SPC Benchmark 1™
Full Disclosure Report

3PARdata, Inc.
3PAR InServ™ S800 X-Series *(8-Node)*

SPC-1 V1.8

Submitted for Review: March 8, 2004
Submission Identifier: A00027
Accepted: May 7, 2004

First Edition – March 2004

Trademarks

SPC Benchmark 1, SPC-1 IOPS, and SPC-1 LRT are trademarks of the Storage Performance Council. 3PAR and the 3PAR logo are registered trademarks of 3PARdata, Inc. in the United States and other countries. All other brands, trademarks, and product names are the property of their respective owners.

Notes

The following terms, used in this document, are defined as:

- Kilobyte (KB) is equal to 1,000 (10^3) bytes.

- Megabyte (MB) is equal to 1,000,000 (10^6) bytes.

- Gigabyte (GB) is equal to 1,000,000,000 (10^9) bytes.

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

Table of Contents

AUDIT CERTIFICATION

3PARdata, Inc.
Le My
4209 Technology Drive
Fremont, CA 94538

March 7, 2004

The SPC Benchmark 1™ results listed below for the 3PAR InServ™ S800 X-Series *(8-Node)* were produced in compliance with the SPC Benchmark 1™ V1.8 Onsite Audit requirements.

SPC Benchmark 1™ V1.8 Results	
Tested Storage Configuration (TSC) Name: 3PAR InServ™ S800 X-Series *(8-Node)*	
Metric	**Reported Result**
SPC-1 IOPS™	100,045.74
SPC-1 Price-Performance	$14.81/SPC-1 IOPS™
Total ASU Capacity	16,468.672 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$1,482,977

The following SPC Benchmark 1™ Onsite Audit requirements were reviewed and found compliant with V1.8 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by physical inspection and information supplied by 3PARdata, Inc.:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).

- The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with

- Physical verification of the components to mach the above diagram.

- 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 verified by physical inspection and information supplied by 3PARdata, Inc.:

  - ✓ 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 execution of Test, Test Phase, and Test Run was observed and found compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification.

- The Test Results Files and resultant Summary Results Files received 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.

Audit Notes:

There were no additional audit notes or exceptions.

Respectfully,

Walter E. Baker

Walter E. Baker
SPC Auditor

SPC BENCHMARK 1™ V1.8   FULL DISCLOSURE REPORT   Submitted for Review: MARCH 8, 2004
3PARdata, Inc.   Submission Identifier: A00027
3PAR InServ™ S800 X-Series *(8-Node)*   Accepted: MAY 7, 2004
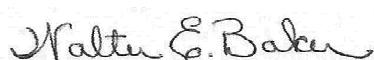
LETTER OF GOOD FAITH

3PAR

Serving Information

Date: February 28, 2004

From: Jeff Price
Vice President of Engineering
3PARdata, Inc.
4209 Technology Drive
Fremont, CA 94538

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

Subject: SPC-1 Letter of Good Faith for the 3PAR InServ™ S800 X-Series
(8-Node, Mirroring, 36GB drives)

3PARdata, Inc. is the SPC-1 Test Sponsor for the above listed product. To the best of
our knowledge and belief, the required SPC-1 benchmark results and materials we have
submitted for that product are complete, accurate, and in full compliance with V1.8 of the
SPC-1 benchmark specification.

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

Signed: **Date:**

_____   2/29/04
Jeff Price   **Date of Signature**
Vice President of Engineering

3PARdata, Inc.   510.413.5999   Main
4209 Technology Drive   510.354.3071   Fax
Fremont, CA 94538   www.3par.com

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	3PARdata, Inc. – www.3par.com Le My – le.my@3pardata.com 4209 Technology Drive Fremont, CA 94538 Phone: 510.413.5999 FAX: 510.413.5998
Test Sponsor Alternate Contact	3PARdata, Inc. – www.3par.com Geoff Hough – geoff.hough@3pardata.com 4209 Technology Drive Fremont, CA 94538 Phone: 510.413.5999 FAX: 510.413.9596
Auditor	Storage Performance Council – 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	V1.8
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	March 8, 2004
Date FDR was submitted to the SPC	March 8, 2004
Date the TSC is/was available for shipment to customers	March 8, 2004
Date the TSC completed audit certification	March 7, 2004

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: 3PAR InServ™ S800 X-Series *(8-Node)*	
Metric	**Reported Result**
SPC-1 IOPS™	100,045.74
SPC-1 Price-Performance	$14.81/SPC-1 IOPS™
Total ASU Capacity	16,468.672 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$1,482,977

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, maintained on separate disks.

Storage Capacities and Relationships

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

Physical Capacity 35,415.571 GB				
Configured Capacity 32,985.348 GB			Unused Storage 1,033.97 GB	Required Storage
Addressable Capacity 16,492.674 GB		Addressable Mirror 16,492.674 GB		1,372.242 GB
ASU Capacity 16,468.672 GB	U n u s e d			
ASU 1 7,421.702 GB	ASU 2 7,421.702 GB	ASU 3 1,625.268 GB		

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 the 100% load point cannot exceed 30 milliseconds or the benchmark measurement is invalid.
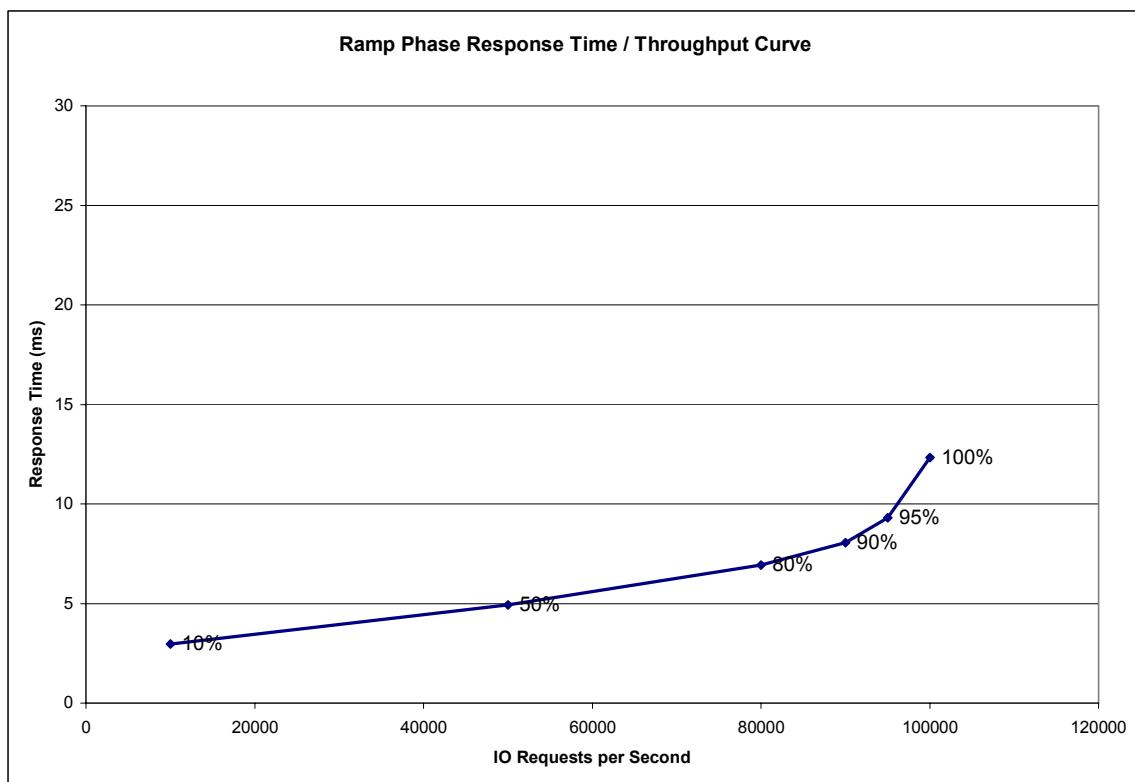
Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	10,001.51	49,991.03	80,008.24	90,019.75	94,996.20	100,045.74
Average Response Time (ms):						
All ASUs	2.96	4.93	6.94	8.06	9.31	12.34
ASU-1	3.90	6.50	9.13	10.54	11.48	13.59
ASU-2	3.19	6.32	9.00	9.88	11.11	13.18
ASU-3	0.88	1.01	1.38	1.99	3.91	9.30
Reads	6.25	11.08	15.59	17.42	18.28	19.33
Writes	0.82	0.93	1.30	1.96	3.46	7.78

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Item	Description	Qty	Price
980-0021-01	2400-MHZ CONTROLLER NODE (X-SERIES)	6	
980-0005-01	2048MB DATA CACHE (2 X 1024 DIMMS)	32	
980-0006-01	2-PORT FIBRE CHANNEL ADAPTER	25	
980-0012-01	4-PORT FIBRE CHANNEL ADAPTER	16	
980-0020-01	INSERV S800 BASE MODEL (X-SERIES)	1	
981-0001-01	10-BAY DRIVE CHASSIS	23	
981-0009-01	4 X 36GB DRIVE MAGAZINE (10K RPM)	240	
982-0003-01	10-METER CABLE (LC-LC)	97	
982-0008-01	2M CABINET KIT (WITH REDUNDANT PDU PAIR)	3	
982-0009-01	2-METER CABLE (LC-LC)	8	
982-0010-01	4-METER CABLE (LC-LC)	48	
982-0014-01	REGIONAL KIT, NORTH AMERICA	4	
985-0001-01	SERVICE PROCESSOR	1	
987-0003-01	EXPRESS SUITE (S800)	8	
985-0005-01	INSTALLATION AND SET-UP 8-NODES	1	
985-0050-01	3PAR ADVANTAGE	8	
	3PAR InServ S800 Storage Server (X-Series) Package	**1**	**$ 1,413,798**
QLA2342	**Qlogic 2Gbit/s Fibre Channel to PCI-X Host Bus Adapters with 3 year-maintenance**	**29**	**$ 68,179**

	Total Cost (including 3-year maintenance)		**$ 1,481,977**

Third-party price quotations for the QLogic Host Bus Adapters and support for those adapters may be found on page 60, "Appendix E: Third-Party Price Quotations".

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

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

Benchmark Configuration/Tested Storage Configuration Diagram

HS-1 *(Master)*

HS-2/3/4 *(Slaves)*

HS-5/6/7/8 *(Slaves)*

SC-1
***3PAR InServ™ S800 X-Series** (8-Node)*
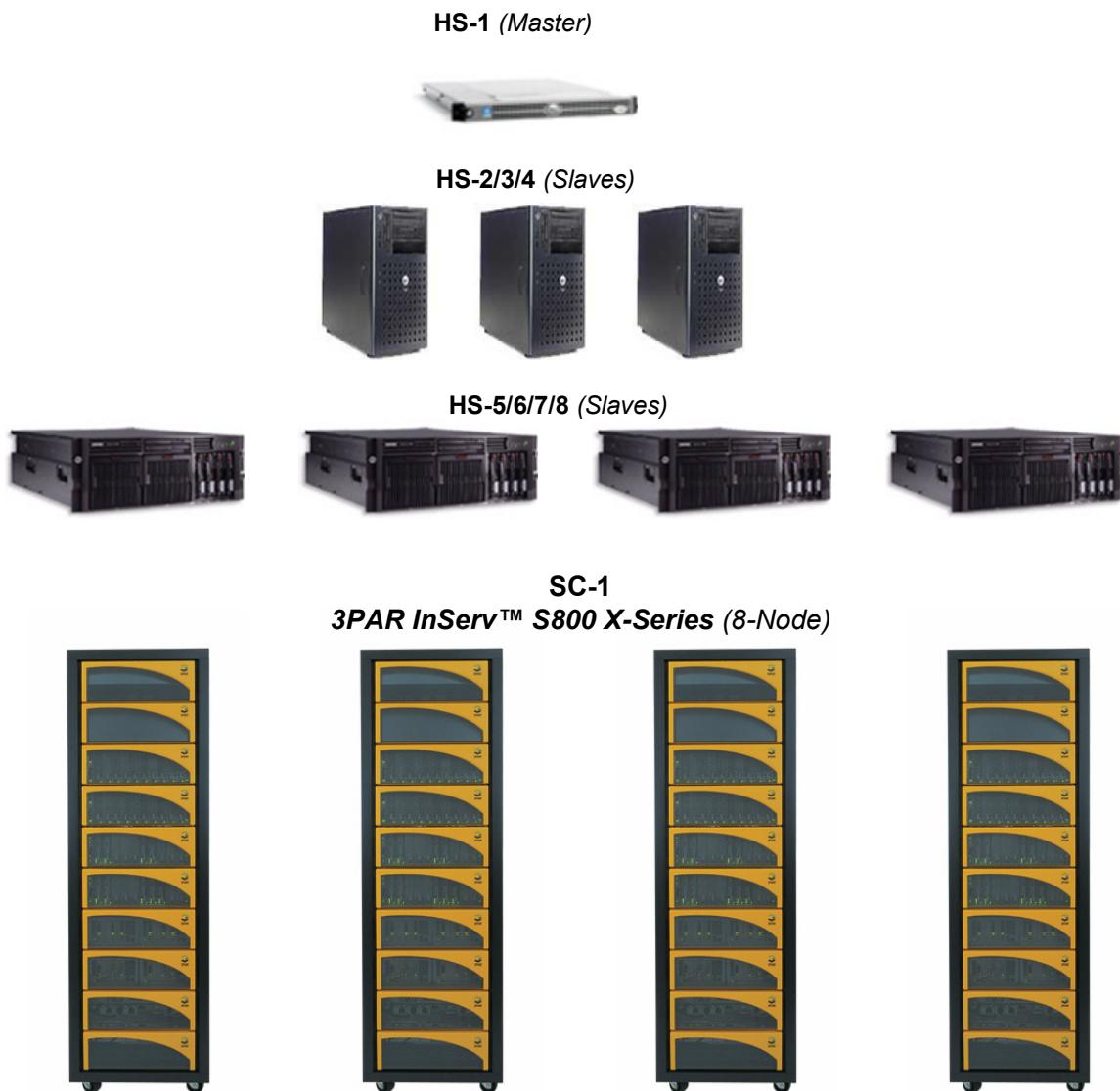
Benchmark Configuration/Tested Storage Configuration Details

Host Systems:	Tested Storage Configuration (TSC):
HS-1: _Dell PowerEdge PE1750_	1 – Qlogic QLA242 dual port HBAs *(HS-1)*
2 – Intel Xeon 2.4 GHz CPUs – 512 KB L2/CPU	12 – Qlogic QLA242 dual port HBAs *(HS-2/3/4)*
4 GB Main Memory	16 – Qlogic QLA242 dual port HBAs *(HS-5/6/7/8)*
Microsoft ® Windows ® 2000 Advanced Server with Service Pack 4	**SC-S800: _3PAR InServ™ S800 X-Series_ *(8-Node)***
WG	8 – 3PAR X-Series Controller Nodes
HS-2/3/4: _Dell PowerEdge PE1600SC_	16 GB Control Cache *(2 GB/node)*
2 – Intel Xeon 2.4 GHz CPUs – 512 KB L2/CPU	64 GB Data Cache *(8 GB/node)*
4 GB Main Memory	64 – 2 Gbs Front-End FC Host Ports *(8 ports/node)*
Microsoft® Windows® 2003 Server, Enterprise Edition	48 – 1 Gbs Backend Disk Port *(6 ports/node)*
WG	24 – 10-bay Drive Chassis
HS-5/6/7/8: _HP Proliant DL580 G2_	240 – 4 x 36 GB Drive Magazines *(10K RPM, FC)*
4 – Intel Xeon 2.5 GHz CPUs – 512 KB L2/CPU	3PAR Express Suite (S800)
4 GB Main Memory	Fibre Channel
Microsoft® Windows® 2003 Server, Enterprise Edition	
WG	

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 13 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Storage Network Configuration

Clause 9.2.4.4.2

If a storage network is employed in the BC/TSC, the FDR shall contain a topology diagram… . This diagram should include, but is not limited to the following components:

1.   *Storage Controller and Domain Controllers (see Clause 9.2.4.4.1)*

2.   *Host Systems (see Clause 9.2.4.4.1)*

3.   *Routers and Bridges*

4.   *Hubs and Switches*

5.   *HBAs to Host Systems and Front End Port to Storage Controllers*

Additionally the diagram shall:

- *Illustrate the physical connection between components.*

- *Describe the type of each physical connection.*

- *Describe the network protocol used over each physical connection.*

- *The maximum theoretical transfer rate of each class of interconnect used in the configuration.*

- *Correlate with the BC Configuration Diagram in Clause 9.2.4.4.1.*

The Test Sponsor shall additionally supply (referenced in an appendix) a wiring diagram of the physical connections and physical port assignments used in the storage network. The diagram should allow anyone to exactly replicate the physical configuration of the storage network.

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 13 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Customer Tuning 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.

Operating System Configuration

"Appendix A: Operating System Configuration" on page 50 contains the operating systems parameters that were changed for the benchmark measurement.

Host Bus Adapter (HBA) Configuration

"Appendix B: Host Bus Adapter (HBA) Configuration" on page 51 contains the HBA configuration parameters that were changed for the benchmark measurement.

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 Benchmark Configuration (BC) diagram in Clause 9.2.4.4.1 and, if applicable, 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.*

In addition the FDR may include listings of scripts and/or commands used to configure the physical components that comprise the TSC.

"Appendix C: Tested Storage Configuration (TSC) Creation" on page 52 contains the script used 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 55.

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).

User Data Copy: An identical copy of user data maintained on separate disks.

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.

