SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

IBM CORPORATION
IBM TOTALSTORAGE DS4500
(MIRRORED WRITE CACHE)

SPC-1 V1.7

Submitted for Review: August 26, 2003
Submission Identifier: A00019
Accepted: October 25, 2003
Revised: September 5, 2006

First Edition – August 2003

Trademarks

SPC Benchmark 1, SPC-1 IOPS, and SPC-1 LRT are trademarks of the Storage Performance Council. FAStT600 with Turbo Option and FAStT900 are trademarks of IBM Corporation. IBM Corporation and IBM TotalStorage are registered trademarks of IBM Corporation. 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 vi

Letter of Good Faith viii

Executive Summary 9

- **Test Sponsor and Contact Information** 9
- **Revision Information and Key Dates** 9
- **Summary of Results** 10
- **Response Time – Throughput Curve** 11
- **Response Time – Throughput Data** 11
- **Tested Storage Configuration Pricing** 12
- **Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration** 12
- **Benchmark Configuration/Tested Storage Configuration Diagram** 13

Configuration Information 15

- **Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram** 15
- **Storage Network Configuration** 16
- **Host System Configuration** 17
- **Customer Tuning Parameters and Options** 17
  - Windows 2000 Registry Changes 17
  - Array Controller Options 17
  - Host Bus Adapter Options 18
- **Tested Storage Configuration (TSC) Description** 19
- **SPC-1 Workload Generator Storage Configuration** 19

Data Repository 20

- **Definitions** 20
- **Storage Capacities and Relationships** 21
  - SPC-1 Storage Capacities 21
  - SPC-1 Storage Capacities and Relationships Illustration 21
  - SPC-1 Storage Hierarchy Ratios 22
- **Logical Volume Capacity and ASU Mapping** 22

SPC-1 Benchmark Execution Results 23

- **Definitions** 23
- **Sustainability Test Phase** 23
  - SPC-1 Workload Generator Input Parameters 24
  - Sustainability Test Results File 24
  - Sustainability – Data Rate Distribution Data *(MB/second)* 25

Sustainability – Data Rate Distribution Graph 25
Sustainability – Data Rate Distribution Graph 26
Sustainability – I/O Request Throughput Distribution Data 27
Sustainability – I/O Request Throughput Distribution Graph 27
Sustainability – I/O Request Throughput Distribution Graph 28
Sustainability – Measured Intensity Multiplier and Coefficient of Variation 28
IOPS Test Phase 29
SPC-1 Workload Generator Input Parameters 29
IOPS Test Results File 29
IOPS Test Run – I/O Request Throughput Distribution Data 30
IOPS Test Run – I/O Request Throughput Distribution Graph 30
IOPS Test Run – Response Time Frequency Distribution Data 30
IOPS Test Run – Response Time Frequency Distribution Data 31
IOPS Test Run –Response Time Frequency Distribution Graph 31
IOPS Test Run – Average Response Time (ms) Distribution Data 31
IOPS Test Run – Average Response Time (ms) Distribution Data 32
IOPS Test Run – Average Response Time (ms) Distribution Graph 32
IOPS Test Run – I/O Request Information 33
IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation 33
Response Time Ramp Test Phase 34
SPC-1 Workload Generator Input Parameters 34
Response Time Ramp Test Results File 34
Response Time Ramp Distribution (IOPS) Data 34
Response Time Ramp Distribution (IOPS) Graph 35
SPC-1 LRT™ Average Response Time (ms) Distribution Data 35
SPC-1 LRT™ Average Response Time (ms) Distribution Data 36
SPC-1 LRT™ Average Response Time (ms) Distribution Graph 36
SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation 37
Repeatability Test 38
SPC-1 Workload Generator Input Parameters 38
Repeatability Test Results File 38
Repeatability 1 LRT – I/O Request Throughput Distribution Data 40
Repeatability 1 LRT – I/O Request Throughput Distribution Graph 40
Repeatability 1 LRT –Average Response Time (ms) Distribution Data 40
Repeatability 1 LRT –Average Response Time (ms) Distribution Data 41
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph 41
Repeatability 1 IOPS – I/O Request Throughput Distribution Data 41
Repeatability 1 IOPS – I/O Request Throughput Distribution Data 42
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph 42

Repeatability 1 IOPS –Average Response Time (ms) Distribution Data 42
Repeatability 1 IOPS –Average Response Time (ms) Distribution Data 43
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph 43
Repeatability 2 LRT – I/O Request Throughput Distribution Data 44
Repeatability 2 LRT – I/O Request Throughput Distribution Graph 44
Repeatability 2 LRT –Average Response Time (ms) Distribution Data 44
Repeatability 2 LRT –Average Response Time (ms) Distribution Data 45
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph 45
Repeatability 2 IOPS – I/O Request Throughput Distribution Data 45
Repeatability 2 IOPS – I/O Request Throughput Distribution Data 46
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph 46
Repeatability 2 IOPS –Average Response Time (ms) Distribution Data 46
Repeatability 2 IOPS –Average Response Time (ms) Distribution Data 47
Repeatability 2 IOPS –Average Response Time (ms) Distribution Graph 47
Repeatability 1 (LRT) Measured Intensity Multiplier and Coefficient of Variation 47
Repeatability 1 (LRT) Measured Intensity Multiplier and Coefficient of Variation 48
Repeatability 1 (IOPS) Measured Intensity Multiplier and Coefficient of Variation 48
Repeatability 2 (LRT) Measured Intensity Multiplier and Coefficient of Variation 48
Repeatability 2 (IOPS) Measured Intensity Multiplier and Coefficient of Variation 48
Data Persistence Test 49
SPC-1 Workload Generator Input Parameters 49
Data Persistence Test Results File 49
Data Persistence Test Results 50
Tested Storage Configuration (TSC) Availability Date 51
Pricing Information 51
Anomalies or Irregularities 51
Appendix A: SPC-1 Workload Generator Storage Configuration Commands and Parameters 52
Master Host System: 52
Slave Host System 1: 53
Slave Host System 2: 54
Appendix B: Tested Storage Configuration (TSC) Creation/Configuration Script 56

AUDIT CERTIFICATION

IBM Corporation
Bruce McNutt
KBV/9062-2
9000 S. Rita Road
Tucson, AZ 85744

August 26, 2003

The SPC Benchmark 1™ results listed below for the IBM TotalStorage® FAStT900 *(mirrored write cache)* were produced in compliance with the SPC Benchmark 1™ V1.7 Remote Audit requirements.

SPC Benchmark 1™ V1.7 Results	
Tested Storage Configuration (TSC) Name: IBM TotalStorage® FAStT900 *(mirrored write cache)*	
Metric	**Reported Result**
SPC-1 IOPS™	18,447.55
SPC-1 Price-Performance	$16.78/SPC-1 IOPS™
Total ASU Capacity	1,196.09 GB
Data Protection Level	Mirroring
SPC-1 LRT™	2.03 ms
Total TSC Price (including three-year maintenance)	$309,449

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with V1.7 of the SPC Benchmark 1™ specification:

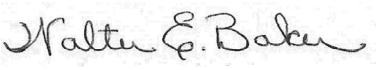
- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified using information supplied by IBM Corporation:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.

- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, included customer tunable parameters.
- Commands and parameters used to configure the SPC-1 Workload Generator.
- The following Host System requirements were reviewed using documentation supplied by IBM Corporation:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The Test Results Files and resultant Summary Results Files received for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification:
  - ✓ Data Persistence Test
  - ✓ Sustainability Test Phase
  - ✓ IOPS Test Phase
  - ✓ Response Time Ramp Test Phase
  - ✓ Repeatability Test
- The differences between the Tested Storage Configuration (TSC) used for the benchmark and Priced Storage Configuration are documented in the Executive Summary. The differences, if applied to the TSC, would not have a negative impact on the reported SPC-1 performance.
- 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
SPC Auditor

LETTER OF GOOD FAITH

P.O. Box 12195
Research Triangle Park, NC 27709

Date: *26 Aug 2003*

From: *IBM Corporation, Test Sponsor*

Submitted by:
J.R. Hagan, Jr.
VP, Storage Systems
3039 Cornwallis
RTP, NC 27709

Contact Information:
John Ponder / Bruce McNutt
KBV/9062-2
IBM Corporation
9000 S. Rita Road
Tucson, AZ 85744

To: *Walter E. Baker, SPC Auditor*
Gradient Systems, Inc.
643 Bair Island Road, Suite 103
Redwood City, CA 94063-2755

Subject: Letter of good faith for the SPC Benchmark-1™ results on the IBM TotalStorage® FAStT900 (with cache mirroring enabled).

IBM sponsored testing of the above listed product in compliance with the SPC-Benchmark-1 Specification. To the best of our knowledge and belief, the associated test results, including the SPC-1 Full Disclosure Report documenting the SPC Benchmark-1 results (per Clause 10 of the SPC Benchmark-1 Specification), are accurate.

Signed:

J.R. Hagan, Jr.
Vice President, Storage Systems
26 Aug 2003

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	IBM Corporation – www.ibm.com John Ponder ponder@us.ibm.com KBV/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-4388 FAX: (520) 799-5530
Test Sponsor Alternate Contact	IBM Corporation – www.ibm.com Bruce McNutt bmcnutt@us.ibm.com KBV/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-2460 FAX: (520) 799-5530
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	V1.7
SPC-1 Workload Generator revision number	V2.00.03
Date Results were first used publicly	August 26, 2003
Date FDR was submitted to the SPC	August 26, 2003
Date revised FDR was submitted to the SPC	September 5, 2006
Date the TSC is/was available for shipment to customers Product name change from FASt900 to DS4500	September 12, 2003
Date the TSC completed audit certification	August 26, 2003

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM TotalStorage DS4500 *(mirrored write cache)*	
Metric	**Reported Result**
SPC-1 IOPS™	18,447.55
SPC-1 Price-Performance	$16.78/SPC-1 IOPS™
Total ASU Capacity	1,196.092 GB
Data Protection Level	Mirroring
SPC-1 LRT™	2.03 ms
Total TSC Price (including three-year maintenance)	$309,499

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. The Addressable Storage Capacity, which contains the Total ASU Capacity, was 1,196.092 GB. The Total ASU Capacity utilized 100% of the Addressable Storage Capacity. The actual Configured Storage Capacity was 2,392.18 GB, which included the multiple copies of user data required by a Data Protection Level of Mirroring. The Configured Storage Capacity utilized 60.82% of the priced Physical Storage Capacity of 3,933.36 GB.

