d33
c109t18d33
c125t18d33
c101t18d33
c117t18d33
c111t19d33
c127t19d33
c103t19d33
c119t19d33
c105t16d42
c121t16d42
c97t16d42
c113t16d42
c107t17d42
c123t17d42
c99t17d42
c115t17d42
c109t18d42
c125t18d42
c101t18d42
c117t18d42
c111t19d42
c127t19d42
c103t19d42
c119t19d42
END
VOLUME_GROUP: asu2-7 (d14)
STRIPE 8m
VOLUME 1
c105t16d7
c121t16d7
c97t16d7
c113t16d7
c107t17d7
c123t17d7
c99t17d7
c115t17d7
```

```
c109t18d7
c125t18d7
c101t18d7
c117t18d7
c111t19d7
c127t19d7
c103t19d7
c119t19d7
c105t16d16
c121t16d16
c97t16d16
c113t16d16
c107t17d16
c123t17d16
c99t17d16
c115t17d16
c109t18d16
c125t18d16
c101t18d16
c117t18d16
c111t19d16
c127t19d16
c103t19d16
c119t19d16
c105t16d25
c121t16d25
c97t16d25
c113t16d25
c107t17d25
c123t17d25
c99t17d25
c115t17d25
c109t18d25
c125t18d25
c101t18d25
c117t18d25
c111t19d25
c127t19d25
c103t19d25
c119t19d25
c105t16d34
c121t16d34
c97t16d34
c113t16d34
c107t17d34
c123t17d34
c99t17d34
c115t17d34
c109t18d34
c125t18d34
c101t18d34
c117t18d34
c111t19d34
c127t19d34
c103t19d34
c119t19d34
c105t16d43
c121t16d43
c97t16d43
c113t16d43
c107t17d43
c123t17d43
c99t17d43
```

```
c115t17d43
c109t18d43
c125t18d43
c101t18d43
c117t18d43
c111t19d43
c127t19d43
c103t19d43
c119t19d43
END
VOLUME_GROUP: asu2-8 (d15)
STRIPE 8m
VOLUME 1
c105t16d8
c121t16d8
c97t16d8
c113t16d8
c107t17d8
c123t17d8
c99t17d8
c115t17d8
c109t18d8
c125t18d8
c101t18d8
c117t18d8
c111t19d8
c127t19d8
c103t19d8
c119t19d8
c105t16d17
c121t16d17
c97t16d17
c113t16d17
c107t17d17
c123t17d17
c99t17d17
c115t17d17
c109t18d17
c125t18d17
c101t18d17
c117t18d17
c111t19d17
c127t19d17
c103t19d17
c119t19d17
c105t16d26
c121t16d26
c97t16d26
c113t16d26
c107t17d26
c123t17d26
c99t17d26
c115t17d26
c109t18d26
c125t18d26
c101t18d26
c117t18d26
c111t19d26
c127t19d26
c103t19d26
c119t19d26
c105t16d35
c121t16d35
```

```
c97t16d35
c113t16d35
c107t17d35
c123t17d35
c99t17d35
c115t17d35
c109t18d35
c125t18d35
c101t18d35
c117t18d35
c111t19d35
c127t19d35
c103t19d35
c119t19d35
c105t16d44
c121t16d44
c97t16d44
c113t16d44
c107t17d44
c123t17d44
c99t17d44
c115t17d44
c109t18d44
c125t18d44
c101t18d44
c117t18d44
c111t19d44
c127t19d44
c103t19d44
c119t19d44
END
VOLUME_GROUP: asu3-1 (d16)
STRIPE 8m
VOLUME 1
c104t16d8
c120t16d8
c96t16d8
c112t16d8
c106t17d8
c122t17d8
c98t17d8
c114t17d8
c108t18d8
c124t18d8
c100t18d8
c116t18d8
c110t19d8
c126t19d8
c102t19d8
c118t19d8
c104t16d17
c120t16d17
c96t16d17
c112t16d17
c106t17d17
c122t17d17
c98t17d17
c114t17d17
c108t18d17
c124t18d17
c100t18d17
c116t18d17
c110t19d17
```