Storage Capacities and Relationships

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)	16,468.672
Addressable Storage Capacity	Gigabytes (GB)	16,492.674
Configured Storage Capacity	Gigabytes (GB)	32,985.348
Physical Storage Capacity	Gigabytes (GB)	35.415.57
User Data Copy (Mirroring)	Gigabytes (GB)	16,492.674
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	1,372.242
Total Unused Storage	Gigabytes (GB)	1,057.978

The Physical Storage Capacity consisted of the following:

- 680 disk drives, each with a formatted capacity of 36.969 GB

- 280 disk drives, each with a formatted capacity of 36.703 GB

SPC-1 Storage Capacities and Relationships Illustration

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

Physical Capacity 35,415.571 GB					
Configured Capacity 32,985.348 GB				Unused Storage 1,033.97 GB	Required Storage
Addressable Capacity 16,492.674 GB		Addressable Mirror 16,492.674 GB			1,372.242 GB
ASU Capacity 16,468.672 GB		Unused			
ASU 1 7,421.702 GB	ASU 2 7,421.702 GB	ASU 3 1,625.268 GB			
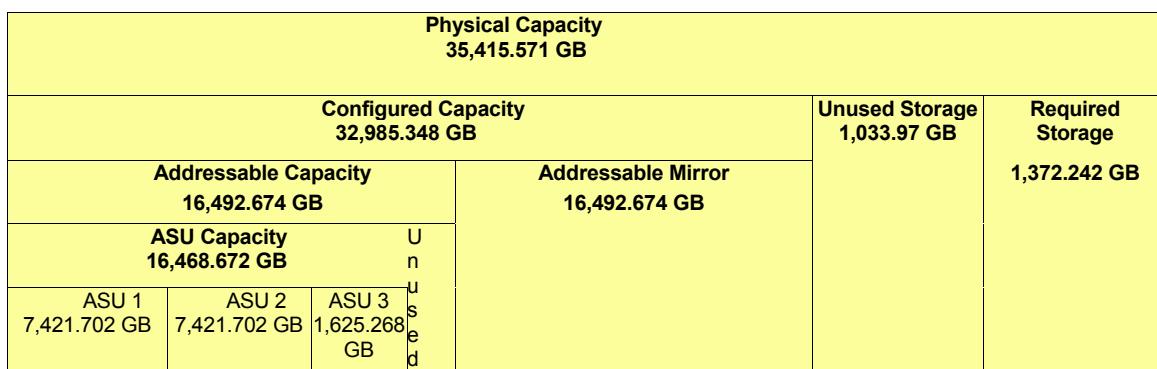
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	99.85%	49.93%	46.50%
User Data Copy (Mirror)		50.00%	46.57%
Addressable Storage Capacity		50.00%	46.57%
Required Storage		4.16%	3.87%
Configured Storage Capacity			93.14%
Global Storage Overhead			0.00%
Unused Storage	0.29%	0.15%	2.99%

The Addressable Storage Capacity contained 48.003 GB (0.29%) of Unused Storage. The Configured Storage Capacity contained 48.003 GB (0.15%) of Unused Storage. Required Storage consisted of the following:

- Spares: 869.730 GB
- Admin RAID1 volume: 21.474 GB
- 8 logging RAID1 devices: 343.597 GB
- Power-fail logging RAID1 devices: 137.438 GB

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 (7,421.702 GB)	**ASU-2 (7,421.702 GB)**	**ASU-3 (1,625.268 GB)**
72 Logical Volumes 103.079215104 GB per Logical Volume (103.07920GB used/Logical Volume)	24 Logical Volumes 309.237645312 GB per Logical Volume (309.23760 GB used/Logical Volume)	24 Logical Volumes 68.719476736 GB per Logical Volume (67.71950 GB used/Logical Volume)

The Data Protection Level used for all Logical Volumes was Mirroring as described on page 10. See "ASU Configuration" in the **IOPS Test Results File** for more detailed configuration information.

SPC-1 BENCHMARK EXECUTION RESULTS

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.*

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.*

Measurement Interval: *The finite and contiguous time period, after the Tested Storage Configuration (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.*

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. Comment: Steady Stated is achieved only after caches in the TSC have filled and as a result the I/O Request throughput of the TSC has stabilized.*

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

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.*

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 Figure 5-1 below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.*

Sustainability Test Phase

Clause 5.4.2.1

The Sustainability Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of three (3) hours. The intent is to demonstrate a sustained maximum I/O Request Throughput as well as insuring the Tested Storage Configuration (TSC) has reached steady state prior to measuring the maximum I/O Request Throughput (SPC-1™ IOPS).

The reported I/O Request Throughput of the Sustainability Test Run must be within 5% of the reported SPC-1™ IOPS primary metric. The Average Response Time measured in Sustainability Test Run cannot exceed thirty (30) milliseconds.

Clause 9.2.4.7.1

For the Sustainability Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

The following SPC-1 Workload Generator input parameters were used for the Sustainability, IOPS, and Response Time Ramp Test Runs :

java -Xmx512m -Xms512m -Xss512k metrics -b 2001 -t 10920 -r 720 -s 360

## 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	23:40:15	23:46:15	0-2	0:06:00
Measurement Interval	23:46:15	2:46:17	3-182	3:00:02

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	820.69	318.78	87.70	414.21	63	820.33	318.39	87.82	414.12	126	819.38	318.82	87.32	413.24
1	820.78	318.72	87.33	414.74	64	821.34	318.71	87.46	415.17	127	821.57	318.88	87.50	415.19
2	821.23	318.90	87.39	414.94	65	820.85	319.07	87.82	413.97	128	820.43	319.34	87.65	413.45
3	821.75	319.38	87.82	414.54	66	820.43	318.49	87.93	414.01	129	820.73	318.89	87.74	414.10
4	820.93	318.72	87.84	414.36	67	822.37	318.95	87.43	415.99	130	820.71	318.95	87.68	414.08
5	821.08	319.26	87.30	414.52	68	821.35	318.92	87.77	414.66	131	821.88	319.27	87.51	415.09
6	821.27	318.36	87.58	415.32	69	820.07	318.47	87.83	413.77	132	821.39	318.74	87.76	414.89
7	820.29	318.65	87.42	414.22	70	821.20	318.62	87.67	414.91	133	820.89	318.55	87.80	414.54
8	821.30	318.90	87.70	414.70	71	821.48	319.18	87.82	414.48	134	820.16	319.06	87.76	413.34
9	821.45	319.00	87.65	414.81	72	822.11	319.02	88.04	415.05	135	820.51	318.58	87.47	414.47
10	820.26	318.88	87.44	413.94	73	820.43	318.89	87.52	414.03	136	820.60	318.72	87.92	413.95
11	821.21	319.22	87.61	414.38	74	822.85	319.28	87.82	415.75	137	820.77	318.91	87.80	414.06
12	820.73	319.11	87.43	414.20	75	820.59	318.74	87.84	414.02	138	822.39	318.98	87.99	415.42
13	821.05	319.15	87.63	414.27	76	820.75	318.80	87.79	414.16	139	820.70	318.87	87.84	413.98
14	821.24	318.99	87.67	414.58	77	820.63	318.89	87.86	413.88	140	821.75	318.88	87.62	415.24
15	821.93	318.99	87.53	415.41	78	820.74	318.88	87.65	414.21	141	820.70	318.87	87.82	414.00
16	820.39	318.76	87.64	414.00	79	822.15	318.80	87.73	415.62	142	820.75	318.56	87.62	414.57
17	821.10	318.21	87.42	415.47	80	821.12	318.43	87.74	414.95	143	820.02	318.64	87.87	413.51
18	820.88	318.55	87.98	414.35	81	821.65	319.30	87.58	414.77	144	820.39	318.62	87.61	414.17
19	820.77	318.54	87.74	414.48	82	821.06	318.95	87.54	414.57	145	821.02	318.71	87.93	414.38
20	820.51	318.47	87.86	414.18	83	819.96	318.10	87.58	414.29	146	820.61	319.00	87.39	414.23
21	821.57	318.64	87.93	415.00	84	820.80	318.61	87.45	414.74	147	821.22	318.58	87.54	415.10
22	820.28	318.60	87.68	414.00	85	820.92	318.99	87.77	414.16	148	820.98	318.59	87.89	414.50
23	821.47	319.01	87.56	414.90	86	822.06	319.41	87.78	414.86	149	821.12	318.67	87.80	414.66
24	819.95	318.09	87.74	414.12	87	821.15	318.91	87.78	414.46	150	820.02	318.71	87.32	413.98
25	821.50	318.84	88.11	414.55	88	822.14	319.44	87.92	414.78	151	821.45	318.59	87.75	415.10
26	821.68	318.75	87.66	415.27	89	821.47	318.79	87.82	414.85	152	820.97	318.75	87.79	414.43
27	820.39	318.99	87.30	414.09	90	820.53	318.55	87.64	414.35	153	820.97	319.09	87.55	414.32
28	820.57	318.72	87.46	414.40	91	820.84	318.74	87.51	414.59	154	820.62	318.64	87.40	414.58
29	820.76	319.24	87.48	414.05	92	821.24	319.10	87.93	414.21	155	820.58	318.70	87.86	414.02
30	821.78	318.80	87.68	415.31	93	820.35	319.03	87.62	413.70	156	821.23	318.76	87.77	414.70
31	821.44	318.93	87.77	414.74	94	819.53	318.56	87.33	413.63	157	821.87	319.22	87.64	415.01
32	821.80	318.90	87.80	415.10	95	820.42	318.98	87.30	414.15	158	820.17	319.31	87.55	413.32
33	821.49	318.83	87.75	414.91	96	821.36	318.78	87.67	414.91	159	821.67	319.19	87.78	414.70
34	820.90	319.08	87.85	413.98	97	820.83	318.58	87.68	414.57	160	821.06	318.80	88.08	414.17
35	821.30	319.03	87.71	414.56	98	820.92	318.61	87.79	414.53	161	820.89	318.48	87.54	414.87
36	820.33	318.89	87.59	413.86	99	820.92	318.18	87.87	414.88	162	821.69	319.06	87.82	414.81
37	821.46	319.20	87.42	414.85	100	820.65	318.46	87.94	414.24	163	821.35	318.74	87.65	414.96
38	820.19	318.89	87.43	413.87	101	820.50	318.72	87.54	414.24	164	821.71	319.15	87.64	414.92
39	820.44	318.50	87.57	414.37	102	821.90	318.76	87.86	415.27	165	821.46	318.51	87.44	415.51
40	820.92	318.94	87.84	414.15	103	820.53	318.37	87.80	414.35	166	821.41	319.16	87.99	414.26
41	820.67	319.17	87.69	413.81	104	820.66	319.04	87.71	413.91	167	821.48	318.88	87.57	415.03
42	820.47	318.69	87.83	413.95	105	822.23	319.73	87.92	414.57	168	821.16	318.78	87.42	414.97
43	820.93	318.63	87.65	414.65	106	821.32	318.59	87.67	415.06	169	821.24	318.80	87.92	414.52
44	821.35	318.49	87.43	415.43	107	821.20	318.77	87.86	414.56	170	820.74	318.96	87.63	414.14
45	821.22	319.03	87.41	414.78	108	821.02	318.28	87.93	414.82	171	820.57	318.17	87.71	414.69
46	820.67	318.63	87.66	414.37	109	821.40	318.89	87.81	414.71	172	821.94	319.07	88.12	414.75
47	820.31	318.53	87.86	413.93	110	820.30	318.44	88.04	413.83	173	820.46	318.78	87.39	414.29
48	820.42	318.56	87.84	414.02	111	820.20	318.44	87.53	414.24	174	821.44	318.76	88.03	414.65
49	820.04	318.29	87.85	413.90	112	820.96	319.32	87.68	413.96	175	820.67	319.15	87.72	413.81
50	822.54	319.47	88.00	415.06	113	821.44	318.88	87.77	414.79	176	820.30	318.92	87.34	414.03
51	821.67	319.26	87.60	414.81	114	821.57	318.41	87.89	415.26	177	822.00	319.15	87.43	415.42
52	820.54	318.65	87.86	414.03	115	820.81	318.51	87.62	414.68	178	820.50	318.80	87.71	413.99
53	821.56	318.55	88.02	414.99	116	821.15	318.81	87.85	414.49	179	821.52	318.77	87.63	415.12
54	821.25	318.77	87.46	415.02	117	820.99	318.71	87.45	414.83	180	820.03	318.33	87.70	414.00
55	821.14	318.71	87.60	414.83	118	820.96	318.86	87.67	414.43	181	821.44	319.09	87.76	414.60
56	820.94	318.64	87.73	414.58	119	822.30	319.37	87.54	415.39	182	820.32	318.60	87.74	413.98
57	821.39	318.69	88.02	414.69	120	819.85	318.96	87.54	413.35	183	820.30	318.24	87.76	414.30
58	821.44	318.29	87.64	415.51	121	820.43	318.49	87.24	414.70	184	821.02	318.84	87.41	414.77
59	821.46	319.35	87.53	414.59	122	821.02	318.62	87.63	414.77	185	821.12	319.13	87.27	414.72
60	821.65	318.89	87.85	414.90	123	819.55	318.51	87.64	413.40					
61	820.01	318.78	87.43	413.80	124	820.68	318.69	87.70	414.29					
62	820.98	318.59	87.94	414.45	125	820.93	318.31	87.70	414.93					

Sustainability – Data Rate Distribution Graph

Data Rate Distribution (Ramp_sust @2001 BSUs)

Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	23:40:15	23:46:15	0-5	0:06:00
Measurement Interval	23:46:15	2:46:17	6-185	3:00:02