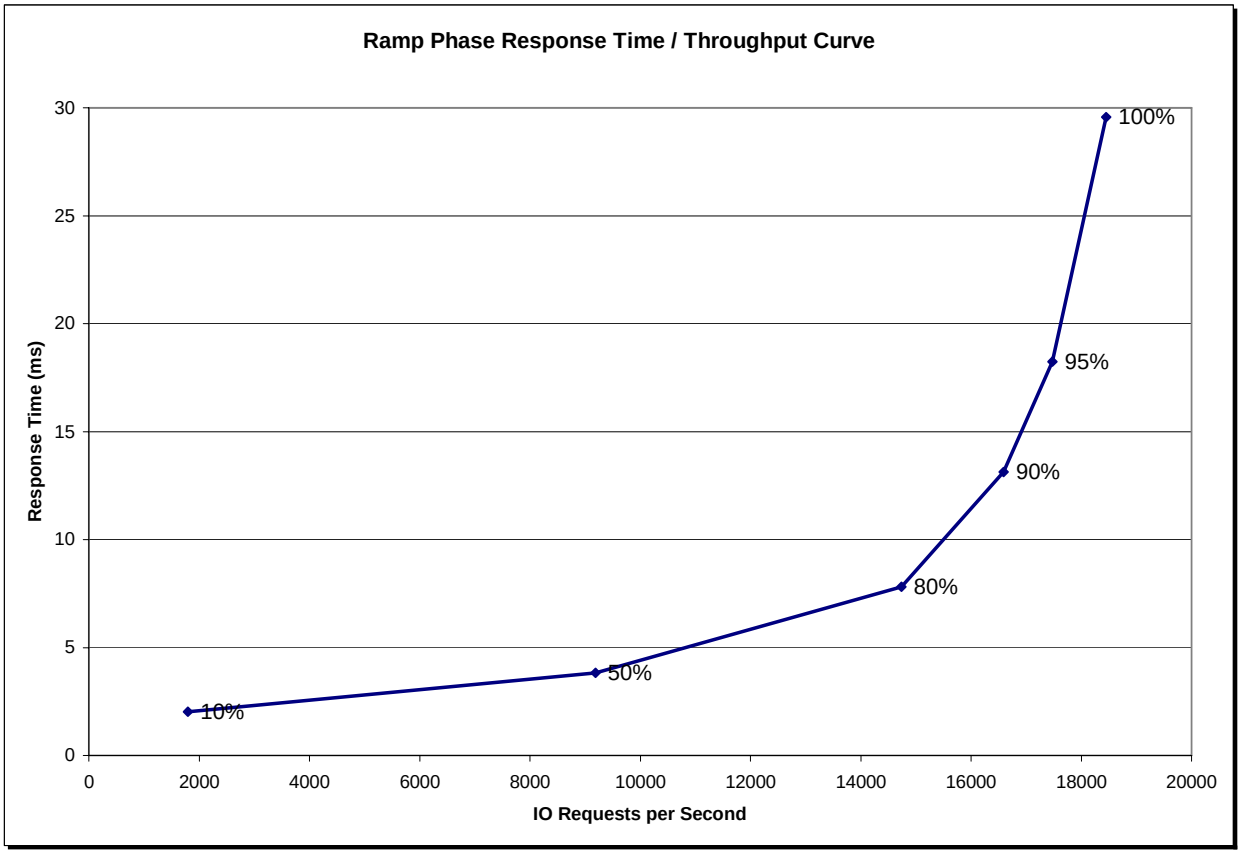
A **Data Protection Level** of Mirroring configures two or more identical copies of user data, maintained on separate disks.

The **SPC-1 LRT™** metric is the Average Response Time measured at the 10% load point, as illustrated on the next page. SPC-1 LRT™ represents the Average Response Time measured on a lightly loaded Tested Storage Configuration (TSC).

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	1,799.52	9,187.16	14,741.60	16,592.22	17,480.36	18,447.55
Average Response Time (ms):						
All ASUs	2.03	3.82	7.81	13.13	18.25	29.57
ASU-1	2.69	4.99	9.49	14.71	19.45	32.31
ASU-2	1.96	3.52	6.33	10.28	14.41	21.00
ASU-3	0.66	1.45	4.87	11.03	17.38	27.53
Reads	4.23	7.46	12.00	15.83	19.13	28.20
Writes	0.60	1.44	5.07	11.37	17.67	30.47

Tested Storage Configuration Pricing

M/T/M	fc#	description	Qty	US List Prices Unit Price	US List Prices Aggregate Price	Total
1742-90U		IBM TotalStorage FAStT900 Storage Server	1	66,500	66,500	
	2104	FAStT FC-2/133 host bus adapter	8	1,485	11,880	
	2210	Shortwave SFP	16	499	7,984	
	3507	FAStT 2Gb miniHub	4	899	3,596	
	5605	5 meter fiber optic cable	8	129	1,032	
	5625	25 meter fiber optic cable	4	189	756	
	7109	FAStT Storage Manager v8.4 upgrade	1	2,999	2,999	
1740-1RU		IBM TotalStorage FAStT EXP700 Storage Expansion Unit	8	6,000	48,000	
	2210	Shortwave SFP	32	499	15,968	
	5211	FAStT 36.4GB/15K rpm 2Gb FC Disk Drive Module	108	1,115	120,420	
	5601	1 meter fiber optic cable	16	79	1,264	
	9009	Attach to FAStT900	8	0	0	
2109-F16		IBM TotalStorage SAN Switch F16	1	25,500	25,500	
	2210	Shortwave Transceiver	4	180	720	
	W73	Warranty Upgrade for 3 years	1	2,880	2,880	
						309,499

NOTES: FAStT models include three year warranty. Warranty extension for 2109-F16 switch added to make entire configuration three years.

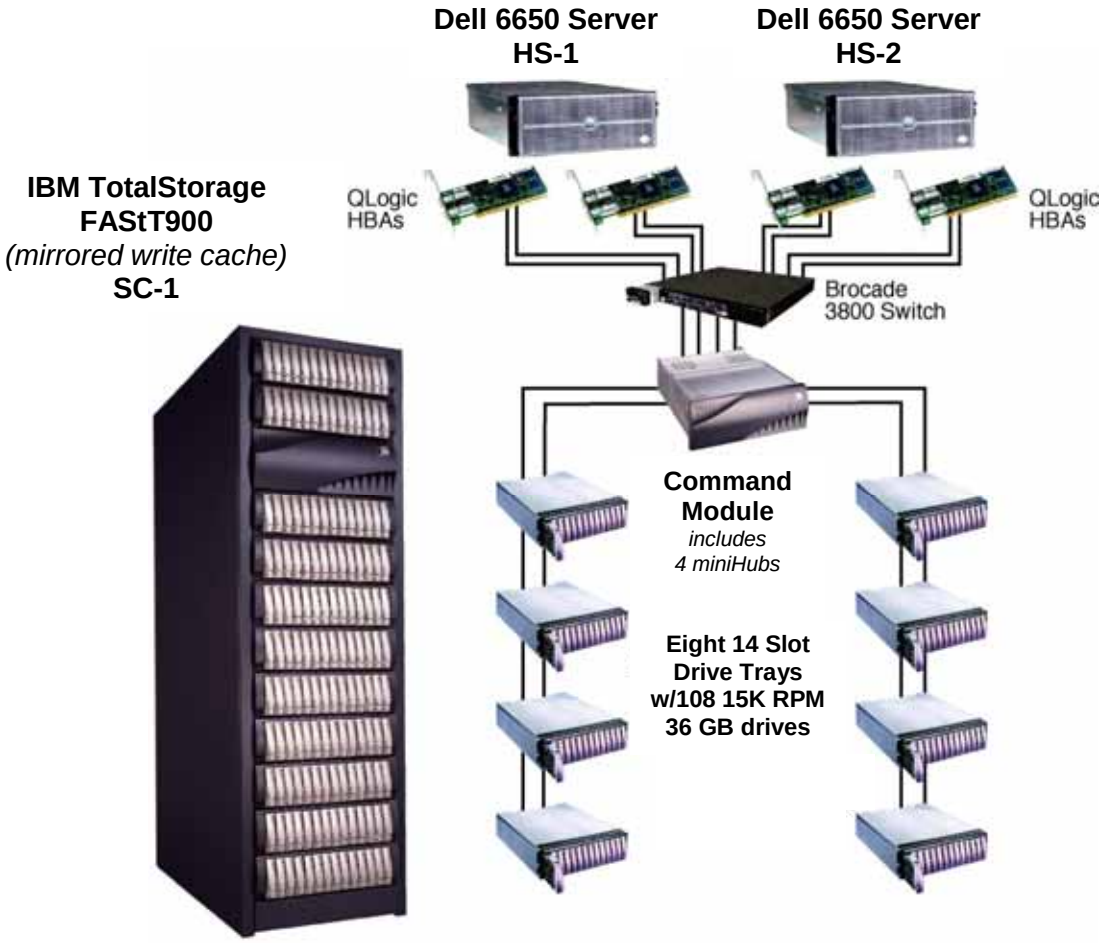
Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The following are the differences between the TSC and Priced Storage Configuration:

- Eight FAStT FC-2/133 HBAs (single port) were priced rather than the four QLogic 2342 dual channel HBAs used in the TSC.
- The priced disk drives have been configured to self-identify as a FAStT brand.
- The mounting of each drive is in an IBM drive carrier.
- The 'data scrubbing' option has a default setting of "off" in the TSC, but would need to be explicitly set to "off" in the Priced Storage Configuration.
- Twenty-five meter fiber optic cables were priced rather than the 30 meter cables used in the TSC.
- The IBM TotalStorage SAN Switch F16 is an IBM relabeled version of the Brocade 3800 Switch identical to the component used in the TSC.

The differences listed above, if applied to the TSC, would not have a negative performance impact on the reported SPC-1 performance.

Benchmark Configuration/Tested Storage Configuration Diagram



Host Systems:	Tested Storage Configuration (TSC):
UID=HS1, HS2	UID=SC-1
2 – Dell 6650 Servers	2 – QLogic 2342 HBAs per Host System
4 – 2 GHz Pentium 4 Xeon CPUs per Host System	Brocade 3800 Switch
3 GB main memory per Host System	Command Module *(includes 4 miniHubs)*
Windows 2000, SP3	2 –Disk Array Controllers 1 GB RAM per controller
WG	4 – 2gb Fibre Channel host connections
	4 – 2gb Fibre Channel drive connections
	8 –Drive Modules
	108 – 36GB 15K RPM Disk Drives

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…

A diagram of the benchmark configuration and tested storage configuration is included on the preceding page. The configuration consists of two host systems, with two Qlogic 2342 PCI to dual-channel 2gb fibre channel host adapters each. The eight host system, fibre channel connections are connected to a Brocade 3800 fibre channel switch. The four fibre channel host connections on the command module are also connected to the Brocade switch. The host system is running Windows 2000, with Service Pack 3 applied.

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 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.

Windows 2000 Registry Changes

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
ql2300\Device\MaximumSGList=0xff

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
ql2300\Device\NumberOfRequests=0xe0

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
Disk\TimeOutValue=0x78

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
ql2300\Device\DriverParameters=UseSameNN=1;BusChange=0;
```

Array Controller Options

All array controller configuration options were set by the configuration script list in “Appendix B: Tested Storage Configuration (TSC) Creation/Configuration Script” on page 56.

Host Bus Adapter Options

The table below lists the Host Bus Adapter options that were changed from their default values.

Host Bus Adapter Settings		
Item	**Default**	**New Value**
Host Adapter Settings		
Loop Reset Delay	5	8
Adapter Hard Loop ID	Disabled	Enabled
Hard Loop ID (unique for each)	0	Eg. 22
Advanced Adapter Settings		
Execution Throttle	16	255
Fast Command Posting	Disabled	Enabled
LUNs per Target	8	0
Enable Target Reset	No	Yes
Login Retry Count	8	30
Port Down Retry Count	8	70
Extended Firmware Settings		
Data Rate	0	2

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.

The Tested Storage Configuration was created and configured using the script that appears in "Appendix B: Tested Storage Configuration (TSC) Creation/Configuration Script" on page 56. The LUNs created by the script comprised the reported Configured Storage Capacity, which contained both the Addressable Storage Capacity and a mirror of the Addressable Storage Capacity.

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 A: SPC-1 Workload Generator Storage Configuration Commands and Parameters" on page 52.

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)	1,196.09
Addressable Storage Capacity	Gigabytes (GB)	1,196.09
Configured Storage Capacity	Gigabytes (GB)	2,392.18
Physical Storage Capacity	Gigabytes (GB)	3,933.36
User Data Copy (Mirroring)	Gigabytes (GB)	1,196.09
Required Storage (metadata) & Hot Spares	Gigabytes (GB)	0.00
Global Storage Overhead	Gigabytes (GB)	57.98
Total Unused Storage	Gigabytes (GB)	1,483.19

The Physical Storage Capacity consisted of 108 disk drives with a formatted capacity of 36.42 GB each. Each disk drive had 0.536 GB reserved by the disk array management firmware, for a total of 57.98 GB of Global Storage Overhead. The Total Unused Storage capacity was 1,483.19 GB.

SPC-1 Storage Capacities and Relationships Illustration

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

<table>
<tr><td colspan="5">Physical Capacity
3,933.36 GB</td></tr>
<tr><td colspan="3">Configured Capacity
2,392.18GB</td><td rowspan="4">Unused Storage
1,483.19GB</td><td rowspan="4">Global
Overhead
57.98GB</td></tr>
<tr><td colspan="2">Addressable Capacity
1,196.09GB</td><td rowspan="3">Addressable Mirror
1,196.09GB</td></tr>
<tr><td colspan="2">ASU Capacity
1,196.09GB</td></tr>
<tr><td>ASU 1
538.24GB</td><td>ASU 2
538.24GB</td><td>ASU 3
119.60GB</td></tr>
</table>

SPC-1 Storage Hierarchy Ratios

SPC-1 Storage Hierarchy Ratios			
	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	100.00%	50.00%	30.41%
User Data Copy (Mirror)		50.00%	30.41%
Addressable Storage Capacity		50.00%	30.41%
Required Storage (metadata) & Hot Spares		0.00%	0.00%
Configured Storage Capacity			60.82%
Global Storage Overhead			1.47%
Unused Storage	0.00%	0.00%	37.71%

The Addressable Storage Capacity and Configured Storage Capacity contained no Unused Storage. The Physical Storage Capacity contained 37.71 % (1,483.19 GB) of Unused Storage.

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 (538.24 GB)	**ASU-2 (538.24 GB)**	**ASU-3 (119.60 GB)**
40 Logical Volumes 13.46 GB per Logical Volume (13.46 GB used/Logical Volume)	1 Logical Volume 538.24 GB per Logical Volume (538.24 GB used/Logical Volume)	1 Logical Volume 119.60 GB per Logical Volume (119.60 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 SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