```
c126t19d17
c102t19d17
c118t19d17
c104t16d26
c120t16d26
c96t16d26
c112t16d26
c106t17d26
c122t17d26
c98t17d26
c114t17d26
c108t18d26
c124t18d26
c100t18d26
c116t18d26
c110t19d26
c126t19d26
c102t19d26
c118t19d26
c104t16d35
c120t16d35
c96t16d35
c112t16d35
c106t17d35
c122t17d35
c98t17d35
c114t17d35
c108t18d35
c124t18d35
c100t18d35
c116t18d35
c110t19d35
c126t19d35
c102t19d35
c118t19d35
c104t16d44
c120t16d44
c96t16d44
c112t16d44
c106t17d44
c122t17d44
c98t17d44
c114t17d44
c108t18d44
c124t18d44
c100t18d44
c116t18d44
c110t19d44
c126t19d44
c102t19d44
c118t19d44
END
VOLUME_GROUP: asu3-2 (d17)
STRIPE 8m
VOLUME 1
c105t16d0
c121t16d0
c97t16d0
c113t16d0
c107t17d0
c123t17d0
c99t17d0
c115t17d0
```

```
c109t18d0
c125t18d0
c101t18d0
c117t18d0
c111t19d0
c127t19d0
c103t19d0
c119t19d0
c105t16d9
c121t16d9
c97t16d9
c113t16d9
c107t17d9
c123t17d9
c99t17d9
c115t17d9
c109t18d9
c125t18d9
c101t18d9
c117t18d9
c111t19d9
c127t19d9
c103t19d9
c119t19d9
c105t16d18
c121t16d18
c97t16d18
c113t16d18
c107t17d18
c123t17d18
c99t17d18
c115t17d18
c109t18d18
c125t18d18
c101t18d18
c117t18d18
c111t19d18
c127t19d18
c103t19d18
c119t19d18
c105t16d27
c121t16d27
c97t16d27
c113t16d27
c107t17d27
c123t17d27
c99t17d27
c115t17d27
c109t18d27
c125t18d27
c101t18d27
c117t18d27
c111t19d27
c127t19d27
c103t19d27
c119t19d27
c105t16d36
c121t16d36
c97t16d36
c113t16d36
c107t17d36
c123t17d36
c99t17d36
```

```
    c115t17d36
    c109t18d36
    c125t18d36
    c101t18d36
    c117t18d36
    c111t19d36
    c127t19d36
    c103t19d36
    c119t19d36
    END
```

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

This benchmark measurement utilized more than the default number of JVMs, which required the two SPC-1 Workload Generator command and parameter files listed below. The first file was used for the Metrics and Repeatability Tests. The second file was used for Persistence Test Run 1.

SPC-1 Workload Generator Commands and Parameters File: Metrics and Repeatability Tests

```
javaparms="-Xmx1024m -Xms1024m -Xss512k"
host=master
slaves=(h1,h2,h3,h4,h5,h6,h7,h8,h9,h10,h11,h12,h13,h14,h15,h16,h17,h18,h19,h20,h21,
h22,h23,h24,h25,h26,h27,h28,h29,h30,h31,h32,h33,h34,h35,h36,h37,h38,h39,h40,h41,h42
,h43,h44)
sd=asu1_1,lun=/dev/md/rdsk/d0,size=639.95g
sd=asu1_2,lun=/dev/md/rdsk/d1,size=639.95g
sd=asu1_3,lun=/dev/md/rdsk/d2,size=639.95g
sd=asu1_4,lun=/dev/md/rdsk/d3,size=639.95g
sd=asu1_5,lun=/dev/md/rdsk/d4,size=639.95g
sd=asu1_6,lun=/dev/md/rdsk/d5,size=639.95g
sd=asu1_7,lun=/dev/md/rdsk/d6,size=639.95g
sd=asu1_8,lun=/dev/md/rdsk/d7,size=639.95g
sd=asu2_1,lun=/dev/md/rdsk/d8,size=639.95g
sd=asu2_2,lun=/dev/md/rdsk/d9,size=639.95g
sd=asu2_3,lun=/dev/md/rdsk/d10,size=639.95g
sd=asu2_4,lun=/dev/md/rdsk/d11,size=639.95g
sd=asu2_5,lun=/dev/md/rdsk/d12,size=639.95g
sd=asu2_6,lun=/dev/md/rdsk/d13,size=639.95g
sd=asu2_7,lun=/dev/md/rdsk/d14,size=639.95g
sd=asu2_8,lun=/dev/md/rdsk/d15,size=639.95g
sd=asu3_1,lun=/dev/md/rdsk/d16,size=569.083g
sd=asu3_2,lun=/dev/md/rdsk/d17,size=569.083g
```

SPC-1 Workload Generator Commands and Parameters File: Persistence Test Run 1