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	100,092.17	59,655.32	12,328.17	28,108.68	63	100,011.03	59,588.75	12,295.23	28,127.05	126	99,951.32	59,613.03	12,269.33	28,068.95
1	100,010.73	59,621.42	12,279.93	28,109.38	64	100,054.23	59,639.40	12,288.62	28,126.22	127	100,105.87	59,667.25	12,289.75	28,148.87
2	100,068.72	59,649.87	12,284.08	28,134.77	65	100,046.27	59,630.83	12,307.50	28,107.93	128	100,070.70	59,662.73	12,293.10	28,114.87
3	100,109.25	59,681.03	12,310.02	28,118.20	66	100,022.50	59,587.95	12,320.35	28,114.20	129	100,041.43	59,650.58	12,294.82	28,096.03
4	100,049.55	59,625.82	12,315.17	28,108.57	67	100,091.35	59,644.02	12,307.47	28,139.87	130	100,059.60	59,656.07	12,295.72	28,107.82
5	100,063.20	59,674.37	12,272.70	28,116.13	68	100,075.98	59,634.38	12,315.73	28,125.87	131	100,086.62	59,657.28	12,286.90	28,142.43
6	100,037.43	59,610.67	12,314.67	28,112.10	69	99,979.10	59,581.02	12,315.40	28,082.68	132	100,054.20	59,622.72	12,325.87	28,105.62
7	100,053.92	59,654.28	12,290.62	28,109.02	70	100,030.25	59,608.63	12,307.90	28,113.72	133	100,001.78	59,589.98	12,290.70	28,121.10
8	100,107.33	59,680.80	12,314.87	28,111.67	71	100,045.05	59,650.57	12,304.70	28,089.78	134	100,024.02	59,647.65	12,309.90	28,066.47
9	100,084.62	59,682.53	12,303.43	28,098.65	72	100,108.20	59,655.05	12,334.48	28,118.67	135	100,026.75	59,606.95	12,318.67	28,101.13
10	100,068.68	59,648.82	12,308.65	28,111.22	73	100,007.75	59,625.35	12,300.85	28,081.55	136	100,054.37	59,658.03	12,313.63	28,082.70
11	100,034.35	59,627.17	12,301.75	28,105.43	74	100,198.32	59,728.50	12,314.15	28,155.67	137	100,039.68	59,667.28	12,296.18	28,076.22
12	100,034.67	59,619.28	12,312.73	28,102.65	75	100,022.77	59,637.30	12,304.38	28,081.08	138	100,100.08	59,655.62	12,318.32	28,126.15
13	100,063.32	59,659.75	12,294.35	28,109.22	76	100,050.10	59,628.58	12,324.82	28,096.70	139	100,052.58	59,637.12	12,303.60	28,111.87
14	100,044.68	59,651.95	12,271.07	28,121.67	77	100,045.32	59,633.42	12,306.88	28,105.02	140	100,034.77	59,597.65	12,315.55	28,121.57
15	100,091.22	59,638.03	12,288.40	28,164.78	78	100,052.33	59,652.75	12,296.43	28,103.15	141	100,034.40	59,631.90	12,312.23	28,090.27
16	100,039.23	59,628.52	12,319.68	28,091.03	79	100,079.13	59,645.37	12,291.17	28,142.60	142	100,012.15	59,598.00	12,296.27	28,117.88
17	100,036.50	59,574.12	12,304.67	28,157.72	80	100,069.02	59,612.18	12,314.37	28,142.47	143	99,996.42	59,579.28	12,306.00	28,111.13
18	100,061.03	59,610.68	12,340.38	28,109.97	81	100,093.72	59,641.00	12,296.90	28,155.82	144	99,990.02	59,573.67	12,306.77	28,109.58
19	100,020.02	59,629.97	12,284.08	28,105.97	82	100,033.28	59,625.13	12,300.28	28,107.87	145	100,032.73	59,594.50	12,302.35	28,135.88
20	99,930.35	59,539.07	12,301.88	28,089.40	83	100,009.77	59,592.68	12,294.93	28,122.15	146	100,016.40	59,612.35	12,293.83	28,110.22
21	100,086.65	59,654.13	12,310.43	28,122.08	84	100,011.48	59,618.55	12,288.12	28,104.82	147	100,056.27	59,599.40	12,323.00	28,133.87
22	100,006.53	59,613.08	12,295.35	28,098.10	85	100,054.05	59,627.50	12,321.75	28,104.80	148	100,067.28	59,621.83	12,306.65	28,138.80
23	100,098.45	59,654.37	12,315.47	28,128.62	86	100,143.78	59,705.78	12,314.33	28,123.67	149	99,986.77	59,565.95	12,286.55	28,134.27
24	99,962.48	59,530.43	12,313.17	28,118.88	87	100,111.43	59,662.68	12,300.23	28,148.52	150	99,972.52	59,617.82	12,274.97	28,079.73
25	100,072.90	59,640.97	12,306.63	28,125.30	88	100,179.72	59,700.88	12,324.33	28,154.50	151	100,048.67	59,610.88	12,300.05	28,137.73
26	100,063.00	59,608.28	12,313.20	28,141.52	89	100,044.52	59,608.78	12,302.63	28,133.10	152	100,033.57	59,612.82	12,297.23	28,123.52
27	100,059.28	59,678.30	12,273.20	28,107.78	90	99,997.65	59,588.33	12,312.43	28,096.88	153	100,034.52	59,641.12	12,307.10	28,086.30
28	100,027.93	59,599.92	12,291.72	28,136.30	91	100,026.95	59,643.55	12,300.58	28,082.82	154	100,048.40	59,645.23	12,292.87	28,110.30
29	100,046.63	59,667.18	12,290.02	28,089.43	92	100,078.82	59,632.48	12,313.17	28,133.17	155	100,074.45	59,638.23	12,314.60	28,121.62
30	100,118.55	59,644.17	12,318.30	28,156.08	93	100,066.18	59,673.73	12,319.50	28,072.95	156	100,088.70	59,640.90	12,307.63	28,140.17
31	100,092.73	59,645.72	12,302.42	28,144.60	94	99,980.47	59,632.37	12,291.43	28,056.67	157	100,078.47	59,656.98	12,298.20	28,123.28
32	100,023.67	59,597.07	12,288.65	28,137.95	95	100,023.32	59,614.73	12,280.80	28,127.78	158	100,069.48	59,667.05	12,313.52	28,088.92
33	100,069.77	59,624.45	12,322.72	28,122.60	96	100,073.48	59,641.35	12,284.08	28,148.05	159	100,141.95	59,678.17	12,318.33	28,145.45
34	100,080.57	59,658.52	12,319.48	28,102.57	97	100,017.03	59,613.33	12,307.50	28,096.20	160	100,038.20	59,622.72	12,312.60	28,102.88
35	100,042.32	59,616.33	12,306.67	28,119.32	98	100,051.10	59,628.73	12,320.55	28,101.82	161	100,069.60	59,623.85	12,300.18	28,145.57
36	99,987.83	59,602.40	12,276.45	28,108.98	99	100,084.27	59,626.90	12,316.03	28,141.33	162	100,105.73	59,693.48	12,294.07	28,118.18
37	100,087.48	59,667.15	12,297.25	28,123.08	100	100,060.98	59,613.68	12,335.22	28,112.08	163	100,108.15	59,641.12	12,321.00	28,146.03
38	100,036.48	59,642.65	12,293.53	28,100.30	101	100,050.12	59,618.00	12,300.48	28,131.63	164	100,135.22	59,722.07	12,310.32	28,102.83
39	99,999.10	59,572.12	12,320.65	28,106.33	102	100,085.15	59,642.07	12,321.35	28,121.73	165	100,073.97	59,587.42	12,324.92	28,161.63
40	100,066.90	59,624.05	12,328.08	28,114.77	103	100,011.50	59,588.63	12,305.07	28,117.80	166	100,045.97	59,619.50	12,326.35	28,100.12
41	100,094.97	59,669.60	12,316.95	28,108.42	104	100,082.48	59,658.28	12,327.25	28,096.95	167	100,094.32	59,661.72	12,295.45	28,137.15
42	100,048.68	59,635.62	12,309.93	28,103.13	105	100,103.10	59,690.72	12,306.07	28,106.32	168	100,044.70	59,626.43	12,296.73	28,121.53
43	100,062.93	59,658.58	12,309.15	28,095.20	106	100,100.63	59,663.40	12,295.45	28,141.78	169	100,061.13	59,632.35	12,304.93	28,123.85
44	100,084.17	59,626.02	12,289.27	28,168.88	107	100,051.05	59,626.25	12,314.45	28,110.35	170	100,024.73	59,639.03	12,290.00	28,095.70
45	100,107.73	59,684.53	12,309.78	28,113.42	108	100,053.05	59,604.47	12,327.18	28,121.40	171	100,064.60	59,641.73	12,294.97	28,127.90
46	100,052.25	59,624.22	12,311.20	28,116.83	109	100,116.02	59,688.93	12,311.33	28,115.75	172	100,117.72	59,677.12	12,307.28	28,133.32
47	99,954.80	59,552.92	12,301.55	28,100.33	110	100,020.70	59,584.97	12,322.27	28,113.47	173	100,010.63	59,618.70	12,286.90	28,105.03
48	100,039.30	59,626.15	12,327.92	28,085.23	111	99,993.52	59,596.67	12,296.72	28,100.13	174	100,069.97	59,608.27	12,308.20	28,153.50
49	99,987.55	59,583.20	12,311.65	28,092.70	112	100,058.30	59,660.07	12,298.02	28,100.22	175	100,037.58	59,630.85	12,302.75	28,103.98
50	100,132.92	59,696.17	12,316.95	28,119.80	113	100,060.78	59,636.72	12,311.30	28,112.77	176	100,043.27	59,618.97	12,304.93	28,119.37
51	100,074.27	59,675.55	12,290.93	28,107.78	114	100,021.97	59,564.62	12,331.80	28,125.55	177	100,104.75	59,687.25	12,284.98	28,132.52
52	100,041.42	59,626.85	12,305.55	28,109.02	115	100,060.47	59,610.22	12,288.68	28,161.57	178	100,009.27	59,640.45	12,295.63	28,073.18
53	100,060.32	59,614.42	12,322.15	28,123.75	116	100,068.60	59,639.48	12,303.90	28,125.22	179	100,092.35	59,632.73	12,311.27	28,148.35
54	100,015.07	59,609.32	12,291.67	28,114.08	117	100,002.72	59,579.82	12,291.63	28,131.27	180	100,045.57	59,617.57	12,324.05	28,103.95
55	100,045.72	59,631.47	12,304.05	28,110.20	118	100,057.88	59,622.08	12,308.80	28,127.00	181	100,063.48	59,622.58	12,312.33	28,128.57
56	100,070.38	59,639.17	12,303.18	28,128.03	119	100,150.88	59,704.68	12,306.75	28,139.45	182	100,055.48	59,634.60	12,316.87	28,104.02
57	100,077.15	59,633.10	12,327.38	28,116.67	120	99,995.12	59,646.40	12,313.58	28,035.13	183	100,072.30	59,632.73	12,289.62	28,149.95
58	100,081.27	59,639.23	12,291.08	28,150.95	121	100,017.63	59,584.92	12,265.25	28,167.47	184	100,008.32	59,622.03	12,298.27	28,088.02
59	100,113.88	59,696.10	12,299.82	28,117.97	122	100,043.00	59,633.50	12,295.33	28,114.17	185	100,019.68	59,650.50	12,258.50	28,110.68
60	100,113.92	59,649.33	12,322.25	28,142.33	123	99,985.77	59,606.88	12,289.98	28,088.90	Average	100,053.77	59,632.19	12,305.11	28,116.47
61	100,003.80	59,577.25	12,314.68	28,111.87	124	100,113.05	59,686.27	12,310.45	28,116.33					
62	100,075.18	59,632.22	12,318.13	28,124.83	125	100,066.67	59,620.37	12,317.67	28,128.63					

Sustainability – I/O Request Throughput Distribution Graph
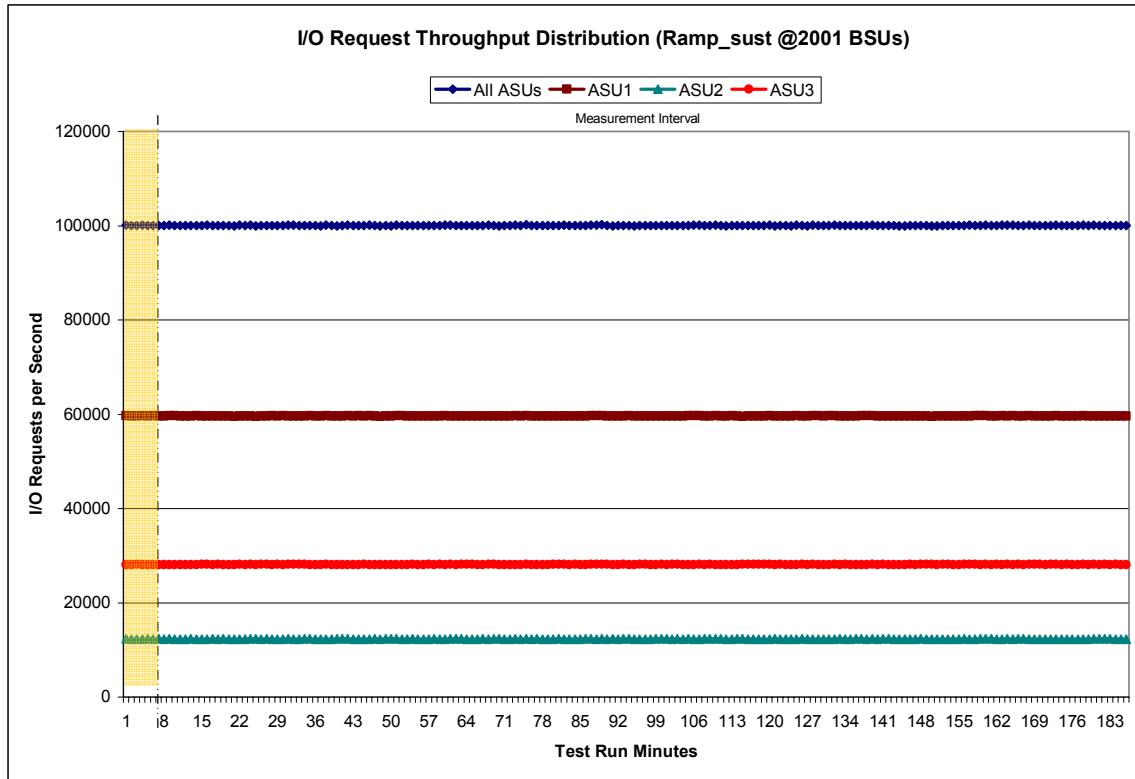
Sustainability – Measured Intensity Multiplier and Coefficient of Variation

	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	0.035	0.2810	0.0700	0.2100	0.0180	0.0700	0.035	0.2810
COV	0.002	0.001	0.001	0.001	0.003	0.002	0.002	0.001

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.*

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%.*

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

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, and Response Time Ramp Test Runs are listed below:

java -Xmx512m -Xms512m -Xss512k metrics -b 2001 -t 10920 -r 720 -s 360

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

2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:50:48	2:56:49	0-5	0:06:01
Measurement Interval	2:56:49	3:06:50	6-15	0:10:01
60 second intervals	**100058.4**	**59631.167**	**12295.8**	**28131.417**
0	100,180.67	59,716.23	12,316.43	28,148.00
1	99,969.13	59,548.65	12,298.42	28,122.07
2	100,045.67	59,645.65	12,312.07	28,087.95
3	100,073.77	59,627.63	12,318.82	28,127.32
4	100,075.10	59,649.37	12,306.02	28,119.72
5	100,045.10	59,644.97	12,301.92	28,098.22
6	100,053.98	59,648.53	12,317.60	28,087.85
7	100,060.13	59,602.27	12,316.42	28,141.45
8	100,058.38	59,631.17	12,295.80	28,131.42
9	100,033.28	59,624.55	12,294.10	28,114.63
10	99,999.70	59,585.12	12,300.38	28,114.20
11	100,055.65	59,658.65	12,299.47	28,097.53
12	100,044.03	59,638.72	12,302.47	28,102.85
13	100,037.17	59,621.42	12,314.82	28,100.93
14	100,098.35	59,660.45	12,306.62	28,131.28
15	100,016.67	59,641.85	12,298.18	28,076.63
Average	100,045.74	59,631.27	12,304.59	28,109.88

IOPS Test Run – I/O Request Throughput Distribution Graph
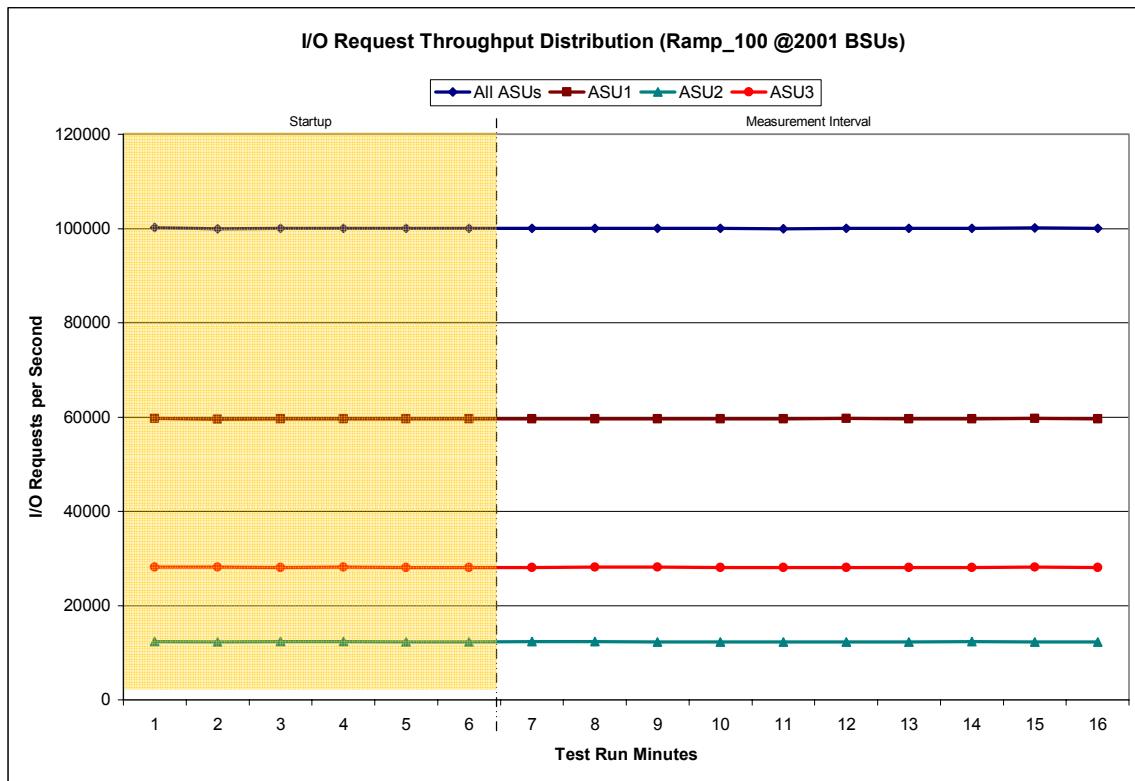
IOPS Test Run – Response Time Frequency Distribution Data

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	5218	1,734,625	2,475,772	743,429	348,012	150,992	64,657	32,498
Write	0	206	886,298	6,073,170	5,549,098	3,009,202	1,713,160	1,182,385
All ASUs	5218	1,734,831	3,362,070	6,816,599	5,897,110	3,160,194	1,777,817	1,214,883
ASU1	4313	1,369,040	2,596,172	4,369,616	3,098,839	1,472,652	761,243	501,997
ASU2	905	365,778	588,848	734,008	544,004	274,398	147,492	101,530
ASU3	0	13	177,050	1,712,975	2,254,267	1,413,144	869,082	611,356

Response Time (ms)	>2.0-2.5	105013	104665	209678	0.280970238	843918	843147	1687065
Read	37,660	14,260	22,100	39,940	95,025	154,341	574,469	972,111
Write	2,117,591	1,248,676	1,098,020	819,948	927,438	725,741	1,361,482	1,317,881
All ASUs	2,155,251	1,262,936	1,120,120	859,888	1,022,463	880,082	1,935,951	2,289,992
ASU1	909,114	556,417	506,669	396,620	487,078	448,306	1,093,926	1,420,342
ASU2	190,291	124,861	117,967	94,443	113,203	98,120	215,957	262,704
ASU3	1,055,846	581,658	495,484	368,825	422,182	333,656	626,068	606,946

Response Time (ms)	>7.0-8.0	>8.0-9.0	>9.0-10.0	>10.0-15.0	>15.0-20.0	>20.0-25.0	>25.0-30.0	>30.0
Read	1,128,846	1,381,833	1,386,198	4,920,838	3,088,307	2,177,718	1,504,301	5,141,293
Write	1,183,038	1,216,268	1,139,011	4,924,841	3,041,377	1,576,431	838,611	1,343,955
All ASUs	2,311,884	2,598,101	2,525,209	9,845,679	6,129,684	3,754,149	2,342,912	6,485,248
ASU1	1,482,958	1,698,521	1,657,231	5,953,191	3,459,472	2,171,481	1,423,311	4,769,425
ASU2	286,399	344,757	351,748	1,466,270	830,042	476,325	251,799	811,415
ASU3	542,527	554,823	516,230	2,426,218	1,840,170	1,106,343	667,802	904,408