```
java –Xmx64m –Xms64m metrics –b 369 –s 600
```

Sustainability Test Results File

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

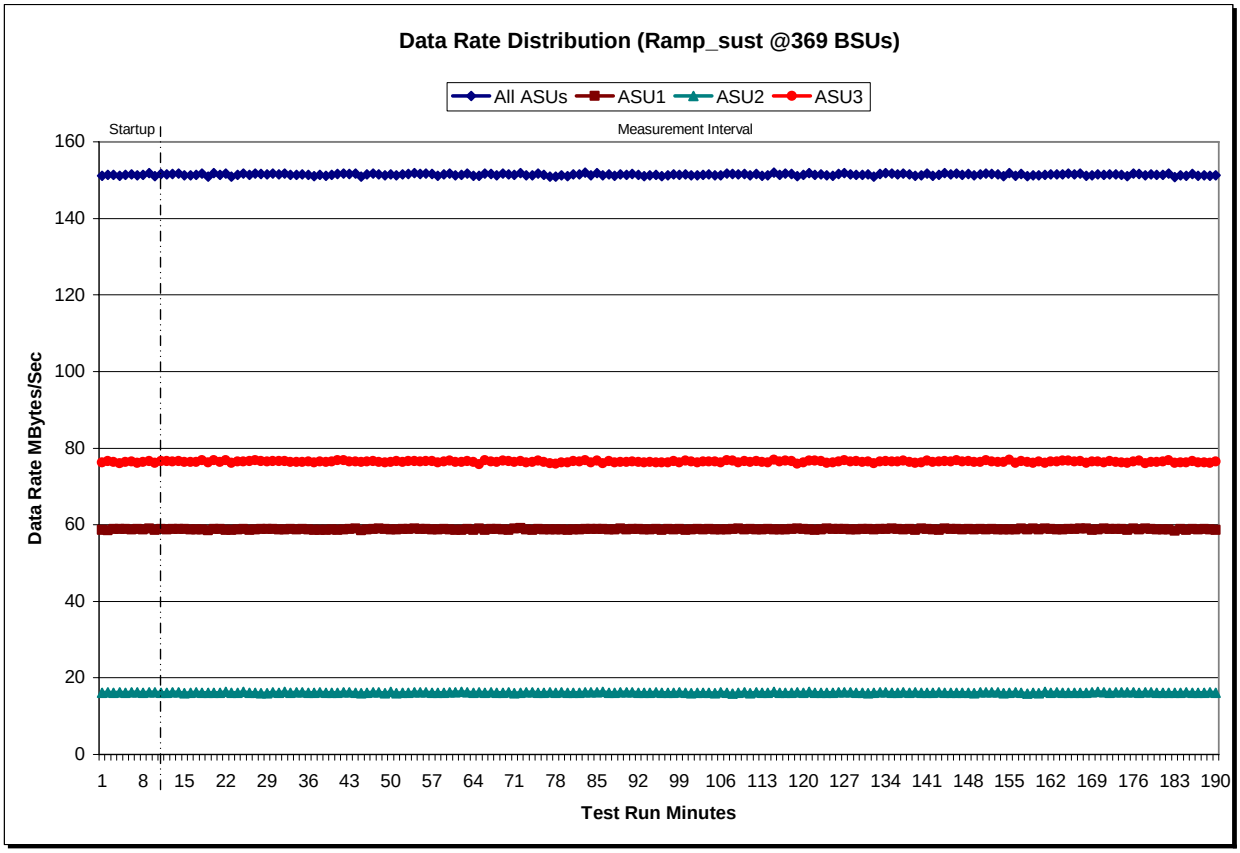
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	16:51:13	17:01:13	0-9	0:10:00
Measurement Interval	17:01:13	20:01:13	9-189	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	151.07	58.66	16.16	76.26	63	151.15	58.62	16.18	76.34	126	151.85	58.82	16.24	76.78
1	151.35	58.53	16.21	76.61	64	151.10	58.98	16.26	75.85	127	151.49	58.79	16.21	76.49
2	151.37	58.91	16.09	76.38	65	151.68	58.68	16.15	76.84	128	151.35	58.72	16.08	76.56
3	151.10	58.86	16.26	75.98	66	151.58	58.85	16.24	76.48	129	151.34	58.85	16.16	76.33
4	151.32	58.83	16.14	76.35	67	151.29	58.85	16.12	76.32	130	151.48	58.89	16.07	76.52
5	151.52	58.77	16.28	76.47	68	151.65	58.79	16.15	76.71	131	150.89	58.78	16.12	75.99
6	151.29	58.84	16.26	76.19	69	151.46	58.64	16.27	76.55	132	151.62	58.89	16.21	76.52
7	151.35	58.74	16.18	76.43	70	151.40	58.95	16.04	76.42	133	151.77	58.90	16.28	76.59
8	151.79	59.03	16.19	76.57	71	151.78	59.09	16.09	76.60	134	151.66	58.97	16.15	76.54
9	151.01	58.58	16.24	76.20	72	151.29	58.72	16.27	76.29	135	151.50	58.90	16.14	76.46
10	151.57	58.84	16.15	76.58	73	151.20	58.63	16.21	76.36	136	151.68	58.76	16.24	76.69
11	151.45	58.75	16.14	76.56	74	151.68	58.84	16.18	76.66	137	151.42	58.89	16.13	76.40
12	151.60	58.86	16.27	76.48	75	151.35	58.78	16.16	76.41	138	151.12	58.68	16.27	76.16
13	151.67	58.84	16.25	76.59	76	150.93	58.74	16.19	76.00	139	151.25	58.94	16.07	76.24
14	151.29	58.91	16.03	76.35	77	150.87	58.78	16.12	75.96	140	151.74	58.90	16.15	76.69
15	151.20	58.71	16.14	76.34	78	151.30	58.72	16.28	76.30	141	151.18	58.70	16.12	76.36
16	151.39	58.78	16.21	76.40	79	150.98	58.66	16.08	76.24	142	151.33	58.60	16.26	76.47
17	151.74	58.74	16.18	76.81	80	151.51	58.78	16.15	76.57	143	151.79	58.99	16.17	76.63
18	150.93	58.57	16.13	76.23	81	151.46	58.80	16.15	76.51	144	151.50	58.83	16.18	76.50
19	151.79	58.88	16.09	76.82	82	151.91	58.84	16.23	76.84	145	151.73	58.82	16.12	76.79
20	151.38	58.89	16.13	76.36	83	151.28	58.81	16.25	76.22	146	151.39	58.70	16.17	76.52
21	151.76	58.68	16.30	76.78	84	151.78	58.83	16.24	76.71	147	151.64	58.90	16.08	76.65
22	150.93	58.65	16.11	76.17	85	151.20	58.84	16.31	76.05	148	151.23	58.76	16.05	76.42
23	151.32	58.72	16.08	76.52	86	151.46	58.74	16.10	76.63	149	151.44	58.82	16.25	76.37
24	151.70	58.91	16.33	76.46	87	151.09	58.74	16.10	76.25	150	151.71	58.72	16.20	76.79
25	151.33	58.66	16.11	76.57	88	151.53	58.93	16.19	76.41	151	151.60	58.83	16.25	76.53
26	151.66	58.78	16.10	76.78	89	151.32	58.79	16.21	76.32	152	151.43	58.75	16.29	76.40
27	151.54	58.88	16.05	76.60	90	151.58	58.85	16.20	76.53	153	151.06	58.70	15.99	76.37
28	151.45	58.90	16.03	76.51	91	151.32	58.83	16.11	76.38	154	151.84	58.71	16.14	77.00
29	151.69	58.83	16.23	76.64	92	151.07	58.76	16.11	76.21	155	151.17	58.77	16.23	76.17
30	151.44	58.75	16.09	76.60	93	151.25	58.75	16.15	76.35	156	151.64	58.95	16.11	76.58
31	151.65	58.79	16.31	76.55	94	151.34	58.86	16.25	76.22	157	151.02	58.75	15.89	76.38
32	151.33	58.82	16.11	76.40	95	151.04	58.68	16.14	76.22	158	151.27	58.95	16.17	76.15
33	151.39	58.77	16.21	76.41	96	151.22	58.81	16.15	76.27	159	151.24	58.70	16.04	76.50
34	151.48	58.81	16.26	76.41	97	151.49	58.78	16.11	76.61	160	151.37	58.95	16.33	76.09
35	151.31	58.69	16.10	76.51	98	151.40	58.90	16.23	76.27	161	151.53	58.85	16.17	76.52
36	151.05	58.58	16.18	76.29	99	151.50	58.68	16.15	76.67	162	151.51	58.75	16.27	76.49
37	151.31	58.62	16.23	76.46	100	151.19	58.79	15.97	76.44	163	151.44	58.69	16.08	76.67
38	151.13	58.61	16.13	76.38	101	151.27	58.89	16.16	76.22	164	151.74	58.84	16.17	76.73
39	151.37	58.76	16.16	76.45	102	151.40	58.80	16.09	76.52	165	151.46	58.85	16.16	76.45
40	151.56	58.68	16.09	76.79	103	151.50	58.86	16.18	76.46	166	151.65	58.92	16.14	76.59
41	151.74	58.73	16.21	76.80	104	151.20	58.71	16.03	76.45	167	151.16	58.94	16.13	76.09
42	151.57	58.84	16.25	76.48	105	151.21	58.72	16.22	76.27	168	151.29	58.65	16.19	76.45
43	151.65	58.99	16.18	76.48	106	151.68	58.71	16.17	76.79	169	151.49	58.70	16.35	76.44
44	150.92	58.54	16.03	76.35	107	151.56	58.91	15.91	76.74	170	151.39	58.93	16.23	76.23
45	151.47	58.78	16.16	76.54	108	151.45	59.01	16.14	76.30	171	151.52	58.81	16.12	76.59
46	151.68	58.81	16.24	76.63	109	151.60	58.80	16.23	76.57	172	151.50	58.87	16.22	76.42
47	151.51	58.93	16.24	76.34	110	151.30	58.82	16.06	76.42	173	151.41	58.84	16.28	76.29
48	151.21	58.92	16.06	76.24	111	151.54	58.75	16.20	76.58	174	151.07	58.61	16.30	76.16
49	151.49	58.77	16.30	76.42	112	151.14	58.71	16.11	76.32	175	151.69	58.97	16.19	76.54
50	151.26	58.71	16.00	76.56	113	151.24	58.82	16.17	76.25	176	151.57	58.73	16.14	76.70
51	151.48	58.92	16.13	76.43	114	151.97	58.69	16.34	76.94	177	151.20	58.92	16.25	76.02
52	151.62	58.88	16.13	76.61	115	151.39	58.70	16.17	76.52	178	151.43	58.83	16.24	76.36
53	151.83	58.97	16.23	76.63	116	151.70	58.79	16.15	76.77	179	151.33	58.80	16.18	76.35
54	151.62	58.83	16.27	76.52	117	151.54	58.85	16.12	76.57	180	151.38	58.76	16.18	76.44
55	151.73	58.86	16.28	76.59	118	151.05	58.92	16.23	75.89	181	151.72	58.74	16.15	76.82
56	151.56	58.79	16.12	76.66	119	151.31	58.88	16.16	76.27	182	150.80	58.45	16.18	76.17
57	151.15	58.77	16.11	76.28	120	151.85	58.78	16.33	76.74	183	151.27	58.82	16.14	76.31
58	151.44	58.82	16.17	76.45	121	151.41	58.62	16.12	76.67	184	151.11	58.63	16.20	76.27
59	151.67	58.71	16.23	76.73	122	151.47	58.73	16.16	76.58	185	151.62	58.88	16.13	76.61
60	151.28	58.69	16.21	76.38	123	151.28	58.97	16.18	76.13	186	151.09	58.76	16.12	76.21
61	151.37	58.66	16.31	76.40	124	151.14	58.81	16.07	76.26	187	151.24	58.85	16.08	76.31
62	151.69	58.83	16.25	76.62	125	151.57	58.87	16.24	76.46	188	151.10	58.73	16.27	76.09
										189	151.29	58.65	16.15	76.50

Sustainability – Data Rate Distribution Graph

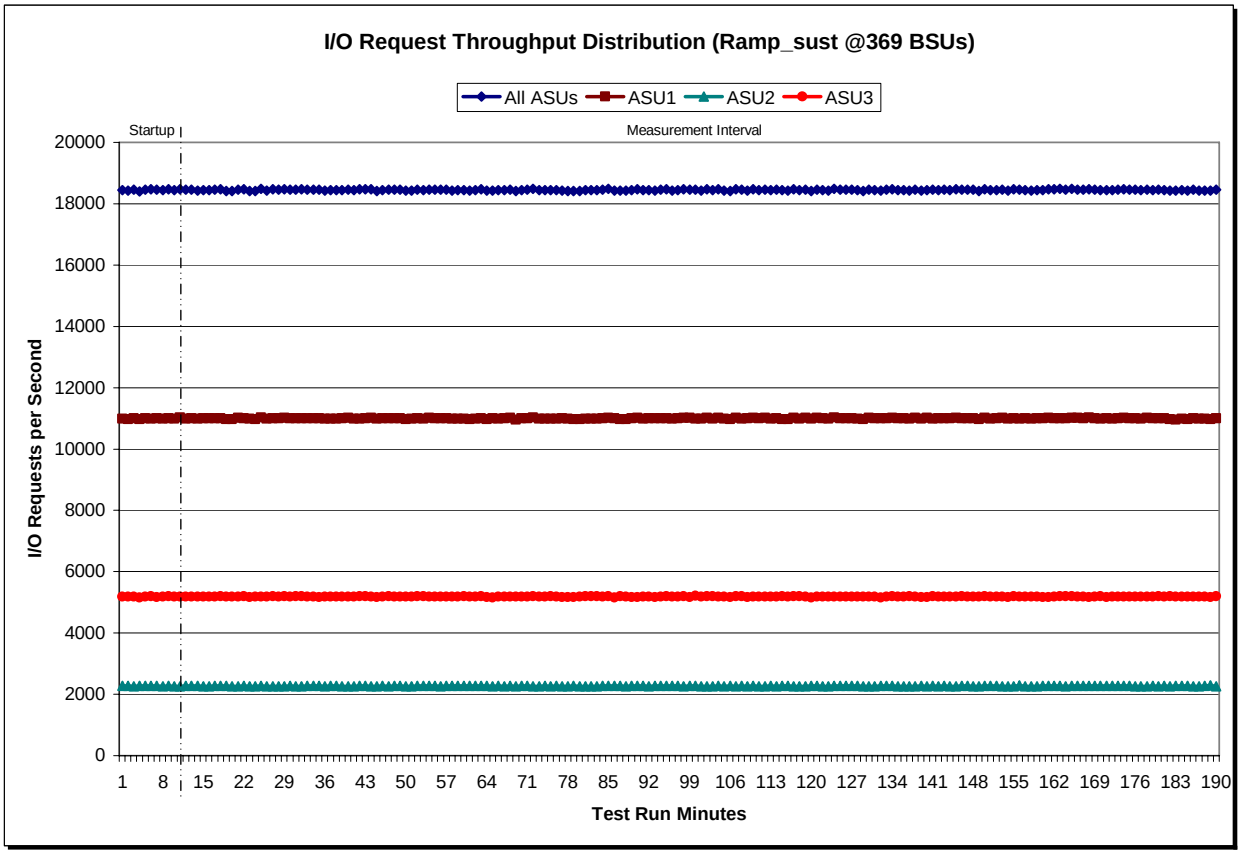


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	16:51:13	17:01:13	0-9	0:10:00
Measurement Interval	17:01:13	20:01:13	10-189	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	18,448.33	10,987.10	2,275.17	5,186.07	63	18,424.50	10,976.17	2,272.33	5,176.00	126	18,459.23	11,003.95	2,271.45	5,183.83
1	18,429.30	10,972.15	2,275.05	5,182.10	64	18,430.32	11,007.33	2,267.00	5,155.98	127	18,440.20	10,985.12	2,273.92	5,181.17
2	18,452.23	11,005.13	2,258.77	5,188.33	65	18,442.98	10,979.38	2,273.67	5,189.93	128	18,412.38	10,968.80	2,265.60	5,177.98
3	18,408.02	10,970.22	2,276.53	5,161.27	66	18,451.72	11,001.37	2,267.13	5,183.22	129	18,464.38	11,013.28	2,267.20	5,183.90
4	18,459.65	11,006.90	2,269.63	5,183.12	67	18,458.45	11,011.33	2,267.85	5,179.27	130	18,451.28	11,001.95	2,264.30	5,185.03
5	18,472.17	10,989.97	2,280.35	5,201.85	68	18,412.87	10,958.48	2,266.60	5,187.78	131	18,428.80	11,004.03	2,271.93	5,152.83
6	18,452.32	11,007.12	2,273.45	5,171.75	69	18,447.80	10,994.97	2,269.70	5,183.13	132	18,466.42	10,994.25	2,281.95	5,190.22
7	18,438.23	10,992.67	2,265.50	5,180.07	70	18,461.92	11,004.25	2,273.98	5,183.68	133	18,472.98	11,010.45	2,271.10	5,191.43
8	18,477.73	11,003.57	2,275.00	5,199.17	71	18,484.53	11,022.52	2,265.78	5,196.23	134	18,439.68	10,999.00	2,263.83	5,176.85