```
javaparms="-Xmx1024m -Xms1024m -Xss512k"
sd=asu1_1,lun=/dev/md/rdsk/d0,size=639.95g
sd=asu1_2,lun=/dev/md/rdsk/d1,size=639.95g
sd=asu1_3,lun=/dev/md/rdsk/d2,size=639.95g
sd=asu1_4,lun=/dev/md/rdsk/d3,size=639.95g
sd=asu1_5,lun=/dev/md/rdsk/d4,size=639.95g
sd=asu1_6,lun=/dev/md/rdsk/d5,size=639.95g
sd=asu1_7,lun=/dev/md/rdsk/d6,size=639.95g
sd=asu1_8,lun=/dev/md/rdsk/d7,size=639.95g
sd=asu2_1,lun=/dev/md/rdsk/d8,size=639.95g
sd=asu2_2,lun=/dev/md/rdsk/d9,size=639.95g
sd=asu2_3,lun=/dev/md/rdsk/d10,size=639.95g
sd=asu2_4,lun=/dev/md/rdsk/d11,size=639.95g
sd=asu2_5,lun=/dev/md/rdsk/d12,size=639.95g
sd=asu2_6,lun=/dev/md/rdsk/d13,size=639.95g
sd=asu2_7,lun=/dev/md/rdsk/d14,size=639.95g
sd=asu2_8,lun=/dev/md/rdsk/d15,size=639.95g
sd=asu3_1,lun=/dev/md/rdsk/d16,size=569.083g
sd=asu3_2,lun=/dev/md/rdsk/d17,size=569.083g
```

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_060223.sh
```

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

```
./run_fdr_060223_persist2.sh
```

Listed below are the scripts invoked by the above commands and subsequent scripts invoked and files used in the scripts.

Main SPC-1 Benchmark Script: "run_fdr_060223.sh"

```
cp –f SPC1.cfg.sl44 SPC1.cfg
./startslaves.sh
#metric
java -Xms1024m -Xmx1024m -Xss512k metrics -b 2175 -s 600
#repeat-1
java -Xms1024m -Xmx1024m -Xss512k repeat1 -b 2175 -s 600
#repeat-2
java -Xms1024m -Xmx1024m -Xss512k repeat2 -b 2175 -s 600
#persist1
./killslaves.sh
cp –f SPC1.cfg.mam SPC1.cfg
java -Xmx1024m -Xms1024m -Xss512k persist1 –b 2175
#
mv persistence1 persist1_060223_2175
mv metrics metrics_060223_2175
mv repeatability1 repeat1_060223_2175
mv repeatability2 repeat2_060223_2175
```

SPC-1 Persistence Test Run 2 Benchmark Script: "run_fdr_060223_persist2.sh"

```
#persist-2
java -Xmx1024m -Xms1024m -Xss512k persist2
#
mv persistence2 persist2_060223_2175
mv SPCOut SPCOut_060223_2175
```

Create Slaves Script: "createslaves.sh"

```
#!/bin/ksh
i=1
while (( $i < 45 ))
do
    FILE=h${i}.txt
echo "master=192.168.10.51" > $FILE
echo "host=h$i" >> $FILE
echo "sd=asu1_1,lun=/dev/md/rdsk/d0,size=639.95g" >> $FILE
echo "sd=asu1_2,lun=/dev/md/rdsk/d1,size=639.95g" >> $FILE
echo "sd=asu1_3,lun=/dev/md/rdsk/d2,size=639.95g" >> $FILE
echo "sd=asu1_4,lun=/dev/md/rdsk/d3,size=639.95g" >> $FILE
```

```
echo "sd=asu1_5,lun=/dev/md/rdsk/d4,size=639.95g" >> $FILE
echo "sd=asu1_6,lun=/dev/md/rdsk/d5,size=639.95g" >> $FILE
echo "sd=asu1_7,lun=/dev/md/rdsk/d6,size=639.95g" >> $FILE
echo "sd=asu1_8,lun=/dev/md/rdsk/d7,size=639.95g" >> $FILE
echo "sd=asu2_1,lun=/dev/md/rdsk/d8,size=639.95g" >> $FILE
echo "sd=asu2_2,lun=/dev/md/rdsk/d9,size=639.95g" >> $FILE
echo "sd=asu2_3,lun=/dev/md/rdsk/d10,size=639.95g" >> $FILE
echo "sd=asu2_4,lun=/dev/md/rdsk/d11,size=639.95g" >> $FILE
echo "sd=asu2_5,lun=/dev/md/rdsk/d12,size=639.95g" >> $FILE
echo "sd=asu2_6,lun=/dev/md/rdsk/d13,size=639.95g" >> $FILE
echo "sd=asu2_7,lun=/dev/md/rdsk/d14,size=639.95g" >> $FILE
echo "sd=asu2_8,lun=/dev/md/rdsk/d15,size=639.95g" >> $FILE
echo "sd=asu3_1,lun=/dev/md/rdsk/d16,size=569.083g" >> $FILE
echo "sd=asu3_2,lun=/dev/md/rdsk/d17,size=569.083g" >> $FILE
    (( i+=1 ))
done
```