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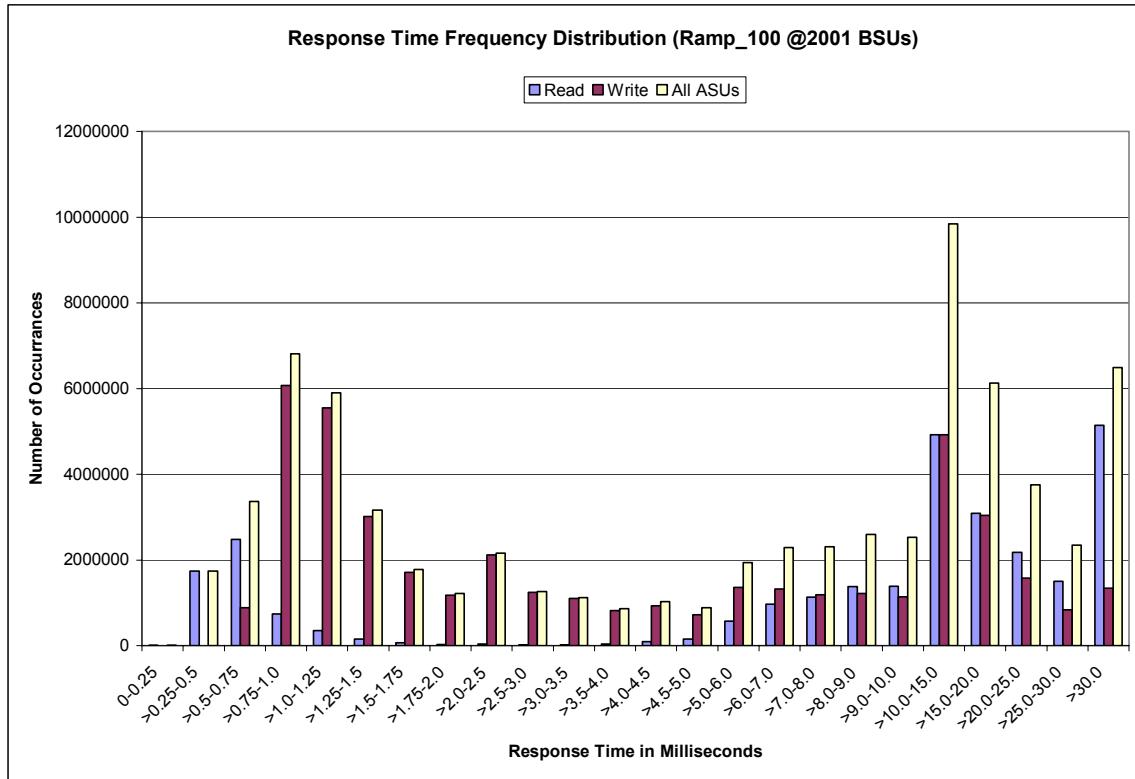
IOPS Test Run – Average Response Time (ms) Distribution Data

2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:50:48	2:56:49	0-5	0:06:01
Measurement Interval	2:56:49	3:06:50	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	10.49	12.06	11.46	6.74
1	12.36	13.54	13.26	9.48
2	12.00	13.16	12.97	9.11
3	11.99	13.12	13.15	9.08
4	11.85	13.03	13.02	8.82
5	11.94	13.06	13.15	9.04
6	12.01	13.14	12.99	9.17
7	11.95	13.03	13.23	9.11
8	12.12	13.33	13.23	9.08
9	11.85	13.03	13.04	8.81
10	11.87	12.93	13.33	8.96
11	11.79	12.95	13.10	8.77
12	11.80	12.92	13.08	8.87
13	12.10	13.34	13.15	9.00
14	15.79	17.91	13.51	12.30
15	12.07	13.33	13.11	8.93
Average	12.34	13.59	13.18	9.30

IOPS Test Run – Average Response Time (ms) Distribution Graph
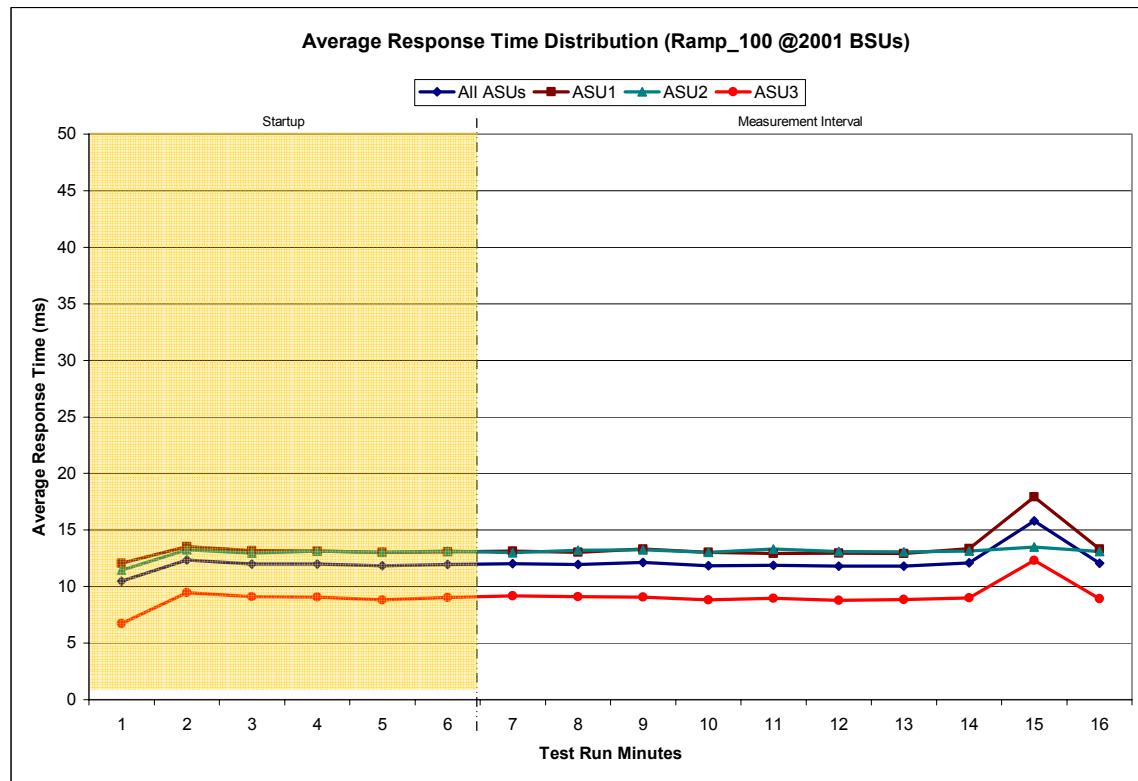
IOPS Test Run – I/O Request Information

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
71,488,271	65,003,023	6,485,248

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	0.0350	0.2811	0.0700	0.2099	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.001	0.002	0.001	0.004	0.001	0.001	0.001

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.*

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%.*

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

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 11.

In addition, the Average Response Time measured during the 10% Test Run is the value for the SPC-1 LRT™ primary 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, and Response Time Ramp Test Runs are listed below:

java -Xmx512m -Xms512m -Xss512k metrics -b 2001 -t 10920 -r 720 -s 360

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 - 2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:50:48	2:56:49	0-5	0:06:01
Measurement Interval	2:56:49	3:06:50	6-15	0:10:01
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	100,180.67	59,716.23	12,316.43	28,148.00
1	99,969.13	59,548.65	12,298.42	28,122.07
2	100,045.67	59,645.65	12,312.07	28,087.95
3	100,073.77	59,627.63	12,318.82	28,127.32
4	100,075.10	59,649.37	12,306.02	28,119.72
5	100,045.10	59,644.97	12,301.92	28,098.22
6	100,053.98	59,648.53	12,317.60	28,087.85
7	100,060.13	59,602.27	12,316.42	28,141.45
8	100,058.38	59,631.17	12,295.80	28,131.42
9	100,033.28	59,624.55	12,294.10	28,114.63
10	99,999.70	59,585.12	12,300.38	28,114.20
11	100,055.65	59,658.65	12,299.47	28,097.53
12	100,044.03	59,638.72	12,302.47	28,102.85
13	100,037.17	59,621.42	12,314.82	28,100.93
14	100,098.35	59,660.45	12,306.62	28,131.28
15	100,016.67	59,641.85	12,298.18	28,076.63
Average	100,045.74	59,631.27	12,304.59	28,109.88

95% Load Level - 1900 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:11:01	3:17:02	0-5	0:06:01
Measurement Interval	3:17:02	3:27:03	6-15	0:10:01
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	95,180.37	56,711.97	11,697.43	26,770.97
1	94,922.53	56,580.58	11,667.52	26,674.43
2	95,041.93	56,619.72	11,668.78	26,753.43
3	95,072.70	56,682.57	11,692.63	26,697.50
4	94,952.83	56,627.25	11,682.12	26,643.47
5	94,971.52	56,573.53	11,685.55	26,712.43
6	95,039.07	56,636.52	11,699.75	26,702.80
7	94,974.02	56,580.93	11,687.75	26,705.33
8	94,988.68	56,617.30	11,686.90	26,684.48
9	95,018.33	56,613.53	11,685.25	26,719.55
10	94,979.42	56,637.90	11,682.53	26,658.98
11	95,031.82	56,611.13	11,720.55	26,700.13
12	95,010.97	56,621.30	11,702.80	26,686.87
13	94,972.45	56,648.77	11,662.65	26,661.03
14	94,965.00	56,582.13	11,677.73	26,705.13
15	94,982.28	56,612.37	11,676.95	26,692.97
Average	94,996.20	56,616.19	11,688.29	26,691.73

90% Load Level - 1800 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:31:07	3:37:08	0-5	0:06:01
Measurement Interval	3:37:08	3:47:09	6-15	0:10:01
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	90,068.37	53,721.25	11,071.48	25,275.63
1	89,955.95	53,630.62	11,061.15	25,264.18
2	90,002.45	53,633.55	11,057.77	25,311.13
3	90,006.32	53,650.65	11,077.17	25,278.50
4	90,008.50	53,633.18	11,060.48	25,314.83
5	90,102.75	53,682.27	11,092.37	25,328.12
6	90,012.42	53,640.88	11,058.80	25,312.73
7	90,017.70	53,628.10	11,080.12	25,309.48
8	90,043.38	53,673.52	11,069.58	25,300.28
9	90,080.23	53,668.67	11,093.78	25,317.78
10	90,028.62	53,642.45	11,090.07	25,296.10
11	89,950.28	53,607.72	11,063.77	25,278.80
12	90,055.00	53,660.00	11,101.67	25,293.33
13	90,014.02	53,635.93	11,058.80	25,319.28
14	89,972.88	53,584.97	11,067.50	25,320.42
15	90,022.97	53,665.43	11,091.15	25,266.38
Average	90,019.75	53,640.77	11,077.52	25,301.46

80% Load Level - 1600 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:51:08	3:57:09	0-5	0:06:01
Measurement Interval	3:57:09	4:07:10	6-15	0:10:01
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	80,018.15	47,730.75	9,835.67	22,451.73
1	80,010.83	47,676.68	9,858.53	22,475.62
2	79,983.67	47,672.82	9,846.73	22,464.12
3	79,990.13	47,681.08	9,824.77	22,484.28
4	80,042.83	47,670.93	9,871.00	22,500.90
5	79,940.02	47,643.38	9,840.57	22,456.07
6	80,011.32	47,719.18	9,836.13	22,456.00
7	79,954.18	47,661.62	9,838.70	22,453.87
8	80,039.12	47,696.68	9,833.48	22,508.95
9	80,001.70	47,678.47	9,854.07	22,469.17
10	80,003.73	47,651.60	9,855.40	22,496.73
11	80,007.35	47,687.83	9,835.10	22,484.42
12	80,020.78	47,697.30	9,847.82	22,475.67
13	80,021.70	47,706.65	9,841.75	22,473.30
14	79,971.05	47,689.57	9,836.58	22,444.90
15	80,051.47	47,718.88	9,834.52	22,498.07
Average	80,008.24	47,690.78	9,841.36	22,476.11

50% Load Level - 1000 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:11:00	4:17:01	0-5	0:06:01
Measurement Interval	4:17:01	4:27:02	6-15	0:10:01
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	50,048.90	29,830.53	6,152.20	14,066.17
1	49,955.67	29,763.52	6,141.22	14,050.93
2	50,018.75	29,816.32	6,151.45	14,050.98
3	50,003.52	29,804.42	6,148.62	14,050.48
4	50,007.63	29,794.45	6,161.48	14,051.70
5	49,998.93	29,769.58	6,170.87	14,058.48
6	49,953.83	29,768.27	6,153.18	14,032.38
7	50,018.58	29,799.33	6,142.65	14,076.60
8	50,001.15	29,792.70	6,135.73	14,072.72
9	49,989.45	29,791.90	6,121.13	14,076.42
10	50,010.72	29,843.77	6,146.40	14,020.55
11	49,993.27	29,811.83	6,143.27	14,038.17
12	50,024.33	29,803.78	6,149.37	14,071.18
13	49,971.37	29,786.30	6,148.07	14,037.00
14	49,984.53	29,787.37	6,147.48	14,049.68
15	49,963.03	29,769.17	6,132.48	14,061.38
Average	49,991.03	29,795.44	6,141.98	14,053.61

10% Load Level - 200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:30:37	4:36:38	0-2	0:06:01
Measurement Interval	4:36:38	4:46:39	3-12	0:10:01
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	10,016.08	5,960.20	1,234.37	2,821.52
1	9,996.38	5,948.70	1,227.23	2,820.45
2	9,995.90	5,951.23	1,231.85	2,812.82
3	9,988.05	5,947.53	1,234.17	2,806.12
4	9,976.72	5,947.92	1,230.40	2,798.40
5	10,014.35	5,981.42	1,226.18	2,806.75
6	10,003.35	5,957.93	1,237.05	2,808.37
7	10,002.02	5,964.72	1,221.25	2,816.05
8	10,009.33	5,956.28	1,233.67	2,819.38
9	9,988.60	5,964.78	1,219.92	2,803.90
10	9,997.28	5,955.67	1,226.68	2,814.93
11	10,005.33	5,960.48	1,232.97	2,811.88
12	9,987.97	5,945.63	1,229.45	2,812.88
13	10,010.78	5,955.35	1,244.65	2,810.78
14	10,016.52	5,951.58	1,240.48	2,824.45
15	9,993.88	5,960.58	1,237.45	2,795.85
Average	10,001.51	5,957.30	1,232.36	2,811.85
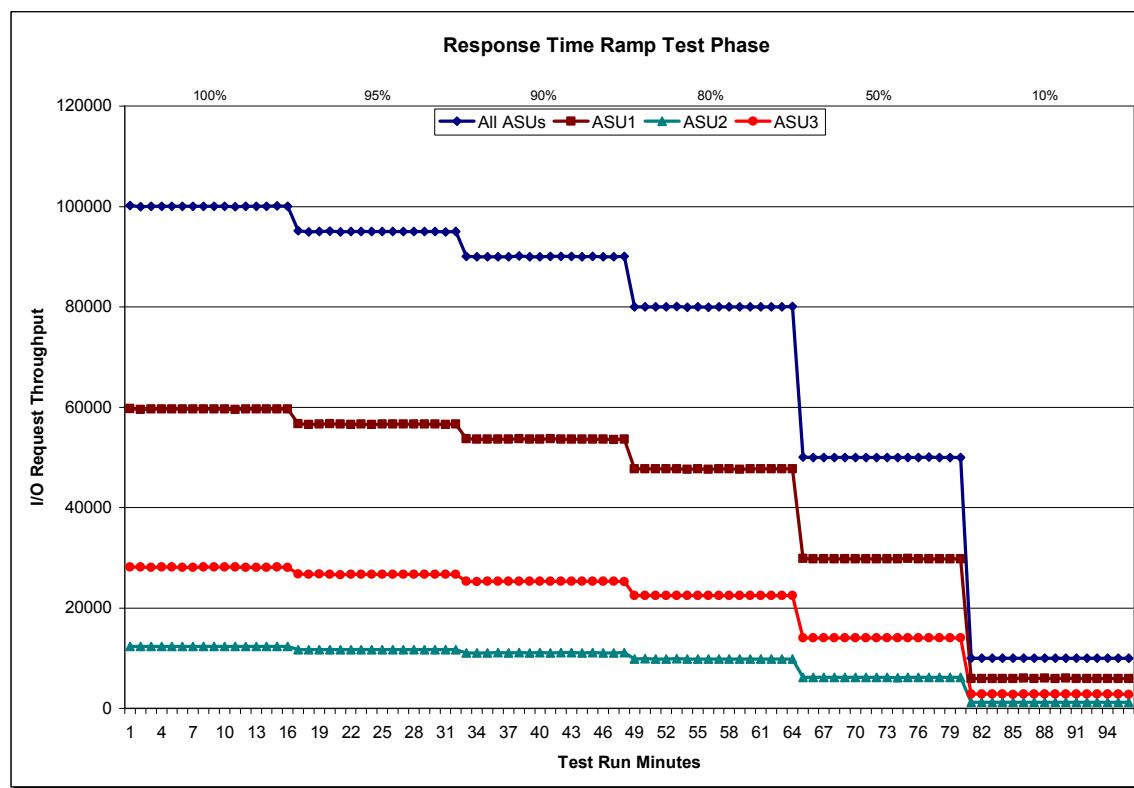
SPC BENCHMARK 1™ V1.8   FULL DISCLOSURE REPORT   Submitted for Review: MARCH 8, 2004
3PARdata, Inc.   Submission Identifier: A00027
3PAR InServ™ S800 X-Series *(8-Node)*   Accepted: MAY 7, 2004