9	18,441.05	10,991.98	2,263.15	5,185.92	72	18,438.92	10,984.50	2,266.15	5,188.27	135	18,444.87	10,998.30	2,265.43	5,181.13
10	18,472.87	11,023.75	2,265.53	5,183.58	73	18,442.80	10,991.07	2,273.38	5,178.35	136	18,436.22	10,981.92	2,263.45	5,190.85
11	18,452.88	10,992.53	2,274.70	5,185.65	74	18,440.67	10,985.80	2,263.80	5,191.07	137	18,458.85	11,010.15	2,263.88	5,184.82
12	18,463.32	11,003.48	2,280.78	5,179.05	75	18,438.20	10,980.85	2,274.35	5,183.00	138	18,432.95	10,989.60	2,274.00	5,169.35
13	18,436.33	10,985.45	2,271.42	5,179.47	76	18,435.48	10,994.28	2,267.07	5,174.13	139	18,440.63	11,020.35	2,258.17	5,162.12
14	18,448.43	11,004.87	2,257.48	5,186.08	77	18,418.18	10,980.98	2,264.43	5,172.77	140	18,462.55	10,993.15	2,269.72	5,199.68
15	18,446.50	10,994.22	2,264.97	5,187.32	78	18,419.45	10,975.45	2,268.25	5,175.75	141	18,449.78	10,997.28	2,267.50	5,185.00
16	18,454.52	11,003.40	2,274.45	5,176.67	79	18,415.75	10,974.43	2,260.32	5,181.00	142	18,458.15	10,993.55	2,280.83	5,183.77
17	18,479.37	11,006.82	2,275.10	5,197.45	80	18,442.83	10,987.62	2,257.20	5,198.02	143	18,445.98	10,996.95	2,261.52	5,187.52
18	18,422.95	10,965.63	2,279.20	5,178.12	81	18,449.37	10,992.18	2,265.10	5,192.08	144	18,471.13	11,014.47	2,267.05	5,189.62
19	18,419.50	10,972.62	2,261.27	5,185.62	82	18,444.50	10,988.47	2,261.58	5,194.45	145	18,460.60	10,996.75	2,270.70	5,193.15
20	18,466.35	11,020.63	2,262.25	5,183.47	83	18,456.12	11,005.42	2,271.35	5,179.35	146	18,458.52	10,998.88	2,273.00	5,186.63
21	18,470.93	10,999.12	2,272.52	5,199.30	84	18,487.10	11,019.62	2,272.30	5,195.18	147	18,455.63	11,004.87	2,262.02	5,188.75
22	18,422.05	10,979.65	2,266.98	5,175.42	85	18,425.22	10,996.42	2,272.27	5,156.53	148	18,419.15	10,976.07	2,266.55	5,176.53
23	18,415.50	10,970.60	2,258.98	5,185.92	86	18,434.12	10,970.23	2,271.73	5,192.15	149	18,480.45	11,011.87	2,274.93	5,193.65
24	18,480.95	11,022.58	2,279.20	5,179.17	87	18,423.62	10,967.73	2,265.80	5,190.08	150	18,445.98	10,990.18	2,270.38	5,185.42
25	18,430.13	10,979.87	2,264.30	5,185.97	88	18,447.02	11,002.73	2,273.02	5,171.27	151	18,449.22	11,000.42	2,269.88	5,178.92
26	18,471.02	11,007.28	2,263.18	5,200.55	89	18,468.43	11,019.80	2,272.35	5,176.28	152	18,452.53	11,009.40	2,265.65	5,177.48
27	18,461.33	11,006.85	2,264.53	5,189.95	90	18,445.48	10,984.43	2,270.80	5,190.25	153	18,433.73	10,992.13	2,266.68	5,174.92
28	18,470.73	11,013.67	2,259.77	5,197.30	91	18,445.18	10,997.53	2,264.93	5,182.72	154	18,468.57	11,006.72	2,260.32	5,201.53
29	18,458.68	11,003.82	2,276.58	5,178.28	92	18,436.57	10,994.73	2,269.48	5,172.35	155	18,453.68	10,992.25	2,283.78	5,177.65
30	18,454.33	10,996.20	2,263.73	5,194.40	93	18,458.55	11,003.98	2,268.48	5,186.08	156	18,448.33	10,999.82	2,263.37	5,185.15
31	18,470.03	11,005.28	2,264.53	5,200.22	94	18,476.55	11,003.45	2,275.28	5,197.82	157	18,432.32	10,989.52	2,258.62	5,184.18
32	18,453.45	11,007.83	2,268.85	5,176.77	95	18,434.20	10,984.18	2,271.53	5,178.48	158	18,451.13	11,007.42	2,266.33	5,177.38
33	18,453.70	11,001.42	2,269.65	5,182.63	96	18,450.98	10,999.33	2,270.03	5,181.62	159	18,443.33	10,999.47	2,269.42	5,174.45
34	18,456.40	11,003.25	2,280.55	5,172.60	97	18,467.25	11,008.83	2,264.82	5,193.60	160	18,467.32	11,009.45	2,281.60	5,176.27
35	18,433.03	10,989.18	2,264.95	5,178.90	98	18,460.13	11,012.42	2,271.45	5,176.27	161	18,470.82	11,007.00	2,274.85	5,188.97
36	18,438.07	10,982.48	2,275.95	5,179.63	99	18,461.07	10,986.60	2,267.87	5,206.60	162	18,483.13	11,005.45	2,276.38	5,201.30
37	18,446.70	10,988.83	2,269.37	5,188.50	100	18,434.50	10,990.18	2,257.75	5,186.57	163	18,454.72	10,997.82	2,264.95	5,191.95
38	18,449.68	10,997.35	2,265.90	5,186.43	101	18,470.40	11,011.60	2,263.85	5,194.95	164	18,487.30	11,014.55	2,278.25	5,194.50
39	18,453.10	11,008.33	2,261.12	5,183.65	102	18,444.85	10,987.58	2,264.15	5,193.12	165	18,465.45	11,012.50	2,272.70	5,180.25
40	18,440.62	10,989.17	2,263.32	5,188.13	103	18,476.10	11,018.05	2,275.02	5,183.03	166	18,457.90	11,002.75	2,273.80	5,181.35
41	18,467.60	10,990.52	2,275.55	5,201.53	104	18,436.12	10,993.18	2,261.28	5,181.65	167	18,467.15	11,031.83	2,269.47	5,165.85
42	18,474.60	11,001.20	2,271.32	5,202.08	105	18,418.98	10,974.93	2,269.07	5,174.98	168	18,466.13	11,005.88	2,271.30	5,188.95
43	18,471.43	11,022.15	2,264.30	5,184.98	106	18,473.62	11,014.48	2,259.62	5,199.52	169	18,452.07	10,979.23	2,281.42	5,191.42
44	18,412.42	10,979.43	2,259.12	5,173.87	107	18,459.50	10,992.00	2,268.42	5,199.08	170	18,444.17	10,997.42	2,271.97	5,174.78
45	18,451.38	10,994.82	2,270.53	5,186.03	108	18,433.02	11,007.15	2,263.35	5,162.52	171	18,448.33	10,993.23	2,273.13	5,181.97
46	18,466.32	11,005.92	2,265.42	5,194.98	109	18,474.75	11,010.80	2,276.38	5,187.57	172	18,460.38	11,005.15	2,269.40	5,185.83
47	18,454.80	11,000.87	2,270.48	5,183.45	110	18,444.62	10,999.40	2,267.07	5,178.15	173	18,471.47	11,008.53	2,276.32	5,186.62
48	18,453.93	10,995.93	2,270.23	5,187.77	111	18,464.33	11,012.73	2,263.93	5,187.67	174	18,458.67	11,001.08	2,273.37	5,184.22
49	18,427.88	10,978.05	2,265.10	5,184.73	112	18,445.03	10,992.77	2,271.03	5,181.23	175	18,458.03	11,004.80	2,266.07	5,187.17
50	18,430.93	10,984.48	2,264.48	5,181.97	113	18,452.48	11,005.90	2,266.58	5,180.00	176	18,448.27	10,991.55	2,267.23	5,189.48
51	18,464.08	11,001.95	2,268.42	5,193.72	114	18,449.00	10,973.43	2,277.93	5,197.63	177	18,459.23	11,013.62	2,263.22	5,182.40
52	18,452.02	10,982.57	2,277.18	5,192.27	115	18,430.90	10,974.32	2,268.80	5,187.78	178	18,444.70	10,997.13	2,269.90	5,177.67
53	18,461.30	11,012.25	2,268.92	5,180.13	116	18,474.08	11,011.62	2,263.58	5,198.88	179	18,464.20	11,000.48	2,264.28	5,199.43
54	18,460.12	10,998.35	2,277.18	5,184.58	117	18,451.87	10,990.47	2,266.35	5,195.05	180	18,442.58	10,994.57	2,268.28	5,179.73
55	18,454.85	11,005.67	2,265.63	5,183.55	118	18,456.70	11,012.60	2,263.48	5,180.62	181	18,426.70	10,977.33	2,256.07	5,193.30
56	18,464.07	11,004.97	2,271.95	5,187.15	119	18,415.23	10,985.17	2,271.87	5,158.20	182	18,425.12	10,963.47	2,274.77	5,186.88
57	18,433.15	10,988.25	2,268.13	5,176.77	120	18,464.90	11,011.68	2,272.45	5,180.77	183	18,440.43	10,990.05	2,270.97	5,179.42
58	18,447.42	10,989.23	2,274.85	5,183.33	121	18,448.32	10,996.97	2,266.95	5,184.40	184	18,432.50	10,972.55	2,273.35	5,186.60
59	18,449.17	10,981.35	2,269.93	5,197.88	122	18,432.27	10,980.03	2,267.68	5,184.55	185	18,454.75	11,006.62	2,264.12	5,184.02
60	18,424.03	10,968.77	2,268.18	5,187.08	123	18,485.47	11,029.70	2,274.18	5,181.58	186	18,434.45	10,988.43	2,263.15	5,182.87
61	18,445.28	10,984.68	2,275.60	5,185.00	124	18,453.05	10,994.35	2,276.28	5,182.42	187	18,430.98	10,984.23	2,268.43	5,178.32
62	18,477.02	11,006.90	2,270.22	5,199.90	125	18,457.67	10,995.72	2,272.62	5,189.33	188	18,425.33	10,974.58	2,283.33	5,167.42
										189	18,455.82	11,003.13	2,261.23	5,191.45
										Average	18,450.29	10,996.71	2,268.95	5,184.63

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	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.005	0.001	0.003	0.002	0.007	0.003	0.005	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.*

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 –Xmx64m –Xms64m metrics –b 369 –s 600
```