Start Slaves Script: "startslaves.sh"

```
#!/bin/ksh
i=1
while (( $i < 45 ))
do
   java -Xmx1024m -Xms1024m -Xss512k spc1 -f h${i}.txt &
   (( i+=1 ))
done
```

Stop Slaves Script: "killslaves.sh"

```
ps -ef|grep java|grep txt|awk '{print $2}'|xargs -n1 kill
```

APPENDIX F: THIRD-PARTY QUOTATIONS

Emulex LP 10000 Fibre Channel HBAs

Micro2nds

Customer Name & Address:
Fujitsu Computer Systems Corporation
1250 E. Arques Avenue
Sunnyvale, CA 94088
Contact Name: Amin Ismail

QUOTE DATE: 2/24/06
QUOTE NO: 036882
QUOTE TERMS: Valid for 30 Days

QUOTE

ITEM NO	QTY	PART NO	DESCRIPTION	PRICE EA	TOTAL AMOUNT
1	16	LP10000	Emulex Host Bus Adapter	$850.00	$13,600.00

Total Amount:	$13,600.00
Tax Amount:	$0.00
Discount Amount:	$0.00
Shipping Cost:	$0.00
Grand Total:	**$13,600.00**

Comments:
All applicable taxes will apply. Hardware cost does not reflect Shipping and handling cost. Parts are subject to availability.
Please reflect quote no on purchase orders and invoices.

ACCEPTED BY:
FUJITSU COMPUTER SYSTEMS

SIGNATURE: _____
NAME: _____
TITLE: _____
DATE: _____

P.O Box 4716, Scottsdale, AZ 85261-4716
Phone: 480-314-5448. Fax: 480-314-5449
E-Mail: info@micro2nds.com

Emulex LP 11000 Fibre Channel HBAs

Info X
Technology Solutions

QUOTE

ORDER NUMBER: 0070311
ORDER DATE: 11/3/2005

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

CUSTOMER NO: FUJTS

SOLD TO:

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

SHIP TO:

Fujitsu Computer Systems
Account Payable-MS 141
1250 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 EMC 4Gb PCI-X Single	EACH 3.3V Signaling, 5V Tolerant	16	0	0	869.72	13,915.52
LP11000-M4 Emulex 4Gb PCI-X Single In Stock	EACH 3.3V Signaling, 5V Tolerant	16	0	0	861.00	13,776.00
LP11002-E EMC 4Gb PCI-X Dual In Stock	EACH 3.3V Sign / 5V Tol	16	0	0	1,172.33	18,757.28
LP11002-M4 Emulex 4Gb PCI-X Dual In Stock	EACH 3.3V Sign / 5V Tol	16	0	0	1,417.50	22,680.00

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:	69,128.80
Less Discount:	0.00
Shipping & Handling:	0.00
Sales Tax:	0.00
Order Total:	**69,128.80**

EMULEX qlogic jni LSI LOGIC CambeX EMERSON

Call 1-800-463-9998 for all your Fibre Channel Needs

Important Notice: Customers purchasing EMC Certified HBAs must supply Info X with the following information: EMC Storage system (i.e. Symmetrix or CLARiiON) and the Operating System on the Host Server. Info X will not process orders without this information.

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

www.info-x.com

Date Accepted:_____