Response Time Ramp Distribution (IOPS) Graph

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

200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:30:37	4:36:38	0-5	0:06:01
Measurement Interval	4:36:38	4:46:39	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3.02	3.97	3.36	0.88
1	2.98	3.94	3.13	0.88
2	2.96	3.90	3.17	0.88
3	3.41	4.50	3.90	0.88
4	2.96	3.89	3.20	0.88
5	2.96	3.90	3.14	0.88
6	3.08	4.09	3.25	0.88
7	2.98	3.94	3.15	0.88
8	2.94	3.87	3.16	0.88
9	2.96	3.88	3.21	0.88
10	2.94	3.86	3.18	0.89
11	2.94	3.87	3.15	0.88
12	2.94	3.86	3.21	0.88
13	2.95	3.86	3.27	0.88
14	2.95	3.88	3.18	0.88
15	2.93	3.85	3.14	0.88
Average	2.96	3.90	3.19	0.88

SPC-1 LRT™ Average Response Time (ms) Distribution Graph
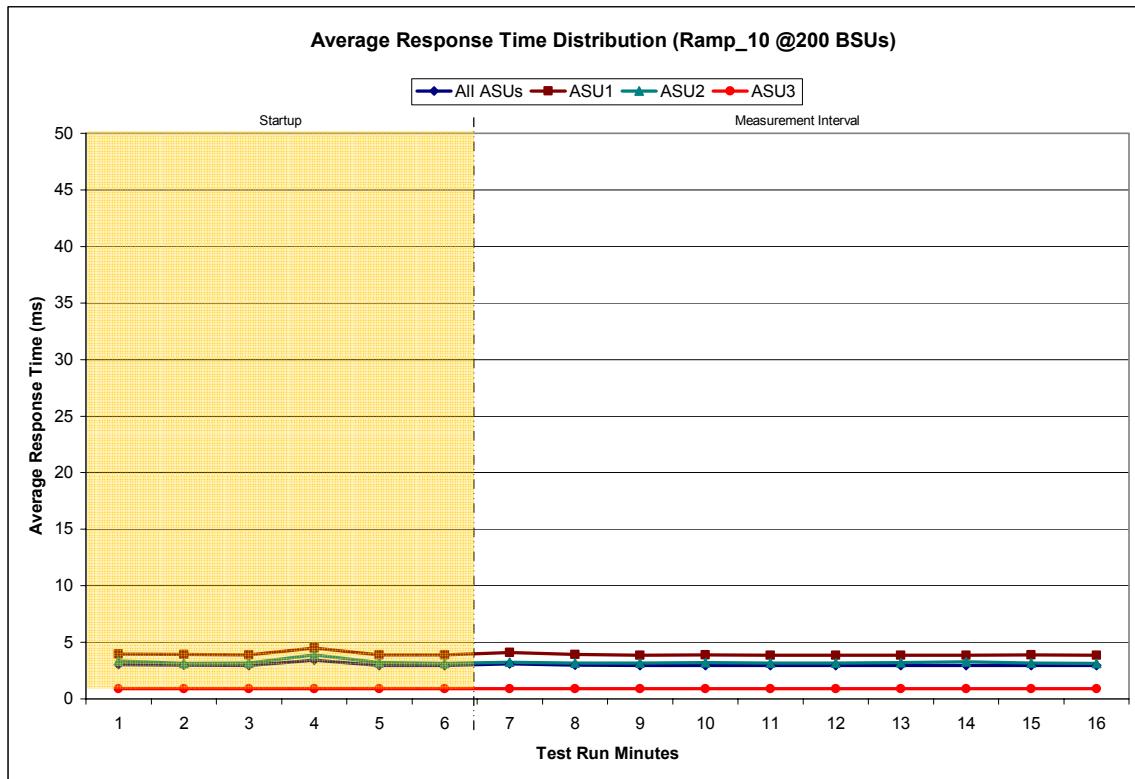
SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation

	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	0.0349	0.2807	0.0700	0.2101	0.0180	0.0702	0.0350	0.2811
COV	0.006	0.002	0.006	0.001	0.011	0.006	0.007	0.002

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.*

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%.*

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

Repeatability Test

Clause 5.4.3

The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ and SPC-1 LRT™ primary metrics 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™ primary metric. Each Average Response Time value must be less than the SPC-1 LRT™ primary 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 9.2.4.7.3

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 two Repeatability Test Phases. The content, appearance, and format of the table are specified in Table 9-11.*
2. *An I/O Request Throughput Distribution (data and graph).*
3. *An Average Response Time Distribution (data and graph).*
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 Repeatability Test Runs are listed below:

java -Xmx512m -Xms512m -Xss512k repeat1 -b 2001 -t 720 -s 360

java -Xmx512m -Xms512m -Xss512k repeat2 -b 2001 -t 720 -s 360

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	*100,045.74*	*2.96*
Repeatability Test Phase 1	100,061.97	2.93
Repeatability Test Phase 2	100,061.85	2.93

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

| 200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:06:00	22:12:00	0-5	0:06:00
Measurement Interval	22:12:00	22:22:01	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	10,000.40	5,957.23	1,232.57	2,810.60
1	9,999.30	5,965.12	1,229.50	2,804.68
2	9,997.27	5,951.33	1,229.35	2,816.58
3	9,997.02	5,960.65	1,223.85	2,812.52
4	10,002.28	5,962.28	1,235.68	2,804.32
5	10,023.05	5,973.37	1,242.85	2,806.83
6	9,997.37	5,971.83	1,229.78	2,795.75
7	10,013.98	5,968.63	1,236.15	2,809.20
8	10,013.27	5,970.73	1,234.73	2,807.80
9	10,011.28	5,961.93	1,230.03	2,819.32
10	10,016.18	5,964.98	1,229.05	2,822.15
11	10,005.38	5,952.92	1,231.80	2,820.67
12	9,995.48	5,966.48	1,221.93	2,807.07
13	9,976.88	5,942.20	1,232.65	2,802.03
14	9,997.83	5,960.83	1,225.97	2,811.03
15	9,978.83	5,942.02	1,227.25	2,809.57
Average	10,000.65	5,960.26	1,229.94	2,810.46

Repeatability 1 LRT – I/O Request Throughput Distribution Graph
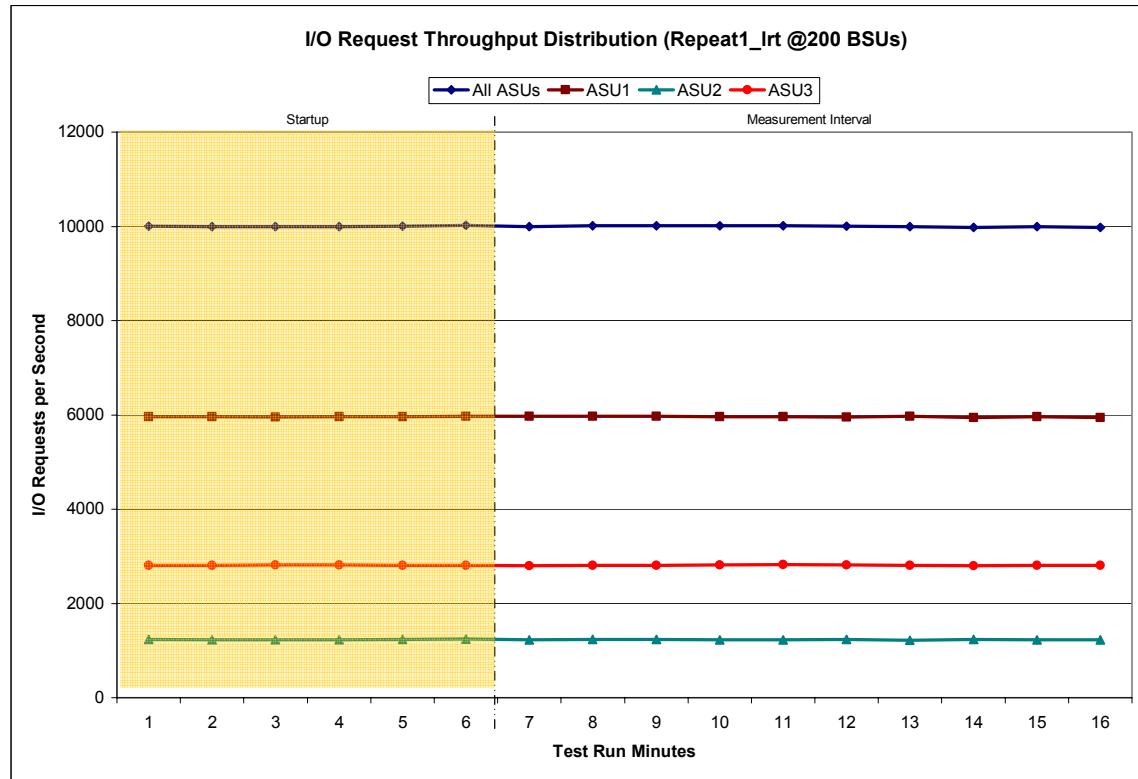
Repeatability 1 LRT –Average Response Time (ms) Distribution Data

| 200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:06:00	22:12:00	0-5	0:06:00
Measurement Interval	22:12:00	22:22:01	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.98	3.89	3.34	0.88
1	2.96	3.88	3.22	0.88
2	2.94	3.87	3.17	0.88
3	2.95	3.87	3.17	0.88
4	2.94	3.86	3.16	0.88
5	2.94	3.84	3.22	0.88
6	2.95	3.86	3.25	0.88
7	2.93	3.84	3.22	0.88
8	2.93	3.83	3.24	0.88
9	2.93	3.85	3.21	0.88
10	2.93	3.85	3.20	0.88
11	2.93	3.84	3.23	0.88
12	2.93	3.83	3.24	0.88
13	2.94	3.84	3.24	0.88
14	2.93	3.84	3.22	0.88
15	2.93	3.84	3.16	0.88
Average	2.93	3.84	3.22	0.88

Repeatability 1 LRT –Average Response Time (ms) Distribution Graph
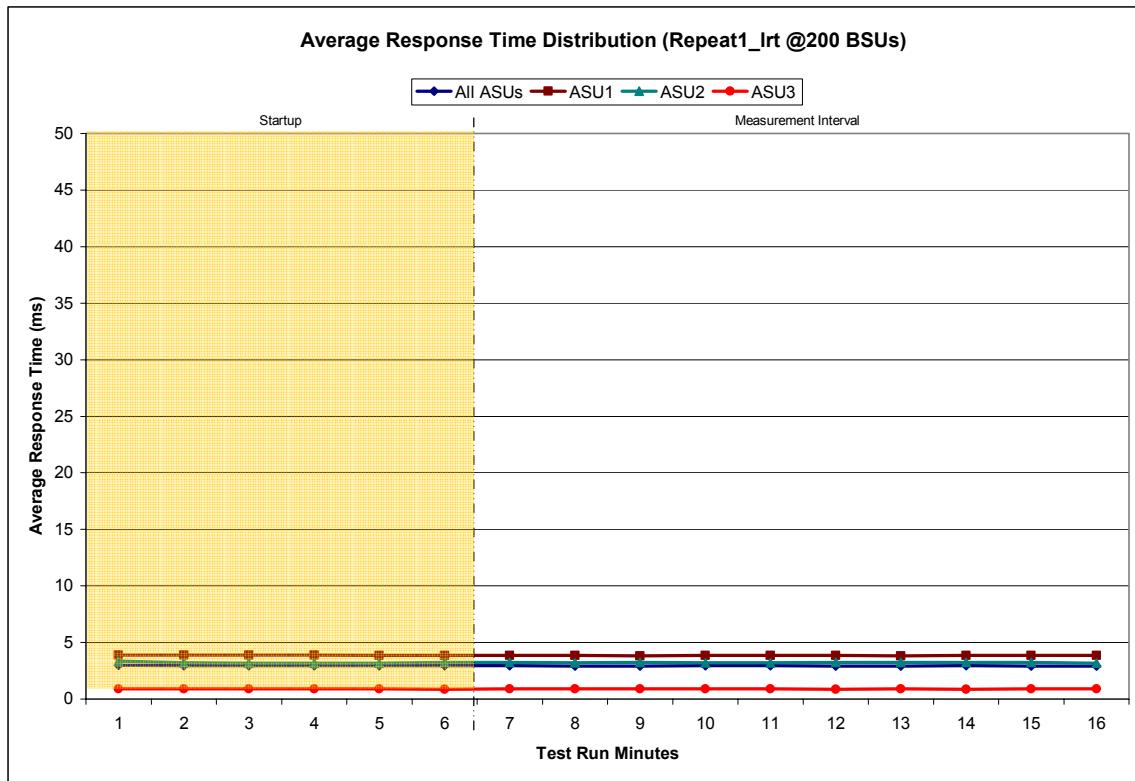
Repeatability 1 IOPS – I/O Request Throughput Distribution Data

2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:25:54	22:31:55	0-5	0:06:01
Measurement Interval	22:31:55	22:41:57	6-15	0:10:02
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	100,172.82	59,700.47	12,310.98	28,161.37
1	100,062.75	59,677.02	12,290.63	28,095.10
2	99,995.03	59,628.32	12,282.15	28,084.57
3	100,101.60	59,702.45	12,296.90	28,102.25
4	100,116.32	59,659.03	12,312.62	28,144.67
5	99,966.28	59,601.47	12,289.18	28,075.63
6	100,098.35	59,657.65	12,317.90	28,122.80
7	100,066.70	59,627.87	12,310.85	28,127.98
8	100,018.58	59,623.00	12,306.07	28,089.52
9	100,002.83	59,619.47	12,311.63	28,071.73
10	100,050.42	59,649.42	12,307.08	28,093.92
11	100,106.00	59,678.50	12,299.77	28,127.73
12	100,105.12	59,659.47	12,304.12	28,141.53
13	100,050.02	59,616.80	12,301.70	28,131.52
14	100,054.55	59,617.22	12,308.08	28,129.25
15	100,067.17	59,678.17	12,292.45	28,096.55
Average	100,061.97	59,642.76	12,305.97	28,113.25

Repeatability 1 IOPS – I/O Request Throughput Distribution Graph
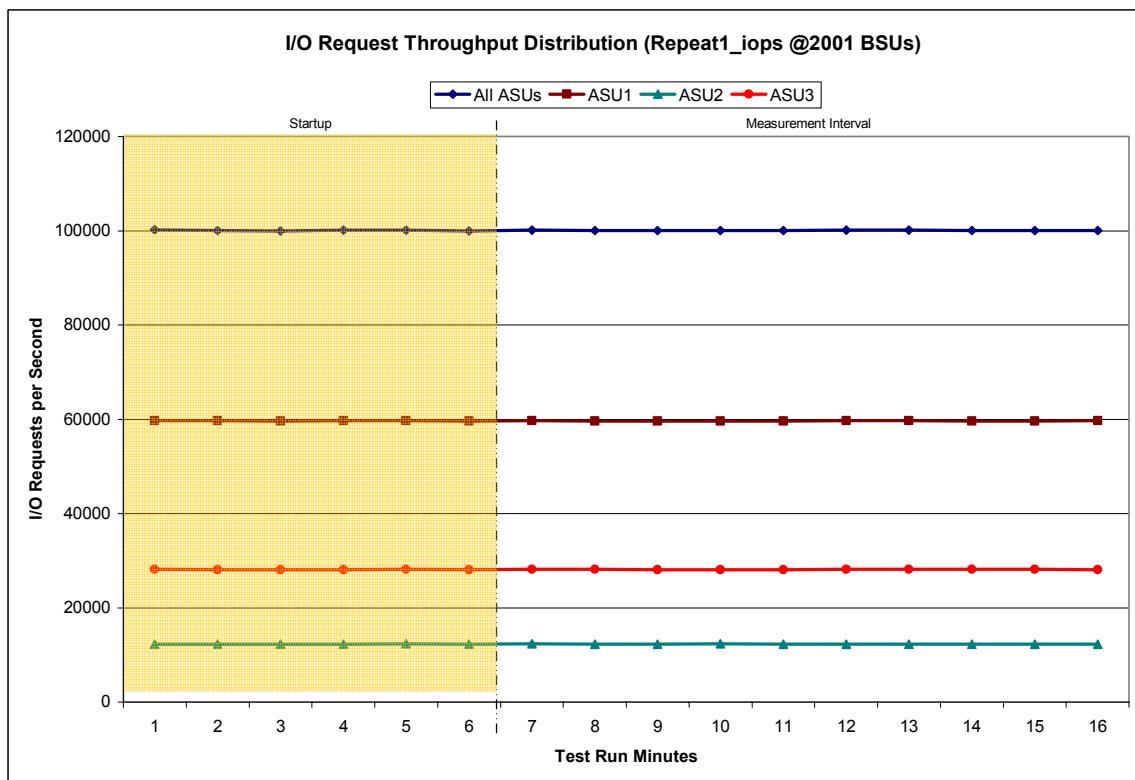
Repeatability 1 IOPS –Average Response Time (ms) Distribution Data

2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:25:54	22:31:55	0-5	0:06:01
Measurement Interval	22:31:55	22:41:57	6-15	0:10:02
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	9.97	11.74	11.01	5.76
1	11.29	12.93	12.50	7.29
2	11.04	12.67	12.18	7.06
3	11.09	12.72	12.24	7.13
4	11.11	12.72	12.25	7.21
5	11.01	12.67	12.17	6.96
6	11.04	12.76	12.06	6.96
7	11.13	12.83	12.14	7.06
8	11.14	12.82	12.28	7.08
9	11.45	13.01	12.58	7.65
10	11.37	13.33	12.29	6.82
11	11.29	13.06	12.20	7.13
12	11.05	12.70	12.12	7.07
13	11.16	12.77	12.24	7.28
14	11.17	12.73	12.27	7.39
15	11.10	12.71	12.12	7.24
Average	11.19	12.87	12.23	7.17

Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph
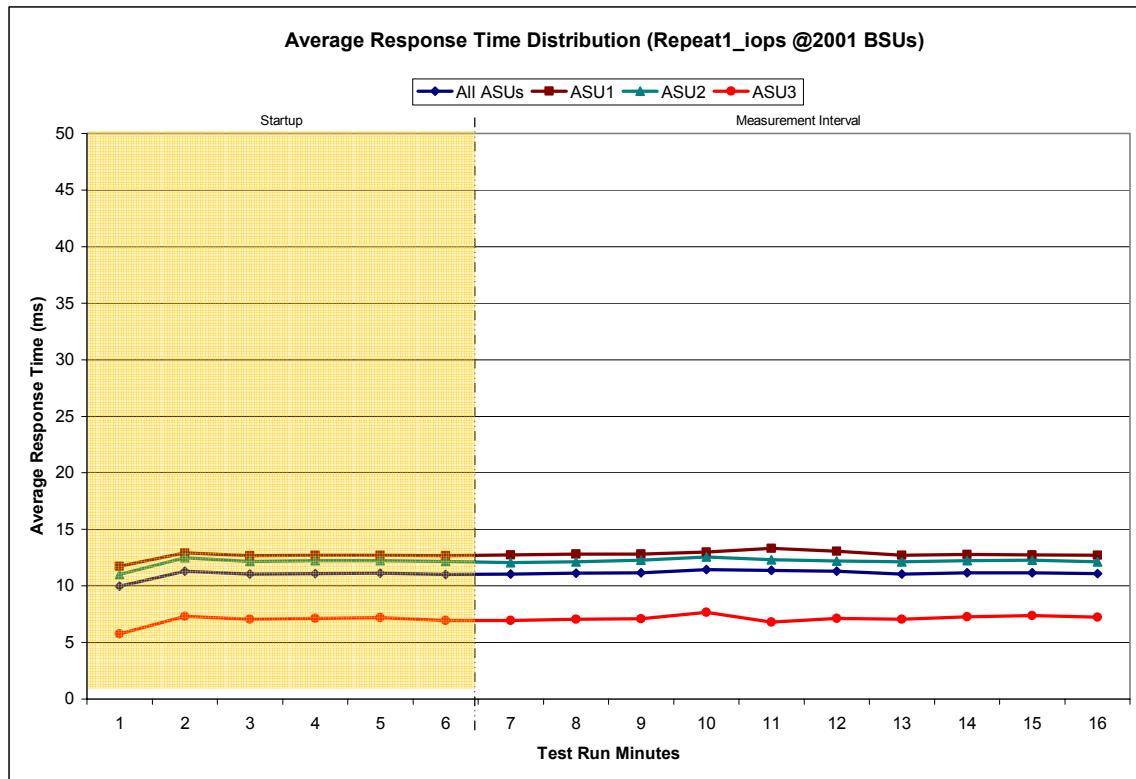
Repeatability 2 LRT – I/O Request Throughput Distribution Data

200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:45:55	22:51:55	0-5	0:06:00
Measurement Interval	22:51:55	23:01:56	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	9,980.02	5,948.68	1,232.77	2,798.57
1	10,006.08	5,971.38	1,230.45	2,804.25
2	9,995.08	5,939.00	1,241.63	2,814.45
3	9,993.03	5,954.52	1,228.45	2,810.07
4	9,987.60	5,957.97	1,228.22	2,801.42
5	10,001.98	5,975.90	1,219.02	2,807.07
6	9,986.27	5,949.58	1,228.60	2,808.08
7	10,011.42	5,976.93	1,225.70	2,808.78
8	9,998.83	5,959.57	1,228.93	2,810.33
9	9,976.67	5,944.93	1,222.47	2,809.27
10	9,992.02	5,955.67	1,226.78	2,809.57
11	9,995.97	5,957.53	1,227.30	2,811.13
12	9,997.82	5,956.75	1,229.52	2,811.55
13	10,016.98	5,961.38	1,237.45	2,818.15
14	9,992.32	5,944.85	1,233.07	2,814.40
15	9,985.75	5,945.77	1,223.67	2,816.32
Average	9,995.40	5,955.30	1,228.35	2,811.76

Repeatability 2 LRT – I/O Request Throughput Distribution Graph
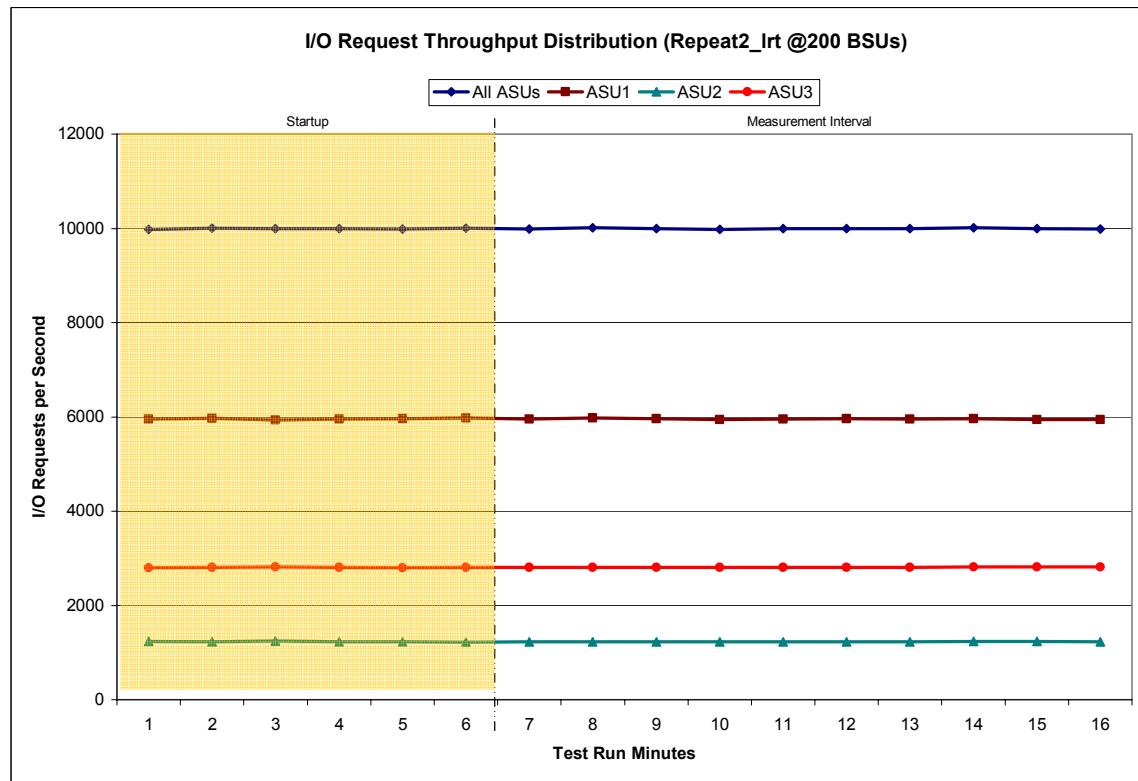
Repeatability 2 LRT –Average Response Time (ms) Distribution Data

200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	22:45:55	22:51:55	0-5	0:06:00
Measurement Interval	22:51:55	23:01:56	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	3.01	3.94	3.36	0.88
1	2.98	3.91	3.23	0.88
2	2.95	3.88	3.17	0.88
3	2.93	3.84	3.19	0.88
4	2.95	3.85	3.26	0.88
5	2.95	3.87	3.22	0.88
6	2.92	3.83	3.21	0.88
7	2.93	3.83	3.24	0.88
8	2.94	3.85	3.21	0.88
9	2.93	3.83	3.21	0.88
10	2.94	3.85	3.22	0.88
11	2.92	3.84	3.13	0.88
12	2.92	3.83	3.14	0.88
13	2.92	3.82	3.23	0.88
14	2.93	3.85	3.17	0.88
15	2.93	3.85	3.21	0.88
Average	2.93	3.84	3.20	0.88

Repeatability 2 LRT –Average Response Time (ms) Distribution Graph
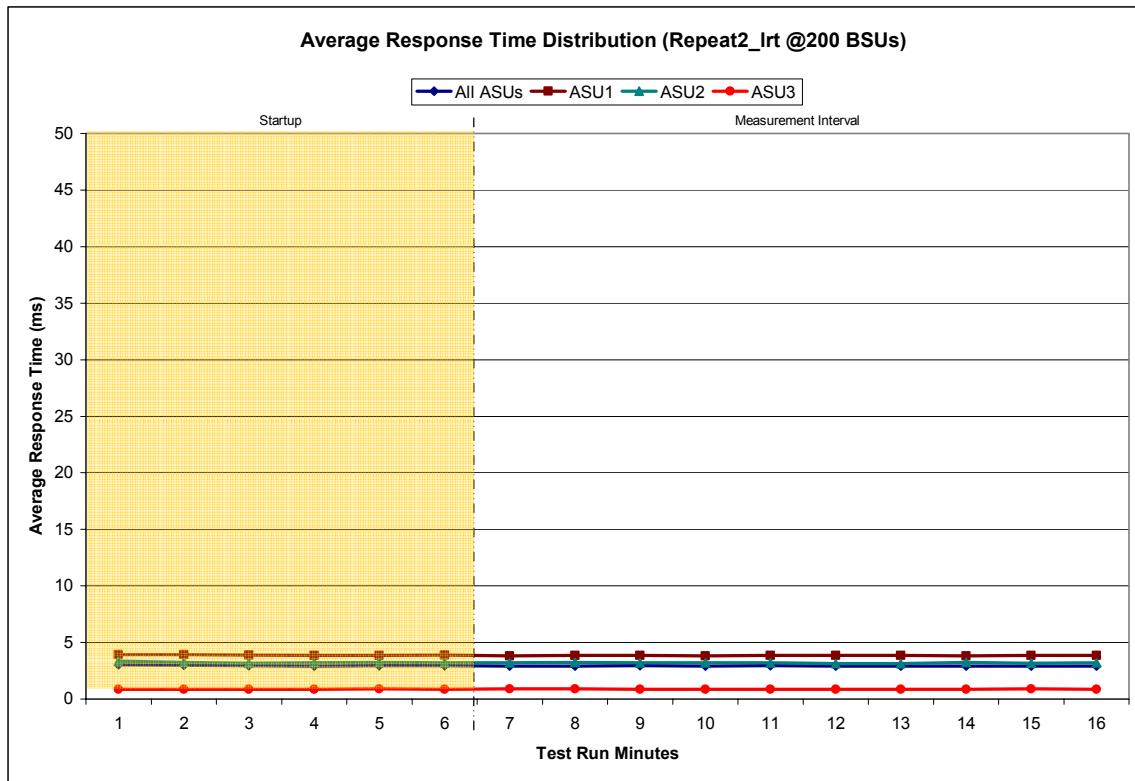
Repeatability 2 IOPS – I/O Request Throughput Distribution Data

2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:05:49	23:11:50	0-5	0:06:01
Measurement Interval	23:11:50	23:21:51	6-15	0:10:01
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	100,148.15	59,689.35	12,315.47	28,143.33
1	100,116.50	59,669.82	12,312.35	28,134.33
2	100,048.58	59,618.18	12,317.43	28,112.97
3	100,144.38	59,642.40	12,334.43	28,167.55
4	100,131.15	59,666.78	12,324.50	28,139.87
5	100,024.78	59,592.62	12,311.50	28,120.67
6	100,070.20	59,655.83	12,290.03	28,124.33
7	100,106.32	59,691.78	12,328.52	28,086.02
8	100,065.23	59,591.92	12,320.97	28,152.35
9	100,034.28	59,654.65	12,292.32	28,087.32
10	100,041.25	59,619.00	12,308.80	28,113.45
11	99,992.07	59,603.45	12,302.03	28,086.58
12	100,090.10	59,653.42	12,296.92	28,139.77
13	100,075.23	59,619.37	12,301.52	28,154.35
14	100,069.38	59,599.63	12,307.40	28,162.35
15	100,074.45	59,632.90	12,295.45	28,146.10
Average	100,061.85	59,632.20	12,304.40	28,125.26

Repeatability 2 IOPS – I/O Request Throughput Distribution Graph
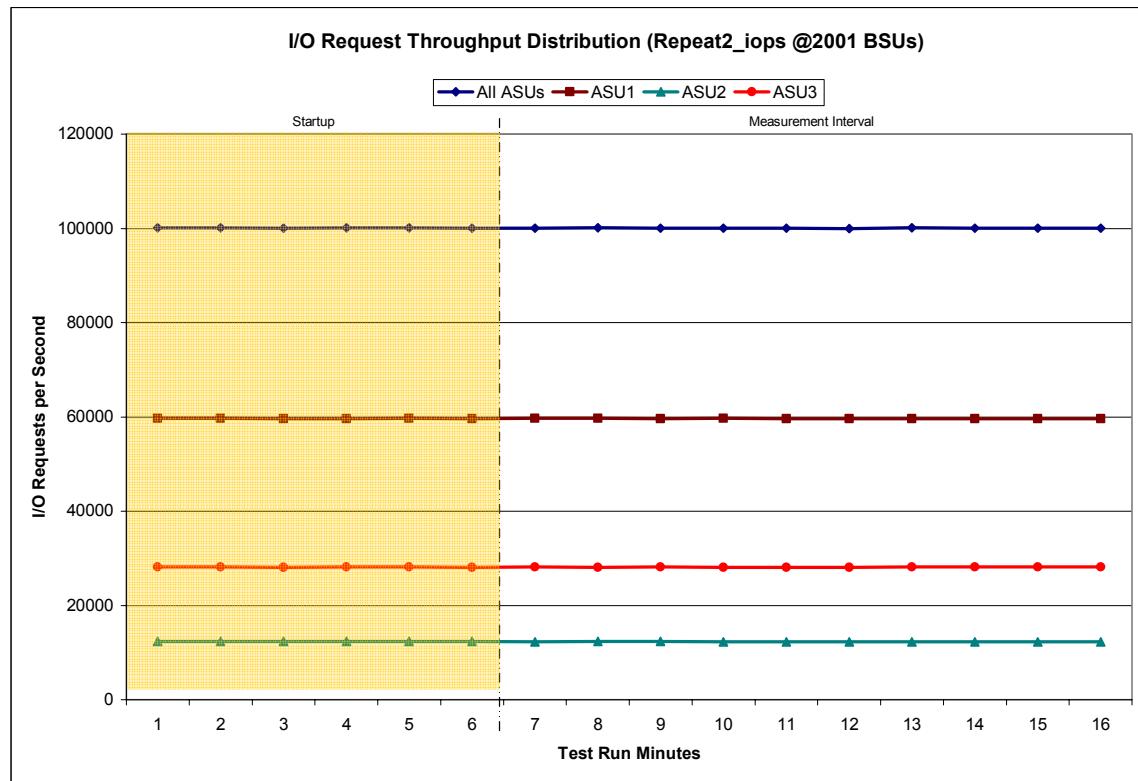
Repeatability 2 IOPS –Average Response Time (ms) Distribution Data

2001 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:05:49	23:11:50	0-5	0:06:01
Measurement Interval	23:11:50	23:21:51	6-15	0:10:01
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	10.64	12.03	11.87	7.17
1	11.80	12.98	13.33	8.62
2	11.37	12.63	13.13	7.94
3	11.47	12.73	13.00	8.13
4	11.52	12.86	13.01	8.03
5	11.39	12.73	12.91	7.88
6	11.48	12.77	13.06	8.05
7	11.38	12.71	13.03	7.84
8	11.65	12.93	13.26	8.23
9	11.57	12.91	13.07	8.05
10	11.45	12.77	12.95	7.99
11	11.34	12.68	12.89	7.81
12	11.38	12.66	12.99	7.96
13	11.35	12.60	12.99	7.99
14	11.27	12.55	12.85	7.87
15	11.46	12.80	12.98	7.95
Average	11.43	12.74	13.01	7.97

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

SPC BENCHMARK 1™ V1.8   FULL DISCLOSURE REPORT   Submitted for Review: MARCH 8, 2004
3PARdata, Inc.   Submission Identifier: A00027
3PAR InServ™ S800 X-Series *(8-Node)*   Accepted: MAY 7, 2004
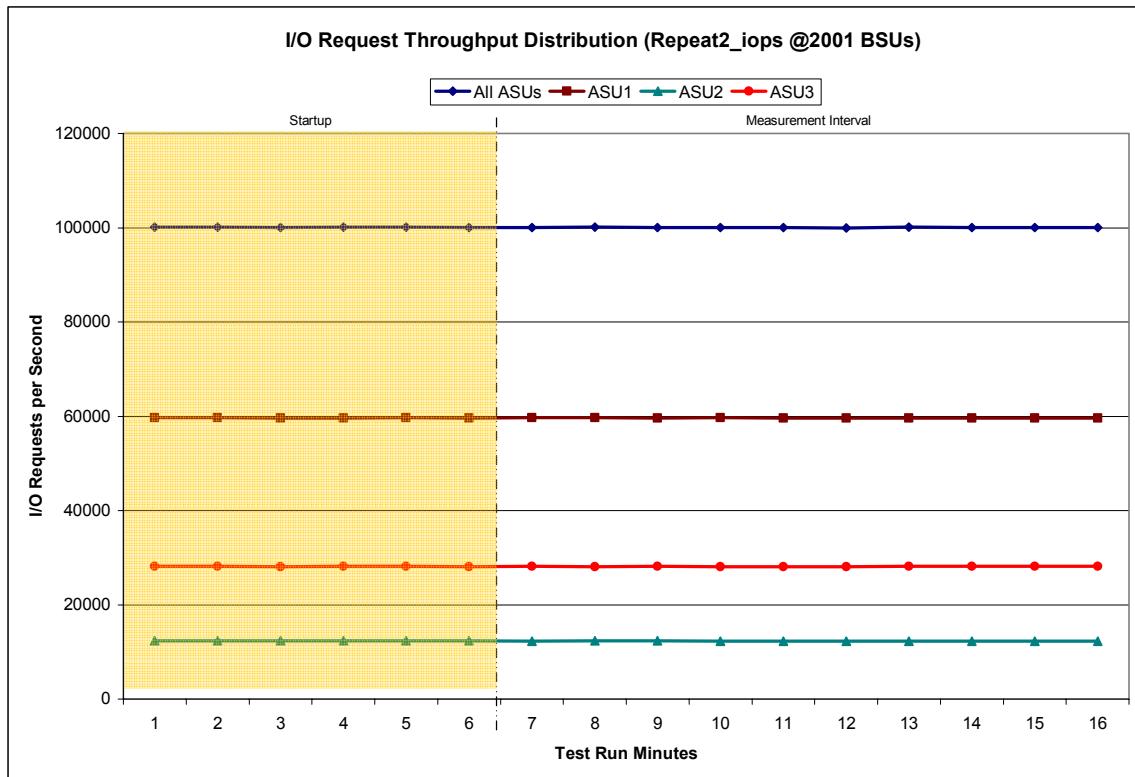
Repeatability 1 (LRT)
Measured Intensity Multiplier and Coefficient of Variation