IOPS Test Results File

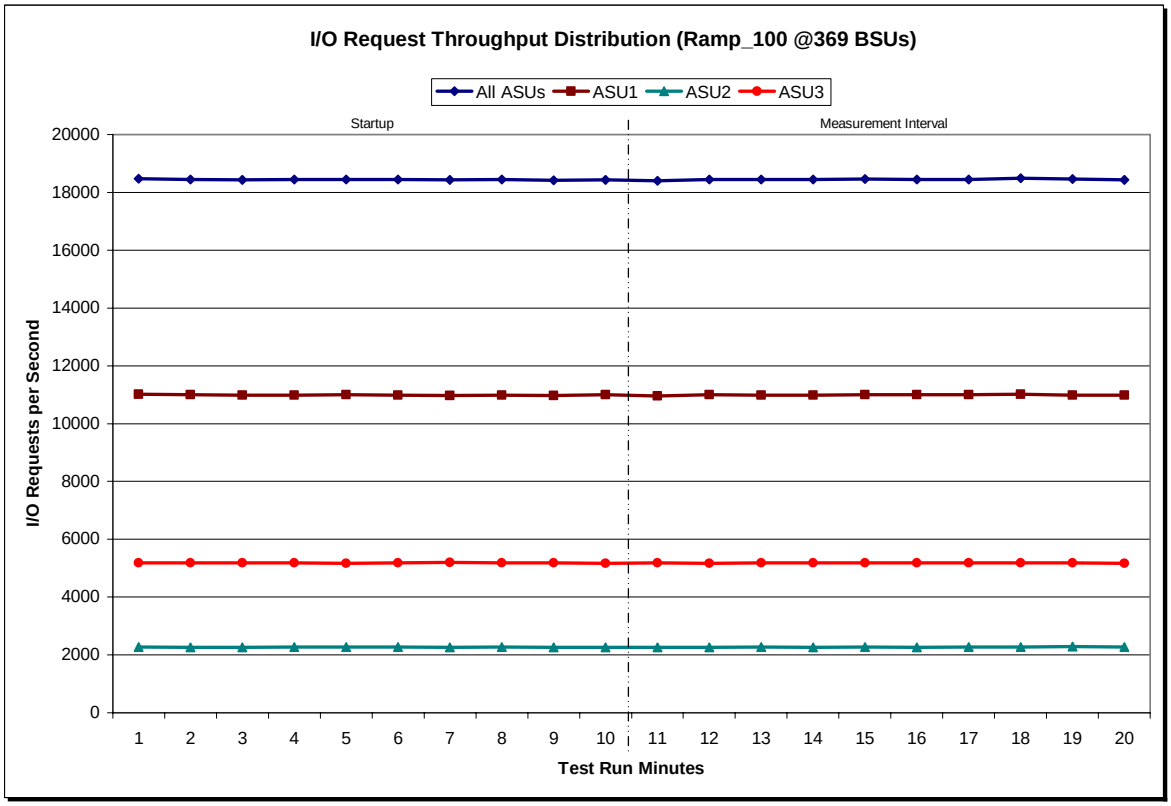
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

369 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	20:02:06	20:12:07	0-9	0:10:01
Measurement Interval	20:12:07	20:22:07	10-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	18,467.33	11,010.92	2,279.55	5,176.87
1	18,448.57	10,997.15	2,264.07	5,187.35
2	18,432.22	10,981.90	2,265.47	5,184.85
3	18,446.20	10,982.88	2,275.62	5,187.70
4	18,445.67	11,004.35	2,270.72	5,170.60
5	18,446.07	10,992.52	2,268.08	5,185.47
6	18,430.75	10,973.80	2,259.38	5,197.57
7	18,446.75	10,992.78	2,276.18	5,177.78
8	18,421.50	10,973.07	2,262.55	5,185.88
9	18,428.07	10,995.70	2,267.17	5,165.20
10	18,405.27	10,959.83	2,258.30	5,187.13
11	18,443.75	11,004.70	2,264.13	5,174.92
12	18,446.73	10,987.15	2,275.83	5,183.75
13	18,441.88	10,990.53	2,262.93	5,188.42
14	18,461.45	10,998.98	2,274.07	5,188.40
15	18,451.37	11,002.63	2,264.73	5,184.00
16	18,451.10	11,004.40	2,269.78	5,176.92
17	18,482.62	11,013.80	2,279.72	5,189.10
18	18,460.33	10,990.63	2,283.02	5,186.68
19	18,431.03	10,985.25	2,270.68	5,175.10
Average	18,447.55	10,993.79	2,270.32	5,183.44

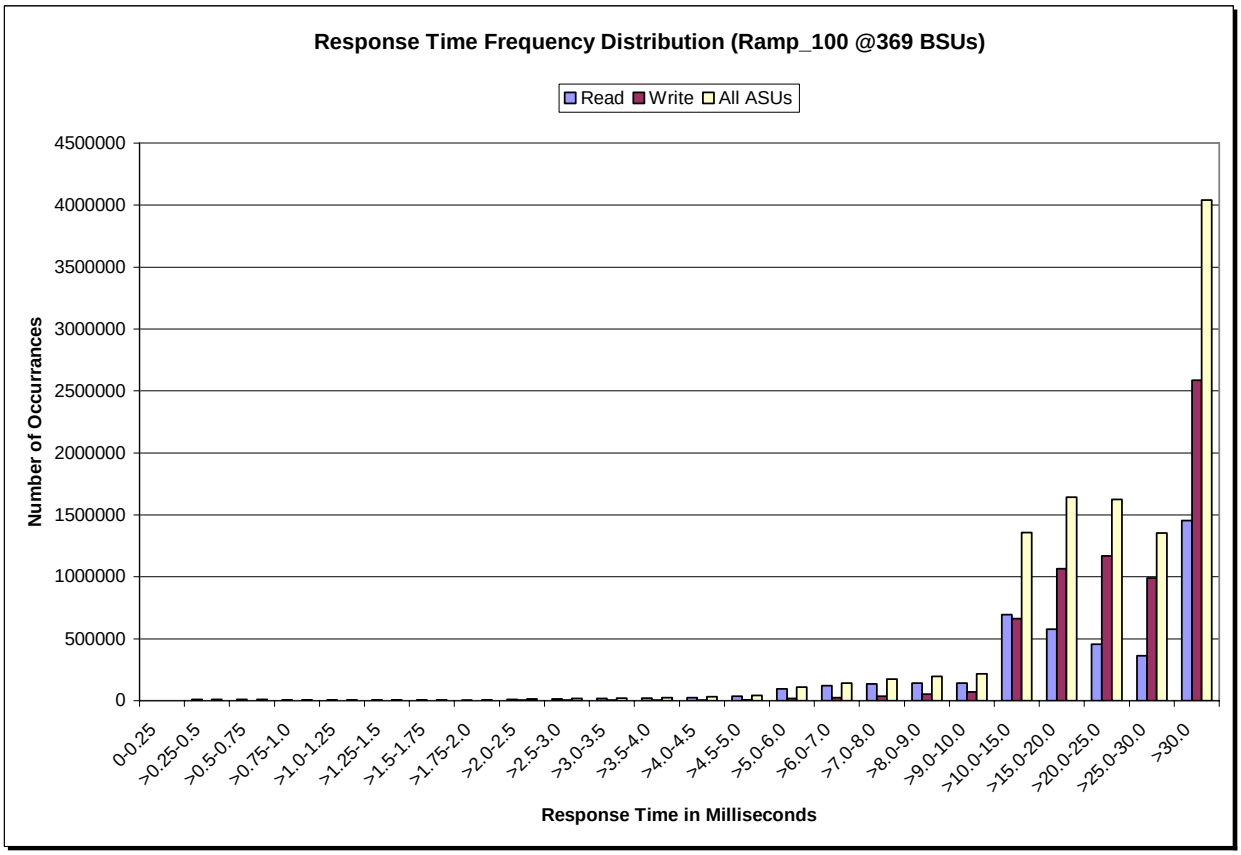
IOPS Test Run – I/O Request Throughput Distribution Graph



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	1680	12,202	10,219	7,702	6,730	5,708	5,425	4,777
Write	0	5	193	541	782	1,148	1,459	1,355
All ASUs	1680	12,207	10,412	8,243	7,512	6,856	6,884	6,132
ASU1	1519	11,006	8,661	6,501	5,746	4,958	4,673	4,148
ASU2	161	1,199	1,660	1,467	1,356	1,319	1,447	1,300
ASU3	0	2	91	275	410	579	764	684
Response Time (ms)	**>2.0-2.5**	**>2.5-3.0**	**>3.0-3.5**	**>3.5-4.0**	**>4.0-4.5**	**>4.5-5.0**	**>5.0-6.0**	**>6.0-7.0**
Read	11,228	14,015	17,644	21,170	26,289	35,864	95,025	119,484
Write	2,565	3,182	3,495	4,029	4,964	5,934	16,392	24,113
All ASUs	13,793	17,197	21,139	25,199	31,253	41,798	111,417	143,597
ASU1	9,526	11,974	14,898	17,917	21,949	30,405	81,437	104,034
ASU2	3,079	3,801	4,868	5,826	7,602	9,471	24,895	32,409
ASU3	1,188	1,422	1,373	1,456	1,702	1,922	5,085	7,154
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	136,808	144,284	143,834	694,891	576,657	456,799	362,470	1,454,439
Write	36,150	51,862	71,787	662,941	1,064,119	1,167,737	991,704	2,585,951
All ASUs	172,958	196,146	215,621	1,357,832	1,640,776	1,624,536	1,354,174	4,040,390
ASU1	123,782	137,424	145,867	837,028	857,629	781,358	659,108	2,714,169
ASU2	38,552	42,848	46,791	258,684	253,781	207,928	150,038	261,655
ASU3	10,624	15,874	22,963	262,120	529,366	635,250	545,028	1,064,566

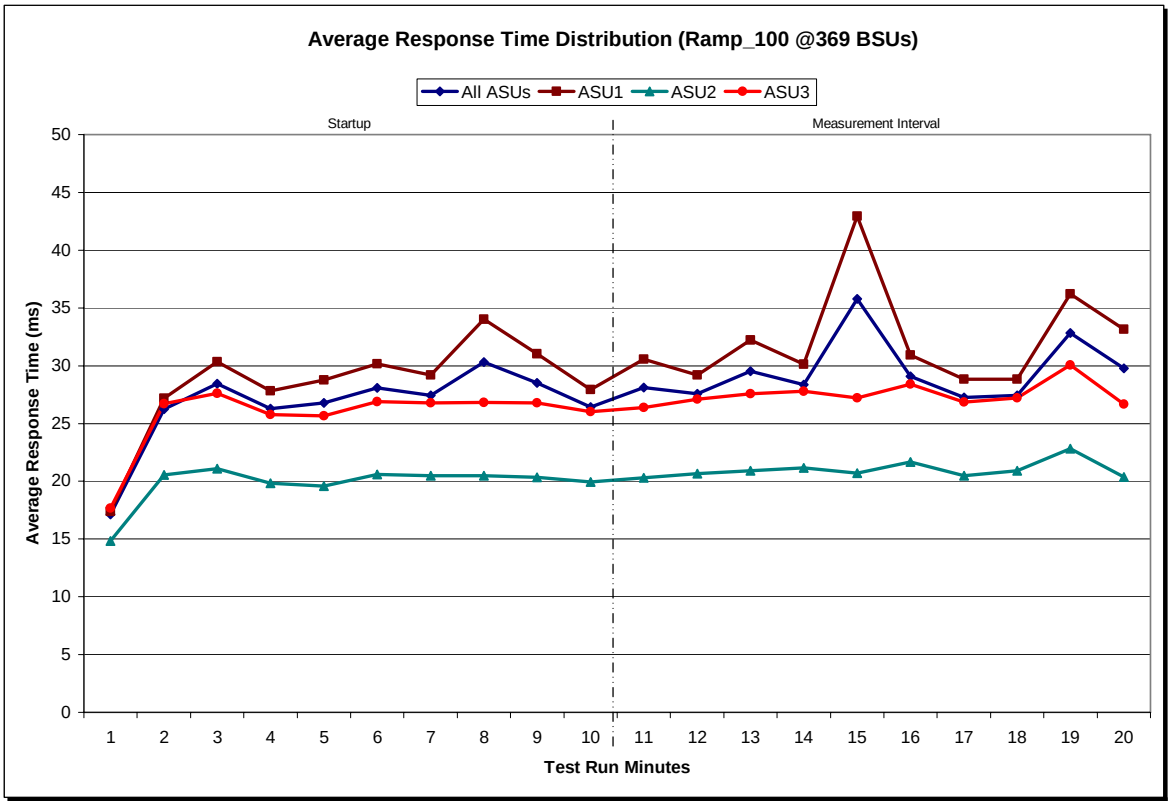
IOPS Test Run –Response Time Frequency Distribution Graph



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

369 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	20:02:06	20:12:07	0-9	0:10:01
Measurement Interval	20:12:07	20:22:07	9-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	17.14	17.37	14.84	17.67
1	26.24	27.19	20.56	26.70
2	28.43	30.33	21.11	27.60
3	26.28	27.84	19.83	25.79
4	26.77	28.77	19.60	25.67
5	28.07	30.17	20.59	26.91
6	27.44	29.18	20.50	26.78
7	30.32	34.01	20.47	26.80
8	28.51	31.02	20.32	26.78
9	26.42	27.95	19.94	26.02
10	28.12	30.55	20.32	26.38
11	27.56	29.21	20.65	27.10
12	29.53	32.22	20.93	27.59
13	28.37	30.13	21.15	27.80
14	35.80	42.96	20.70	27.22
15	29.08	30.93	21.66	28.39
16	27.26	28.85	20.48	26.84
17	27.41	28.85	20.90	27.22
18	32.81	36.20	22.82	30.04
19	29.77	33.16	20.38	26.68
Average	29.57	32.31	21.00	27.53

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
11,067,752	7,027,362	4,040,390

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	0.0701	0.0350	0.2810
COV	0.004	0.002	0.003	0.003	0.009	0.005	0.005	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 –Xmx64m –Xms64m metrics –b 369 –s 600

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

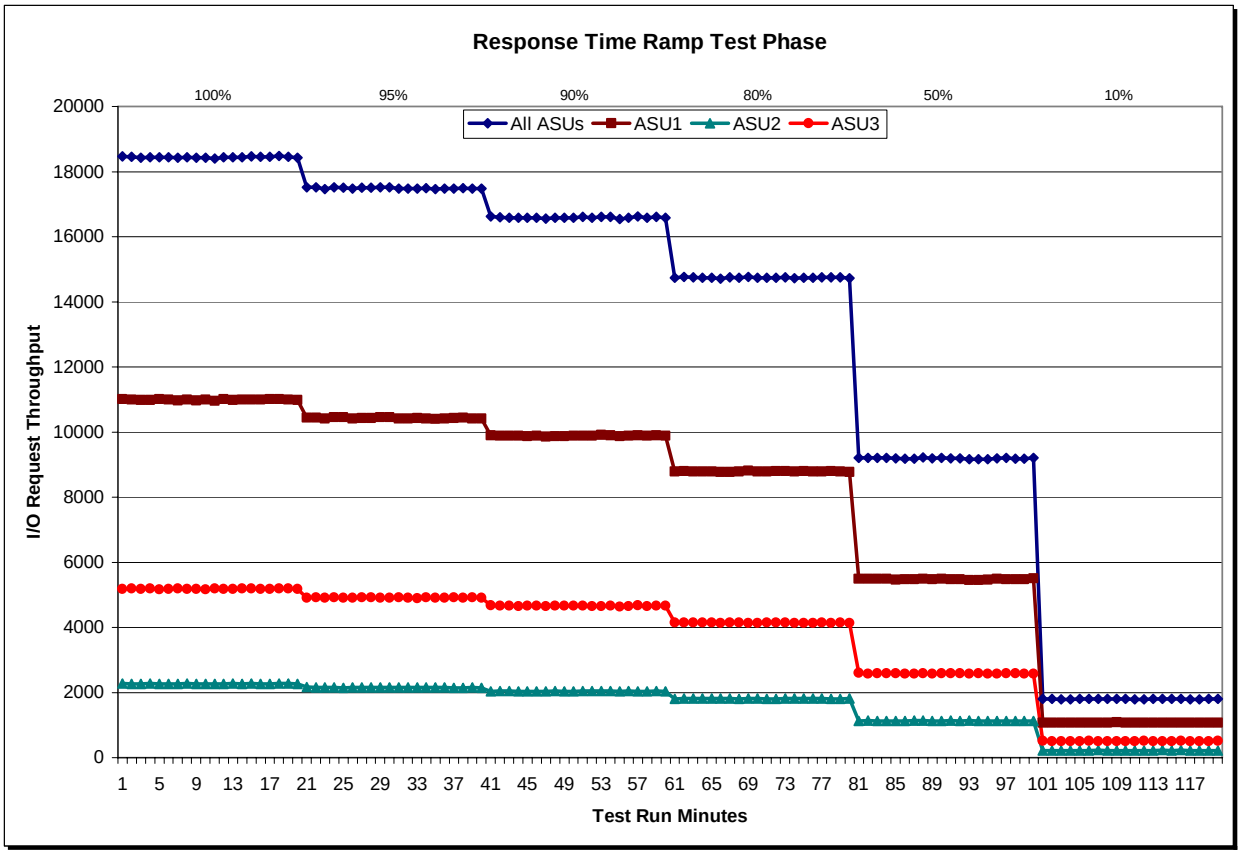
50% Load Level

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.