	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	0.0350	0.2813	0.0699	0.2099	0.0181	0.0701	0.0349	0.2810
COV	0.008	0.003	0.004	0.002	0.010	0.004	0.006	0.003

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.*

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%.*

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	0.2101	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.001	0.001	0.001	0.003	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	0.0350	0.2810	0.0699	0.2099	0.0180	0.0699	0.0350	0.2813
COV	0.006	0.002	0.004	0.002	0.008	0.005	0.007	0.001

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

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

Data Persistence Test

Clause 6

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

- *Is capable of maintain data integrity across a power cycle.*

- *Ensures the transfer of data between Logical Volumes and host systems occurs without corruption or loss.*

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

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

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

Clause 9.2.4.8

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

1. *A listing or screen image of all input parameters supplied to the Workload Generator.*

2. *For the successful Data Persistence Test Run, able 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 Data Persistence Test are listed below:

java -Xmx512m -Xms512m -Xss128k persist1 -b 2020

java -Xmx512m -Xms512m -Xss128k persist2

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	145,843,728
Total Number of Logical Blocks Verified	111,207,248
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 3PAR InServ™ S800 X-Series, as documented in this Full Disclosure Report became available for customer purchase and shipment on March 8, 2004.

PRICING INFORMATION

Clause 9.2.4.11

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

Pricing information may found in the Tested Storage Configuration Pricing section on page 12.

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 3PAR InServ™ S800 X-Series.

APPENDIX A: OPERATING SYSTEM CONFIGURATION

Microsoft Windows 2003 Server Enterprise Edition was installed with the following Security Patches:

- Cumulative Security Update for Internet Explorer for Windows Server 2003 (KB832894)
- Security Update for Microsoft Windows Server 2003 (KB828035)
- Security Update for Microsoft Windows (KB823182)
- 823559: Security Update for Microsoft Windows
- Security Update for Microsoft Data Access Components (KB832483)
- Security Update for Microsoft Windows Server 2003 (KB825119)
- Update for Windows Media Player Script Commands (KB828026)
- Security Update for Microsoft Windows (KB824105)
- Security Update for Microsoft Windows (KB824141)
- Security Update for Windows Server 2003 (KB824146)
- Security Update for Windows Server 2003 (819696)

APPENDIX B: HOST BUS ADAPTER (HBA) CONFIGURATION

Host bus adapter (HBA) information:

HBA:	QLogic QLA2342
HBA BIOS:	QLA2342, version 1.34
HBA Driver:	QLA2342, version 8.2.3.11
HBA Utility:	SANblade, version 2.0.26

The following HBA parameters were enabled for the benchmark measurement:

Fast!Util > *Configuration Settings* > *Host Adapter Settings*

Host Adapter BIOS	Disabled
Frame Size	2048
Loop Reset Delay	5
Adapter Hard Loop ID	Disabled
Hard Loop ID	0
Spinup Delay	Disabled
Connection Option	0
Fibre Channel Tape Support	Disabled
Data Rate	2

Fast!Util > *Configuration Settings* > *Advanced Adapter Settings*

Execution Throttle	256
LUNs per Target	256
Enable LIP Reset	Yes
Enable LIP Full Login	Yes
Enable Target Reset	Yes
Login Retry Count	8
Port Down Retry Count	8
Link Down Timeout	0
Extended Error Logging	Disabled
RIO Operation Mode	0
Interrupt Delay Timer	0

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

The following script creates and configures the logical TSC:

```
#/bin/bash
#
# As part of the out of the box (OOTB) installation, the admin volume, logging devices and spare are created

###
# The following commands create the host definition for HP Proliant (CPQ1, CPQ2, CPQ3, and CPQ4)
# which are slave hosts, each has a host connection to each node 0 through 7 on a separate FC connection
#
createhost cpq10 210000E08B1075F1
createhost cpq11 210000E08B10AFF1
createhost cpq12 210000E08B1061F1
createhost cpq13 210000E08B10B0F1
createhost cpq14 210100E08B3075F1
createhost cpq15 210100E08B30AFF1
createhost cpq16 210100E08B3061F1
createhost cpq17 210100E08B30B0F1
#
createhost cpq20 210000E08B1074F1
createhost cpq21 210000E08B10A4F1
createhost cpq22 210000E08B1055F1
createhost cpq23 210000E08B1094EF
createhost cpq24 210100E08B3074F1
createhost cpq25 210100E08B30A4F1
createhost cpq26 210100E08B3055F1
createhost cpq27 210100E08B3094EF
#
createhost cpq40 210000E08B1079F1
createhost cpq41 210000E08B10A7F1
createhost cpq42 210000E08B10AEF1
createhost cpq43 210000E08B10A5F1
createhost cpq44 210100E08B3079F1
createhost cpq45 210100E08B30A7F1
createhost cpq46 210100E08B30AEF1
createhost cpq47 210100E08B30A5F1
#
createhost cpq30 210000E08B1060F1
createhost cpq31 210000E08B10AAEF
createhost cpq32 210000E08B105EF1
createhost cpq33 210000E08B10B3F1
createhost cpq34 210100E08B3060F1
createhost cpq35 210100E08B30AAEF
createhost cpq36 210100E08B305EF1
createhost cpq37 210100E08B30B3F1
#
####
# The following commands create the host definition for Dell PowerEdge PE1600SC (PE1602, PE1603, PE1604)
# which are slave hosts, each has a host connection to each node 0 through 7 on a separate FC connection
#
createhost pe16020 10000E08B110A1B
createhost pe16021 10000E08B11471B
createhost pe16022 10000E08B11041B
createhost pe16023 10000E08B11F81A
createhost pe16024 10100E08B310A1B
createhost pe16025 10100E08B31471B
createhost pe16026 10100E08B31041B
createhost pe16027 10100E08B31F81A
#
createhost pe16030 10000E08B0759B5
```

```
createhost pe16031 10000E08B0734BE
createhost pe16032 10000E08B07F5BD
createhost pe16033 10000E08B1082F1
createhost pe16034 10100E08B2759B5
createhost pe16035 10100E08B2734BE
createhost pe16036 10100E08B27F5BD
createhost pe16037 10100E08B3082F1
#
createhost pe16040 10000E08B1088EF
createhost pe16041 10000E08B10C8F1
createhost pe16042 10000E08B10A1F1
createhost pe16043 10000E08B10D0F1
createhost pe16044 10100E08B3088EF
createhost pe16045 10100E08B30C8F1
createhost pe16046 10100E08B30A1F1
createhost pe16047 10100E08B30D0F1
#
####
# The following commands create the host definition for Dell PowerEdge PE1750 (del2)
# which is the master hosts, and has only one host connection to a single node
#
createhost del2 210000E08B084950
#
####
# The following commands create 120 Volumes: 72 for ASU1, 24 for ASU2, and 24 for ASU3
#
#
for i in 0 1 2 3 4 5 6 7
do
   createaldvv -t r1 -ss 128 -cnt 9 -p -nd $i asu1.nd${i} 96g
   createaldvv -t r1 -ss 128 -cnt 3 -p -nd $i asu2.nd${i} 288g
   createaldvv -t r1 -ss 128 -cnt 3 -p -nd $i asu3.nd${i} 64g
done


####
# The following commands export 120 VLUNs to each HP Proliant DL580 G2 Server
#
for i in 0 1 2 3 4 5 6 7
do
   for j in 1 2 3 4
   do
     createvlun -cnt 9 asu1.nd${i}.0 0  cpq${j}${i}
     createvlun -cnt 3 asu2.nd${i}.0 10 cpq${j}${i}
     createvlun -cnt 3 asu3.nd${i}.0 13 cpq${j}${i}
   done
done


####
# The following commands export 120 VLUNs to each Dell PowerEdge 1600SC Server
#
for i in 0 1 2 3 4 5 6 7
do
   for j in 2 3 4
   do
     createvlun -cnt 9 asu1.nd${i}.0 0  pe160${j}${i}
     createvlun -cnt 3 asu2.nd${i}.0 10 pe160${j}${i}
     createvlun -cnt 3 asu3.nd${i}.0 13 pe160${j}${i}
   done
done


####
# The following commands export 120 VLUNs to the master host Dell PowerEdge 1750 Server
```

```
#
createvlun -cnt 9 asu1.nd0.0 0  del2
createvlun -cnt 3 asu2.nd0.0 9  del2
createvlun -cnt 3 asu3.nd0.0 12 del2

createvlun -cnt 9 asu1.nd1.0 15 del2
createvlun -cnt 3 asu2.nd1.0 24 del2
createvlun -cnt 3 asu3.nd1.0 27 del2

createvlun -cnt 9 asu1.nd2.0 30 del2
createvlun -cnt 3 asu2.nd2.0 39 del2
createvlun -cnt 3 asu3.nd2.0 42 del2

createvlun -cnt 9 asu1.nd3.0 45 del2
createvlun -cnt 3 asu2.nd3.0 54 del2
createvlun -cnt 3 asu3.nd3.0 57 del2

createvlun -cnt 9 asu1.nd4.0 60 del2
createvlun -cnt 3 asu2.nd4.0 69 del2
createvlun -cnt 3 asu3.nd4.0 72 del2

createvlun -cnt 9 asu1.nd5.0 75 del2
createvlun -cnt 3 asu2.nd5.0 84 del2
createvlun -cnt 3 asu3.nd5.0 87 del2

createvlun -cnt 9 asu1.nd6.0  90 del2
createvlun -cnt 3 asu2.nd6.0  99 del2
createvlun -cnt 3 asu3.nd6.0 102 del2

createvlun -cnt 9 asu1.nd7.0 105 del2
createvlun -cnt 3 asu2.nd7.0 114 del2
createvlun -cnt 3 asu3.nd7.0 117 del2
#
###
# The following commands change the port connected to the host to target mode from the default initiator mode
# The host port are in slot 4 and 5 of each controller node
#
for i in 0 1 2 3 4 5 6 7
do
  for j in 1 2 3 4
  do
    controlport persona 1 -f ${i}:4:${j}
    controlport persona 1 -f ${i}:5:${j}
  done
done
########### END OF SCRIPT #########
```

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

Master configuration file ("SPC1.cfg"):

```
javaparms="-Xmx512m -Xms512m -Xss128k"

host=master
slaves=(slave101,slave102,slave103,slave201,slave202,slave203,slave301,slave302,slave303,slave401,slave402,
slave403,slave601,slave602,slave603,slave701,slave702,slave703,slave801,slave802,slave803)
*
* ASU1
sd=asu1_1,lun=\\.\PhysicalDrive44,size=103079.2m
sd=asu1_2,lun=\\.\PhysicalDrive14,size=103079.2m
sd=asu1_3,lun=\\.\PhysicalDrive104,size=103079.2m
sd=asu1_4,lun=\\.\PhysicalDrive74,size=103079.2m
sd=asu1_5,lun=\\.\PhysicalDrive59,size=103079.2m
sd=asu1_6,lun=\\.\PhysicalDrive29,size=103079.2m
sd=asu1_7,lun=\\.\PhysicalDrive119,size=103079.2m
sd=asu1_8,lun=\\.\PhysicalDrive89,size=103079.2m
sd=asu1_9,lun=\\.\PhysicalDrive43,size=103079.2m
sd=asu1_10,lun=\\.\PhysicalDrive13,size=103079.2m
sd=asu1_11,lun=\\.\PhysicalDrive103,size=103079.2m
sd=asu1_12,lun=\\.\PhysicalDrive88,size=103079.2m
sd=asu1_13,lun=\\.\PhysicalDrive118,size=103079.2m
sd=asu1_14,lun=\\.\PhysicalDrive73,size=103079.2m
sd=asu1_15,lun=\\.\PhysicalDrive6,size=103079.2m
sd=asu1_16,lun=\\.\PhysicalDrive28,size=103079.2m
sd=asu1_17,lun=\\.\PhysicalDrive42,size=103079.2m
sd=asu1_18,lun=\\.\PhysicalDrive12,size=103079.2m
sd=asu1_19,lun=\\.\PhysicalDrive102,size=103079.2m
sd=asu1_20,lun=\\.\PhysicalDrive72,size=103079.2m
sd=asu1_21,lun=\\.\PhysicalDrive57,size=103079.2m
sd=asu1_22,lun=\\.\PhysicalDrive27,size=103079.2m
sd=asu1_23,lun=\\.\PhysicalDrive117,size=103079.2m
sd=asu1_24,lun=\\.\PhysicalDrive87,size=103079.2m
sd=asu1_25,lun=\\.\PhysicalDrive41,size=103079.2m
sd=asu1_26,lun=\\.\PhysicalDrive11,size=103079.2m
sd=asu1_27,lun=\\.\PhysicalDrive101,size=103079.2m
sd=asu1_28,lun=\\.\PhysicalDrive71,size=103079.2m
sd=asu1_29,lun=\\.\PhysicalDrive56,size=103079.2m
sd=asu1_30,lun=\\.\PhysicalDrive26,size=103079.2m
sd=asu1_31,lun=\\.\PhysicalDrive116,size=103079.2m
sd=asu1_32,lun=\\.\PhysicalDrive86,size=103079.2m
sd=asu1_33,lun=\\.\PhysicalDrive40,size=103079.2m
sd=asu1_34,lun=\\.\PhysicalDrive10,size=103079.2m
sd=asu1_35,lun=\\.\PhysicalDrive100,size=103079.2m
sd=asu1_36,lun=\\.\PhysicalDrive70,size=103079.2m
sd=asu1_37,lun=\\.\PhysicalDrive55,size=103079.2m
sd=asu1_38,lun=\\.\PhysicalDrive25,size=103079.2m
sd=asu1_39,lun=\\.\PhysicalDrive115,size=103079.2m
sd=asu1_40,lun=\\.\PhysicalDrive85,size=103079.2m
sd=asu1_41,lun=\\.\PhysicalDrive39,size=103079.2m
sd=asu1_42,lun=\\.\PhysicalDrive9,size=103079.2m
sd=asu1_43,lun=\\.\PhysicalDrive99,size=103079.2m
sd=asu1_44,lun=\\.\PhysicalDrive69,size=103079.2m
sd=asu1_45,lun=\\.\PhysicalDrive54,size=103079.2m
sd=asu1_46,lun=\\.\PhysicalDrive24,size=103079.2m
sd=asu1_47,lun=\\.\PhysicalDrive114,size=103079.2m
```

```
sd=asu1_48,lun=\\.\PhysicalDrive84,size=103079.2m
sd=asu1_49,lun=\\.\PhysicalDrive97,size=103079.2m
sd=asu1_50,lun=\\.\PhysicalDrive113,size=103079.2m
sd=asu1_51,lun=\\.\PhysicalDrive98,size=103079.2m
sd=asu1_52,lun=\\.\PhysicalDrive68,size=103079.2m
sd=asu1_53,lun=\\.\PhysicalDrive53,size=103079.2m
sd=asu1_54,lun=\\.\PhysicalDrive8,size=103079.2m
sd=asu1_55,lun=\\.\PhysicalDrive38,size=103079.2m
sd=asu1_56,lun=\\.\PhysicalDrive83,size=103079.2m
sd=asu1_57,lun=\\.\PhysicalDrive37,size=103079.2m
sd=asu1_58,lun=\\.\PhysicalDrive7,size=103079.2m
sd=asu1_59,lun=\\.\PhysicalDrive23,size=103079.2m
sd=asu1_60,lun=\\.\PhysicalDrive67,size=103079.2m
sd=asu1_61,lun=\\.\PhysicalDrive52,size=103079.2m
sd=asu1_62,lun=\\.\PhysicalDrive22,size=103079.2m
sd=asu1_63,lun=\\.\PhysicalDrive112,size=103079.2m
sd=asu1_64,lun=\\.\PhysicalDrive82,size=103079.2m
sd=asu1_65,lun=\\.\PhysicalDrive36,size=103079.2m
sd=asu1_66,lun=\\.\PhysicalDrive58,size=103079.2m
sd=asu1_67,lun=\\.\PhysicalDrive96,size=103079.2m
sd=asu1_68,lun=\\.\PhysicalDrive66,size=103079.2m
sd=asu1_69,lun=\\.\PhysicalDrive51,size=103079.2m
sd=asu1_70,lun=\\.\PhysicalDrive21,size=103079.2m
sd=asu1_71,lun=\\.\PhysicalDrive111,size=103079.2m
sd=asu1_72,lun=\\.\PhysicalDrive81,size=103079.2m
* ASU2
sd=asu2_1,lun=\\.\PhysicalDrive35,size=309237.6m
sd=asu2_2,lun=\\.\PhysicalDrive5,size=309237.6m
sd=asu2_3,lun=\\.\PhysicalDrive49,size=309237.6m
sd=asu2_4,lun=\\.\PhysicalDrive65,size=309237.6m
sd=asu2_5,lun=\\.\PhysicalDrive50,size=309237.6m
sd=asu2_6,lun=\\.\PhysicalDrive20,size=309237.6m
sd=asu2_7,lun=\\.\PhysicalDrive110,size=309237.6m
sd=asu2_8,lun=\\.\PhysicalDrive80,size=309237.6m
sd=asu2_9,lun=\\.\PhysicalDrive64,size=309237.6m
sd=asu2_10,lun=\\.\PhysicalDrive4,size=309237.6m
sd=asu2_11,lun=\\.\PhysicalDrive94,size=309237.6m
sd=asu2_12,lun=\\.\PhysicalDrive34,size=309237.6m
sd=asu2_13,lun=\\.\PhysicalDrive95,size=309237.6m
sd=asu2_14,lun=\\.\PhysicalDrive19,size=309237.6m
sd=asu2_15,lun=\\.\PhysicalDrive109,size=309237.6m
sd=asu2_16,lun=\\.\PhysicalDrive79,size=309237.6m
sd=asu2_17,lun=\\.\PhysicalDrive33,size=309237.6m
sd=asu2_18,lun=\\.\PhysicalDrive3,size=309237.6m
sd=asu2_19,lun=\\.\PhysicalDrive93,size=309237.6m
sd=asu2_20,lun=\\.\PhysicalDrive63,size=309237.6m
sd=asu2_21,lun=\\.\PhysicalDrive48,size=309237.6m
sd=asu2_22,lun=\\.\PhysicalDrive18,size=309237.6m
sd=asu2_23,lun=\\.\PhysicalDrive108,size=309237.6m
sd=asu2_24,lun=\\.\PhysicalDrive78,size=309237.6m
* ASU3
sd=asu3_1,lun=\\.\PhysicalDrive32,size=67719.5m
sd=asu3_2,lun=\\.\PhysicalDrive2,size=67719.5m
sd=asu3_3,lun=\\.\PhysicalDrive92,size=67719.5m
sd=asu3_4,lun=\\.\PhysicalDrive62,size=67719.5m
sd=asu3_5,lun=\\.\PhysicalDrive16,size=67719.5m
sd=asu3_6,lun=\\.\PhysicalDrive90,size=67719.5m
sd=asu3_7,lun=\\.\PhysicalDrive30,size=67719.5m
sd=asu3_8,lun=\\.\PhysicalDrive77,size=67719.5m
sd=asu3_9,lun=\\.\PhysicalDrive31,size=67719.5m
sd=asu3_10,lun=\\.\PhysicalDrive1,size=67719.5m
sd=asu3_11,lun=\\.\PhysicalDrive91,size=67719.5m
```

```
sd=asu3_12,lun=\\.\PhysicalDrive61,size=67719.5m
sd=asu3_13,lun=\\.\PhysicalDrive45,size=67719.5m
sd=asu3_14,lun=\\.\PhysicalDrive47,size=67719.5m
sd=asu3_15,lun=\\.\PhysicalDrive0,size=67719.5m
sd=asu3_16,lun=\\.\PhysicalDrive76,size=67719.5m
sd=asu3_17,lun=\\.\PhysicalDrive107,size=67719.5m
sd=asu3_18,lun=\\.\PhysicalDrive106,size=67719.5m
sd=asu3_19,lun=\\.\PhysicalDrive46,size=67719.5m
sd=asu3_20,lun=\\.\PhysicalDrive60,size=67719.5m
sd=asu3_21,lun=\\.\PhysicalDrive17,size=67719.5m
sd=asu3_22,lun=\\.\PhysicalDrive15,size=67719.5m
sd=asu3_23,lun=\\.\PhysicalDrive105,size=67719.5m
sd=asu3_24,lun=\\.\PhysicalDrive75,size=67719.5m
```