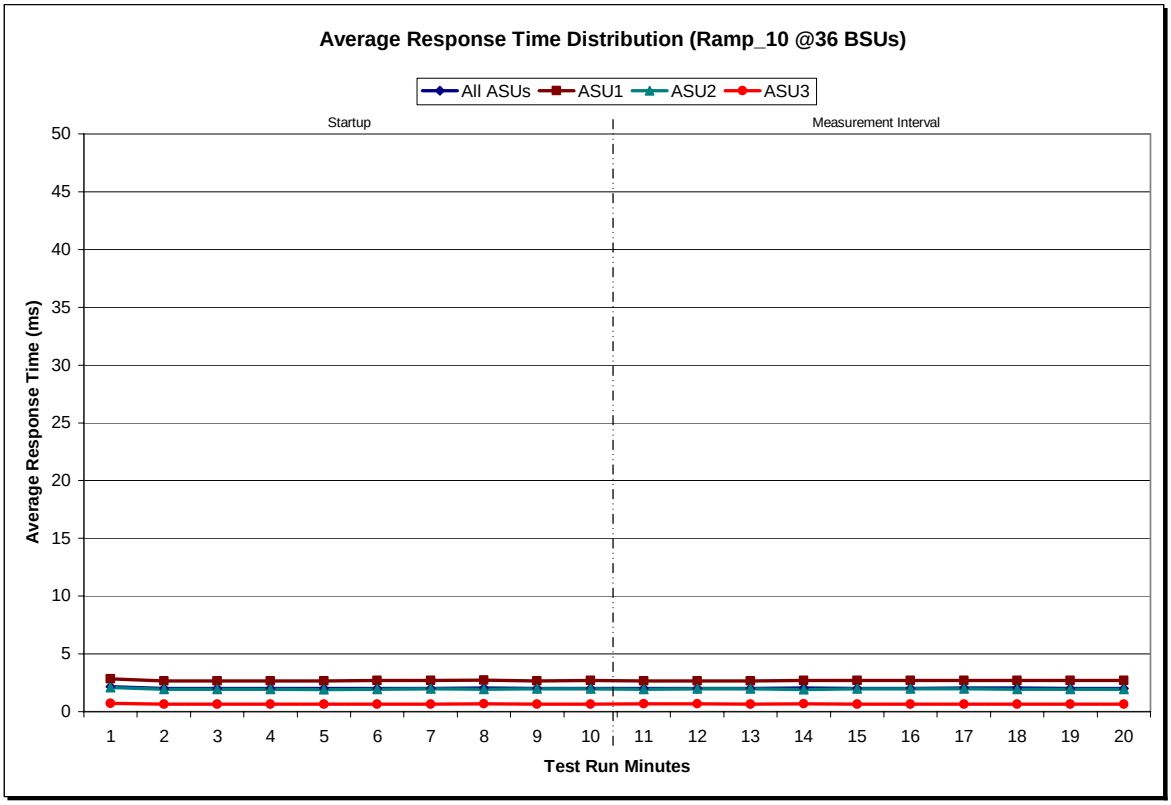
Response Time Ramp Distribution (IOPS) Graph



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

36 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	21:42:58	21:52:59	0-9	0:10:01
Measurement Interval	21:52:59	22:02:59	9-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.15	2.85	2.08	0.72
1	2.02	2.68	1.96	0.65
2	2.01	2.67	1.93	0.66
3	2.01	2.66	1.96	0.66
4	2.00	2.65	1.91	0.65
5	2.01	2.69	1.93	0.65
6	2.03	2.69	1.96	0.66
7	2.06	2.74	1.95	0.67
8	2.02	2.67	1.97	0.66
9	2.03	2.69	1.97	0.67
10	2.02	2.67	1.94	0.67
11	2.02	2.67	1.97	0.67
12	2.01	2.66	1.98	0.66
13	2.04	2.71	1.93	0.67
14	2.03	2.69	1.99	0.66
15	2.03	2.69	1.96	0.66
16	2.04	2.72	1.97	0.65
17	2.04	2.71	1.96	0.66
18	2.03	2.69	1.94	0.66
19	2.03	2.71	1.94	0.65
Average	2.03	2.69	1.96	0.66

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



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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	*0.0350*	*0.2810*	*0.0700*	*0.2100*	*0.0180*	*0.0700*	*0.0350*	*0.2810*
MIM	0.0351	0.2803	0.0701	0.2095	0.0180	0.0702	0.0351	0.2816
COV	0.012	0.003	0.011	0.004	0.026	0.010	0.017	0.004

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 –Xmx64m –Xms64m repeat1 –b 369 –s 600

java –Xmx64m –Xms64m repeat1 –b 369 –s 600

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	*18,447.55*	*2.03*
Repeatability Test Phase 1	18,447.25	2.03
Repeatability Test Phase 2	18,441.27	2.04

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

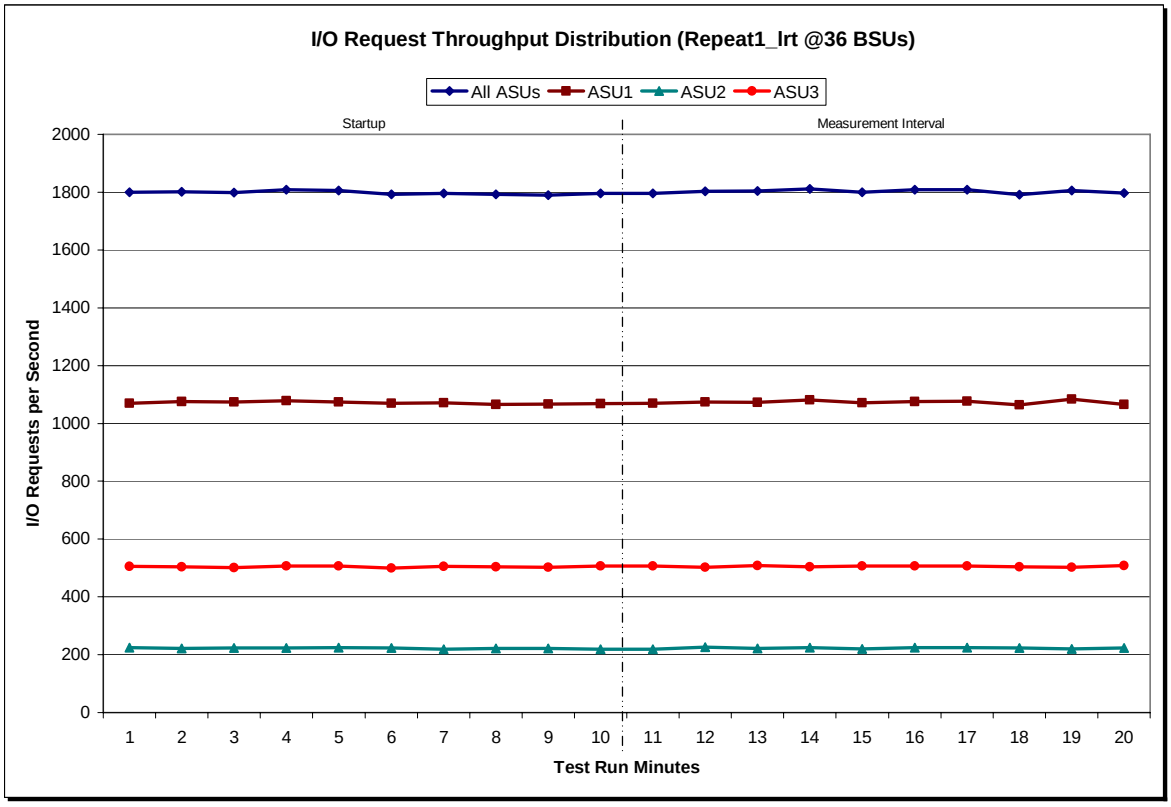
Repeatability Test Phase 1, Test Run 1 (LRT)
Repeatability Test Phase 1, Test Run 2 (IOPS)
Repeatability Test Phase 2, Test Run 1 (LRT)
Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

36 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:30:26	15:40:26	0-9	0:10:00
Measurement Interval	15:40:26	15:50:26	10-19	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1,799.50	1,069.37	224.78	505.35
1	1,801.98	1,075.45	222.40	504.13
2	1,798.67	1,074.33	223.03	501.30
3	1,808.95	1,079.02	223.75	506.18
4	1,805.80	1,074.12	224.83	506.85
5	1,792.13	1,069.98	223.15	499.00
6	1,795.12	1,071.47	218.18	505.47
7	1,792.78	1,065.87	222.25	504.67
8	1,789.23	1,066.28	221.12	501.83
9	1,794.92	1,069.03	218.95	506.93
10	1,794.88	1,070.05	218.55	506.28
11	1,802.80	1,074.13	225.63	503.03
12	1,803.97	1,073.28	222.42	508.27
13	1,810.85	1,081.37	225.23	504.25
14	1,799.32	1,071.78	220.40	507.13
15	1,808.12	1,075.93	224.90	507.28
16	1,808.60	1,077.50	224.53	506.57
17	1,791.80	1,063.92	223.48	504.40
18	1,806.10	1,083.55	220.25	502.30
19	1,797.02	1,065.27	223.00	508.75
Average	1,802.35	1,073.68	222.84	505.83

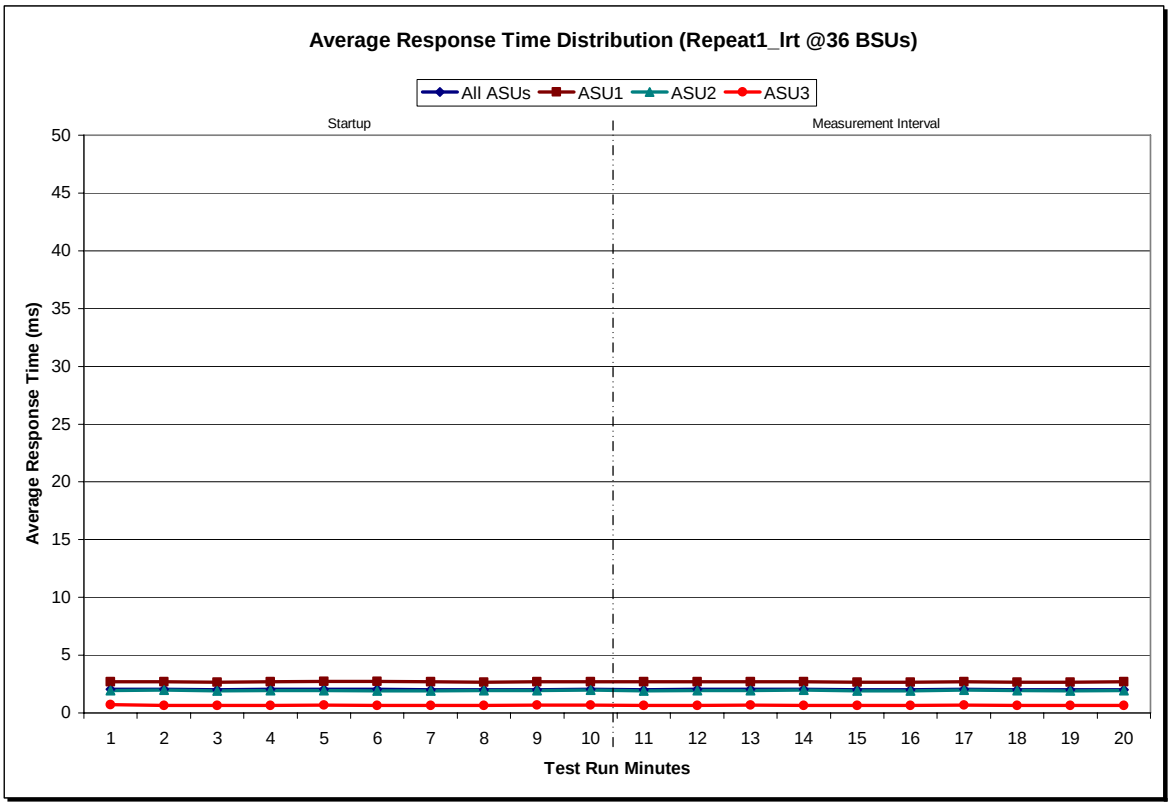
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

36 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:30:26	15:40:26	0-9	0:10:00
Measurement Interval	15:40:26	15:50:26	9-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.06	2.72	1.94	0.71
1	2.05	2.72	1.97	0.66
2	2.02	2.67	1.91	0.65
3	2.04	2.72	1.94	0.65
4	2.05	2.72	1.96	0.67
5	2.05	2.72	1.91	0.67
6	2.02	2.68	1.90	0.66
7	2.01	2.67	1.94	0.65
8	2.03	2.69	1.95	0.67
9	2.04	2.71	1.97	0.67
10	2.02	2.69	1.91	0.65
11	2.04	2.72	1.95	0.65
12	2.04	2.71	1.94	0.68
13	2.05	2.71	1.97	0.66
14	2.01	2.68	1.90	0.66
15	2.01	2.67	1.92	0.65
16	2.04	2.69	1.99	0.67
17	2.02	2.68	1.95	0.66
18	2.00	2.65	1.89	0.64
19	2.02	2.69	1.93	0.66
Average	2.03	2.69	1.93	0.66