Slave configuration file ("SPC1.cfg"):

```
javaparms="-Xmx512m -Xms512m -Xss128k"
master=pe1750-02
host=slave301
*
* ASU1
sd=asu1_1,lun=\\.\PhysicalDrive60,size=103079.2m
sd=asu1_2,lun=\\.\PhysicalDrive0,size=103079.2m
sd=asu1_3,lun=\\.\PhysicalDrive45,size=103079.2m
sd=asu1_4,lun=\\.\PhysicalDrive105,size=103079.2m
sd=asu1_5,lun=\\.\PhysicalDrive90,size=103079.2m
sd=asu1_6,lun=\\.\PhysicalDrive30,size=103079.2m
sd=asu1_7,lun=\\.\PhysicalDrive15,size=103079.2m
sd=asu1_8,lun=\\.\PhysicalDrive75,size=103079.2m
sd=asu1_9,lun=\\.\PhysicalDrive61,size=103079.2m
sd=asu1_10,lun=\\.\PhysicalDrive1,size=103079.2m
sd=asu1_11,lun=\\.\PhysicalDrive46,size=103079.2m
sd=asu1_12,lun=\\.\PhysicalDrive76,size=103079.2m
sd=asu1_13,lun=\\.\PhysicalDrive16,size=103079.2m
sd=asu1_14,lun=\\.\PhysicalDrive31,size=103079.2m
sd=asu1_15,lun=\\.\PhysicalDrive8,size=103079.2m
sd=asu1_16,lun=\\.\PhysicalDrive106,size=103079.2m
sd=asu1_17,lun=\\.\PhysicalDrive62,size=103079.2m
sd=asu1_18,lun=\\.\PhysicalDrive2,size=103079.2m
sd=asu1_19,lun=\\.\PhysicalDrive47,size=103079.2m
sd=asu1_20,lun=\\.\PhysicalDrive107,size=103079.2m
sd=asu1_21,lun=\\.\PhysicalDrive92,size=103079.2m
sd=asu1_22,lun=\\.\PhysicalDrive32,size=103079.2m
sd=asu1_23,lun=\\.\PhysicalDrive17,size=103079.2m
sd=asu1_24,lun=\\.\PhysicalDrive77,size=103079.2m
sd=asu1_25,lun=\\.\PhysicalDrive63,size=103079.2m
sd=asu1_26,lun=\\.\PhysicalDrive3,size=103079.2m
sd=asu1_27,lun=\\.\PhysicalDrive48,size=103079.2m
sd=asu1_28,lun=\\.\PhysicalDrive108,size=103079.2m
sd=asu1_29,lun=\\.\PhysicalDrive93,size=103079.2m
sd=asu1_30,lun=\\.\PhysicalDrive33,size=103079.2m
sd=asu1_31,lun=\\.\PhysicalDrive18,size=103079.2m
sd=asu1_32,lun=\\.\PhysicalDrive78,size=103079.2m
sd=asu1_33,lun=\\.\PhysicalDrive64,size=103079.2m
sd=asu1_34,lun=\\.\PhysicalDrive4,size=103079.2m
sd=asu1_35,lun=\\.\PhysicalDrive49,size=103079.2m
sd=asu1_36,lun=\\.\PhysicalDrive109,size=103079.2m
sd=asu1_37,lun=\\.\PhysicalDrive94,size=103079.2m
sd=asu1_38,lun=\\.\PhysicalDrive34,size=103079.2m
sd=asu1_39,lun=\\.\PhysicalDrive19,size=103079.2m
```

```
sd=asu1_40,lun=\\.\PhysicalDrive79,size=103079.2m
sd=asu1_41,lun=\\.\PhysicalDrive65,size=103079.2m
sd=asu1_42,lun=\\.\PhysicalDrive5,size=103079.2m
sd=asu1_43,lun=\\.\PhysicalDrive50,size=103079.2m
sd=asu1_44,lun=\\.\PhysicalDrive110,size=103079.2m
sd=asu1_45,lun=\\.\PhysicalDrive95,size=103079.2m
sd=asu1_46,lun=\\.\PhysicalDrive35,size=103079.2m
sd=asu1_47,lun=\\.\PhysicalDrive20,size=103079.2m
sd=asu1_48,lun=\\.\PhysicalDrive80,size=103079.2m
sd=asu1_49,lun=\\.\PhysicalDrive66,size=103079.2m
sd=asu1_50,lun=\\.\PhysicalDrive21,size=103079.2m
sd=asu1_51,lun=\\.\PhysicalDrive51,size=103079.2m
sd=asu1_52,lun=\\.\PhysicalDrive111,size=103079.2m
sd=asu1_53,lun=\\.\PhysicalDrive96,size=103079.2m
sd=asu1_54,lun=\\.\PhysicalDrive6,size=103079.2m
sd=asu1_55,lun=\\.\PhysicalDrive52,size=103079.2m
sd=asu1_56,lun=\\.\PhysicalDrive81,size=103079.2m
sd=asu1_57,lun=\\.\PhysicalDrive67,size=103079.2m
sd=asu1_58,lun=\\.\PhysicalDrive7,size=103079.2m
sd=asu1_59,lun=\\.\PhysicalDrive36,size=103079.2m
sd=asu1_60,lun=\\.\PhysicalDrive112,size=103079.2m
sd=asu1_61,lun=\\.\PhysicalDrive97,size=103079.2m
sd=asu1_62,lun=\\.\PhysicalDrive37,size=103079.2m
sd=asu1_63,lun=\\.\PhysicalDrive22,size=103079.2m
sd=asu1_64,lun=\\.\PhysicalDrive82,size=103079.2m
sd=asu1_65,lun=\\.\PhysicalDrive68,size=103079.2m
sd=asu1_66,lun=\\.\PhysicalDrive91,size=103079.2m
sd=asu1_67,lun=\\.\PhysicalDrive53,size=103079.2m
sd=asu1_68,lun=\\.\PhysicalDrive113,size=103079.2m
sd=asu1_69,lun=\\.\PhysicalDrive98,size=103079.2m
sd=asu1_70,lun=\\.\PhysicalDrive38,size=103079.2m
sd=asu1_71,lun=\\.\PhysicalDrive23,size=103079.2m
sd=asu1_72,lun=\\.\PhysicalDrive83,size=103079.2m
* ASU2
sd=asu2_1,lun=\\.\PhysicalDrive69,size=309237.6m
sd=asu2_2,lun=\\.\PhysicalDrive9,size=309237.6m
sd=asu2_3,lun=\\.\PhysicalDrive100,size=309237.6m
sd=asu2_4,lun=\\.\PhysicalDrive114,size=309237.6m
sd=asu2_5,lun=\\.\PhysicalDrive99,size=309237.6m
sd=asu2_6,lun=\\.\PhysicalDrive39,size=309237.6m
sd=asu2_7,lun=\\.\PhysicalDrive24,size=309237.6m
sd=asu2_8,lun=\\.\PhysicalDrive84,size=309237.6m
sd=asu2_9,lun=\\.\PhysicalDrive115,size=309237.6m
sd=asu2_10,lun=\\.\PhysicalDrive10,size=309237.6m
sd=asu2_11,lun=\\.\PhysicalDrive55,size=309237.6m
sd=asu2_12,lun=\\.\PhysicalDrive70,size=309237.6m
sd=asu2_13,lun=\\.\PhysicalDrive54,size=309237.6m
sd=asu2_14,lun=\\.\PhysicalDrive40,size=309237.6m
sd=asu2_15,lun=\\.\PhysicalDrive25,size=309237.6m
sd=asu2_16,lun=\\.\PhysicalDrive85,size=309237.6m
sd=asu2_17,lun=\\.\PhysicalDrive71,size=309237.6m
sd=asu2_18,lun=\\.\PhysicalDrive11,size=309237.6m
sd=asu2_19,lun=\\.\PhysicalDrive56,size=309237.6m
sd=asu2_20,lun=\\.\PhysicalDrive116,size=309237.6m
sd=asu2_21,lun=\\.\PhysicalDrive101,size=309237.6m
sd=asu2_22,lun=\\.\PhysicalDrive41,size=309237.6m
sd=asu2_23,lun=\\.\PhysicalDrive26,size=309237.6m
sd=asu2_24,lun=\\.\PhysicalDrive86,size=309237.6m
* ASU3
sd=asu3_1,lun=\\.\PhysicalDrive72,size=67719.5m
sd=asu3_2,lun=\\.\PhysicalDrive12,size=67719.5m
sd=asu3_3,lun=\\.\PhysicalDrive57,size=67719.5m
```

```
sd=asu3_4,lun=\\.\PhysicalDrive117,size=67719.5m
sd=asu3_5,lun=\\.\PhysicalDrive43,size=67719.5m
sd=asu3_6,lun=\\.\PhysicalDrive59,size=67719.5m
sd=asu3_7,lun=\\.\PhysicalDrive27,size=67719.5m
sd=asu3_8,lun=\\.\PhysicalDrive87,size=67719.5m
sd=asu3_9,lun=\\.\PhysicalDrive73,size=67719.5m
sd=asu3_10,lun=\\.\PhysicalDrive13,size=67719.5m
sd=asu3_11,lun=\\.\PhysicalDrive58,size=67719.5m
sd=asu3_12,lun=\\.\PhysicalDrive118,size=67719.5m
sd=asu3_13,lun=\\.\PhysicalDrive42,size=67719.5m
sd=asu3_14,lun=\\.\PhysicalDrive102,size=67719.5m
sd=asu3_15,lun=\\.\PhysicalDrive14,size=67719.5m
sd=asu3_16,lun=\\.\PhysicalDrive88,size=67719.5m
sd=asu3_17,lun=\\.\PhysicalDrive74,size=67719.5m
sd=asu3_18,lun=\\.\PhysicalDrive28,size=67719.5m
sd=asu3_19,lun=\\.\PhysicalDrive103,size=67719.5m
sd=asu3_20,lun=\\.\PhysicalDrive119,size=67719.5m
sd=asu3_21,lun=\\.\PhysicalDrive104,size=67719.5m
sd=asu3_22,lun=\\.\PhysicalDrive44,size=67719.5m
sd=asu3_23,lun=\\.\PhysicalDrive29,size=67719.5m
sd=asu3_24,lun=\\.\PhysicalDrive89,size=67719.5m
```

APPENDIX E: THIRD-PARTY PRICE QUOTATIONS

Qlogic HBAs:

Order Preview

I C T

ICTcompany.com   800-772-5188   Saturday, February 28 2004, 21:24

Search for: [   ] [Search]

(Home) (About) (Trade) (Contact) (Support) 🛒 (1 item)   HACKER SAFE TESTED DAILY 30-JAN

Home > **Order Preview** > Buyer's Information > Shipping Method > Payment Method

ICT Part #:	QLA2342-CK
Manufact. Part#:	QLA2342-CK
Category :	Fiber Optic Products
Availability :	In stock
Quantity :	13
Weight :	0.5 lb.
Condition:	New OEM This product is new in original BULK package.

Item	Description	Price	Avail.Qty.	Qty.	Ext.Price
QLA2342-CK	Qlogic QLA2342 2Gbit/s Fibre Channel to PCI-X Host Bus Adapters - New OEM	$1,595.00	13	1	$1,595.00
TOTAL:					$1,595.00

Qlogic HBA Support:

Symbiat		SALES QUOTE		
4920 Avalon Ridge Pkwy				
Suite 600			Quote #	Date
Norcross, GA 30071			AV02020403-3PAR	February 27, 2004
866 SYMBIAT				
Fax: 770-638-6996				

Customer		End User	
Company Name	3PAR	Company Name	
Contact Name	Geoff Hough	Contact Name	
Company Address		Company Address	
Ste #		Ste #	
City, State Zip		City, State Zip	
phone		phone	
fax		fax	
email	geoff@3pardata.com	email	

Terms	Sales Representative	Strategic Account Manager		Page
PrePay	AV	RMcC		1 of 1

Manufacturer	Manufacturer Part #	Description	Qty	Symbiat Price	Total Amount
Qlogic	QLA2342	Qlogic 2Gb dual FC PCI HBA (SANblade 2300)	2	$756.00	$1,512.00
		All the above equipment covered under **24x7x4** maintenance for a period of Three **(3) years**			

This quotation is valid for fifteen days. This quotation is based on all the above components being placed under one maintenance contract, if components are added or subtracted a new quotation will be required. Equipment is presumed to be fully functional prior to placing under maintenance and a thirty-day "grace period" is in effect from acceptance of contract by Symbiat to a first call being placed on equipment. All orders are subject to Symbiat's standard terms and conditions. This quotation is subject to review of a final equipment list to be supplied to Symbiat. Maintenance will not be in effect until a FULL component list is supplied to Symbiat. All service contracts are pre-pay unless otherwise stated. Replacement parts may be refurbished units and may be same, like, similar, or better than. Coverage is provided for hardware only (no software or software applications, unless otherwise quoted). Symbiat will diagnose hardware issues "through" the operating system. Coverage is NOT provided for consumables. Consumables are considered to be any parts that may be worn out or depleted by use, for example batteries, printer ribbons etc.

The information contained within this quotation including but not limited to prices, equipment lists, and terms and conditions is the property of the two parties and constitutes a confidential exchange of information between the parties. Note: Pricing is based on a failure rate no greater than 6% should the failure rate exceed 6% pricing may change.

Total	$1,512.00