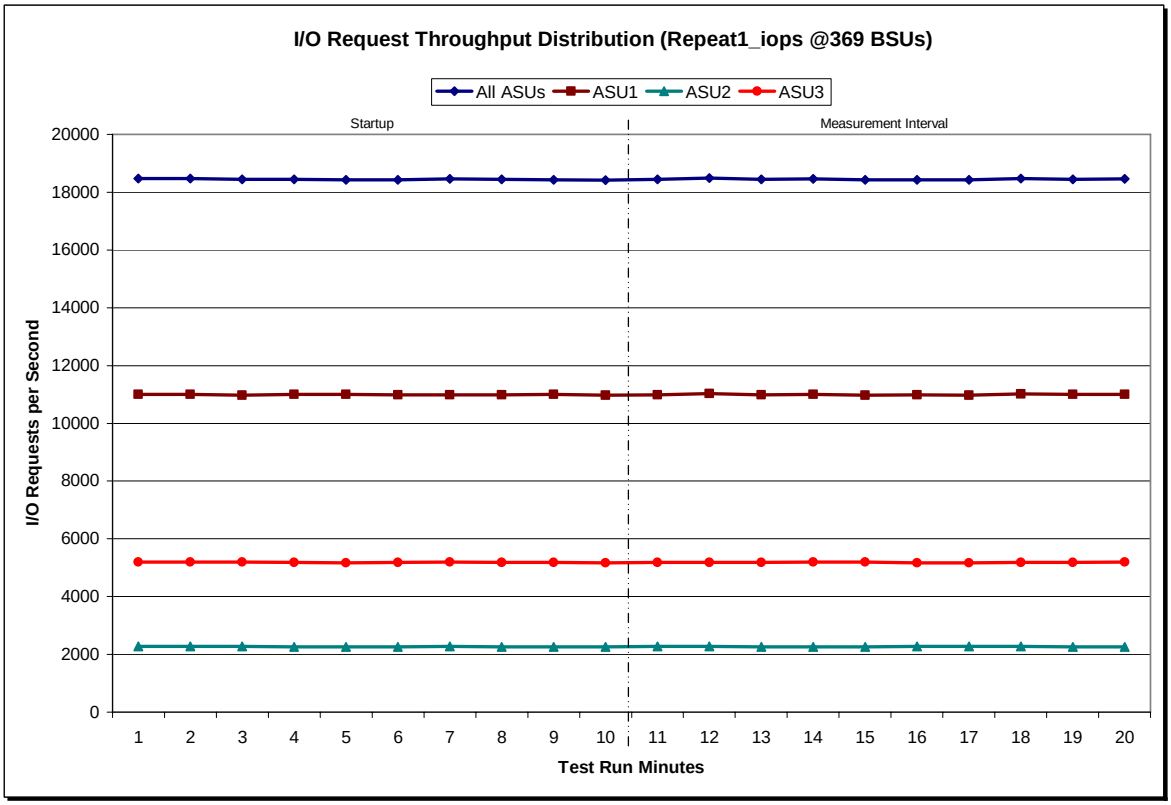
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

369 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:50:34	16:00:35	0-9	0:10:01
Measurement Interval	16:00:35	16:10:35	10-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	18,474.12	10,998.42	2,277.15	5,198.55
1	18,478.28	11,003.90	2,276.78	5,197.60
2	18,441.27	10,973.72	2,274.48	5,193.07
3	18,439.02	11,000.05	2,262.50	5,176.47
4	18,434.23	11,005.28	2,260.13	5,168.82
5	18,433.28	10,986.43	2,262.17	5,184.68
6	18,461.95	10,985.97	2,271.55	5,204.43
7	18,449.32	10,993.27	2,267.52	5,188.53
8	18,435.72	10,995.18	2,263.00	5,177.53
9	18,416.13	10,975.53	2,265.72	5,174.88
10	18,439.67	10,981.22	2,270.25	5,188.20
11	18,481.43	11,028.18	2,274.02	5,179.23
12	18,440.13	10,991.12	2,265.78	5,183.23
13	18,453.37	10,994.70	2,266.48	5,192.18
14	18,424.22	10,966.58	2,265.83	5,191.80
15	18,426.33	10,980.77	2,270.28	5,175.28
16	18,428.65	10,978.52	2,273.85	5,176.28
17	18,472.32	11,012.07	2,273.05	5,187.20
18	18,448.83	10,998.37	2,262.85	5,187.62
19	18,457.55	10,994.73	2,263.58	5,199.23
Average	18,447.25	10,992.63	2,268.60	5,186.03

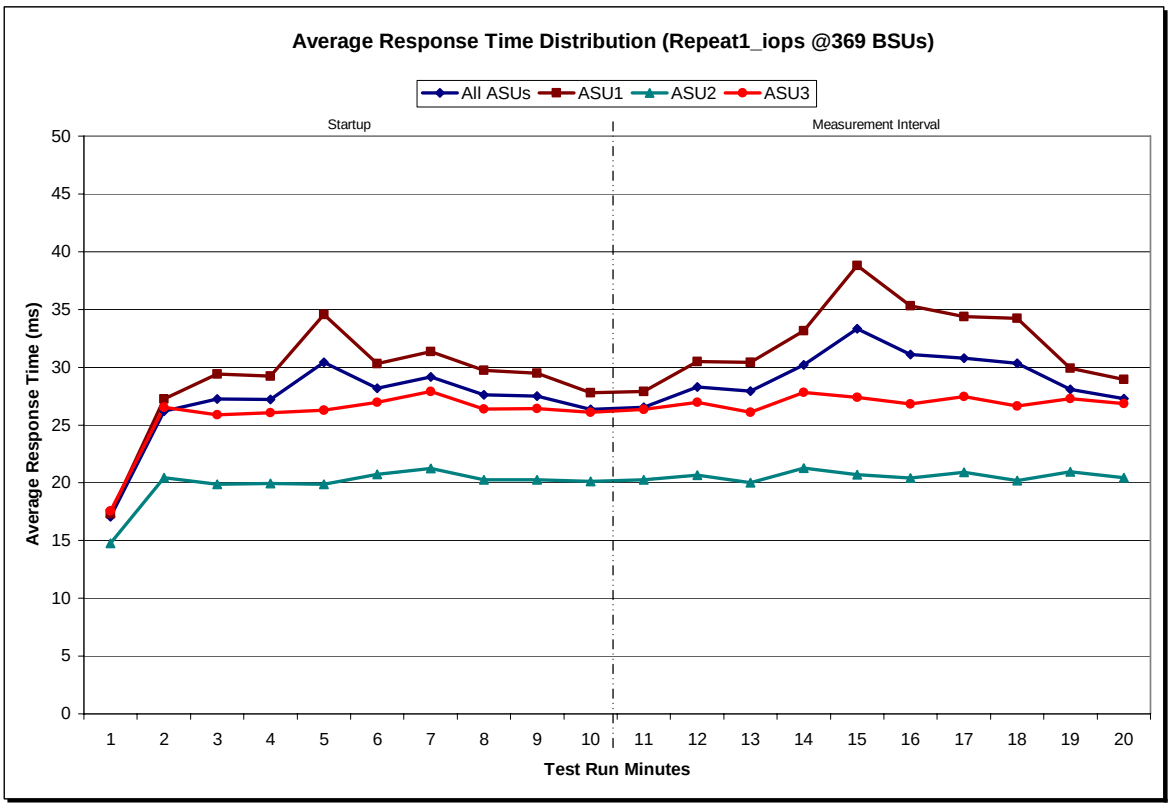
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

369 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:50:34	16:00:35	0-9	0:10:01
Measurement Interval	16:00:35	16:10:35	9-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	17.06	17.30	14.75	17.56
1	26.19	27.23	20.44	26.51
2	27.23	29.41	19.86	25.87
3	27.20	29.23	19.94	26.05
4	30.43	34.55	19.88	26.27
5	28.19	30.30	20.72	26.96
6	29.14	31.37	21.25	27.90
7	27.61	29.72	20.26	26.37
8	27.49	29.48	20.25	26.41
9	26.36	27.77	20.13	26.08
10	26.52	27.89	20.27	26.34
11	28.28	30.47	20.65	26.97
12	27.93	30.43	20.03	26.10
13	30.20	33.15	21.28	27.83
14	33.35	38.79	20.68	27.38
15	31.10	35.32	20.42	26.83
16	30.76	34.36	20.90	27.46
17	30.36	34.22	20.18	26.63
18	28.09	29.93	20.95	27.30
19	27.30	28.92	20.46	26.85
Average	29.39	32.35	20.58	26.97

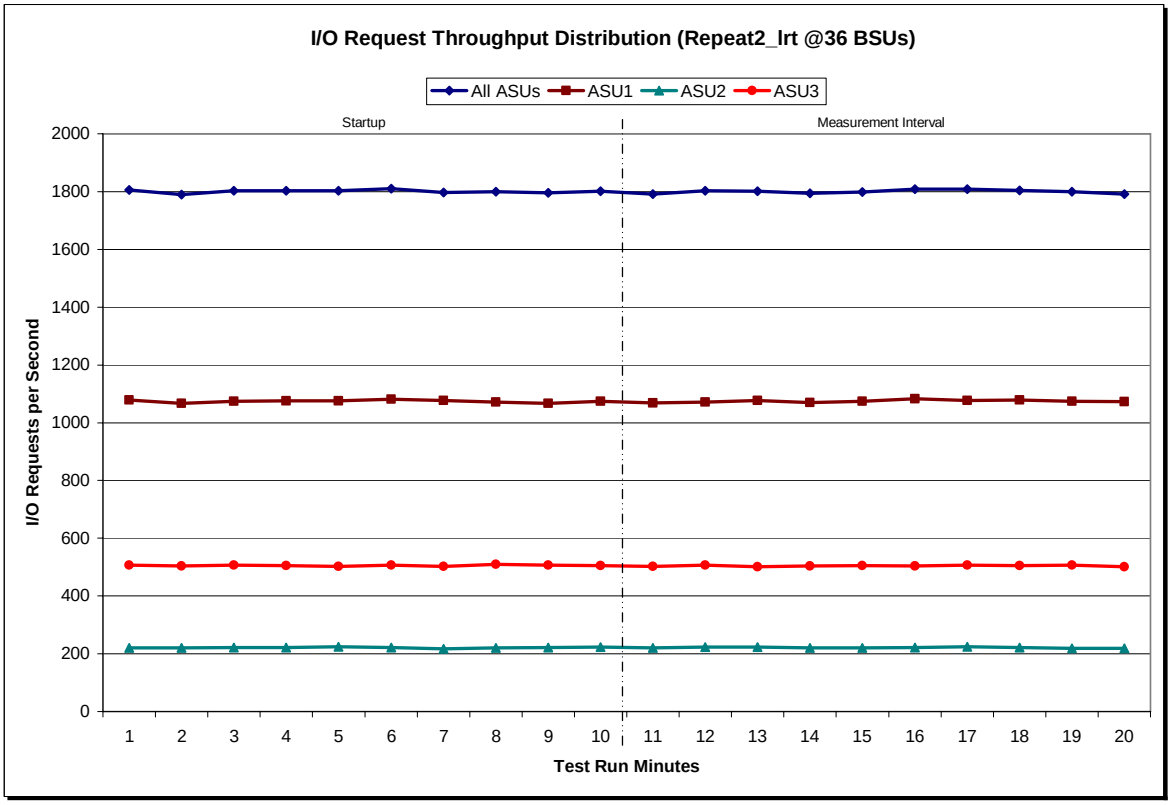
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

36 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:10:49	16:20:49	0-9	0:10:00
Measurement Interval	16:20:49	16:30:49	10-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1,804.93	1,078.35	220.25	506.33
1	1,790.25	1,066.28	219.68	504.28
2	1,802.80	1,073.77	222.12	506.92
3	1,802.98	1,075.70	221.47	505.82
4	1,802.77	1,076.15	224.00	502.62
5	1,809.83	1,080.92	222.17	506.75
6	1,797.47	1,076.43	217.82	503.22
7	1,800.50	1,071.12	219.80	509.58
8	1,795.43	1,066.68	221.40	507.35
9	1,801.75	1,073.75	222.90	505.10
10	1,791.75	1,068.47	220.98	502.30
11	1,802.32	1,071.18	223.62	507.52
12	1,801.20	1,077.52	222.68	501.00
13	1,793.93	1,070.30	220.32	503.32
14	1,798.45	1,073.93	219.68	504.83
15	1,808.55	1,083.45	221.75	503.35
16	1,809.13	1,076.65	225.10	507.38
17	1,804.88	1,077.98	222.22	504.68
18	1,800.32	1,073.92	218.85	507.55
19	1,791.23	1,072.28	218.18	500.77
Average	1,800.18	1,074.57	221.34	504.27

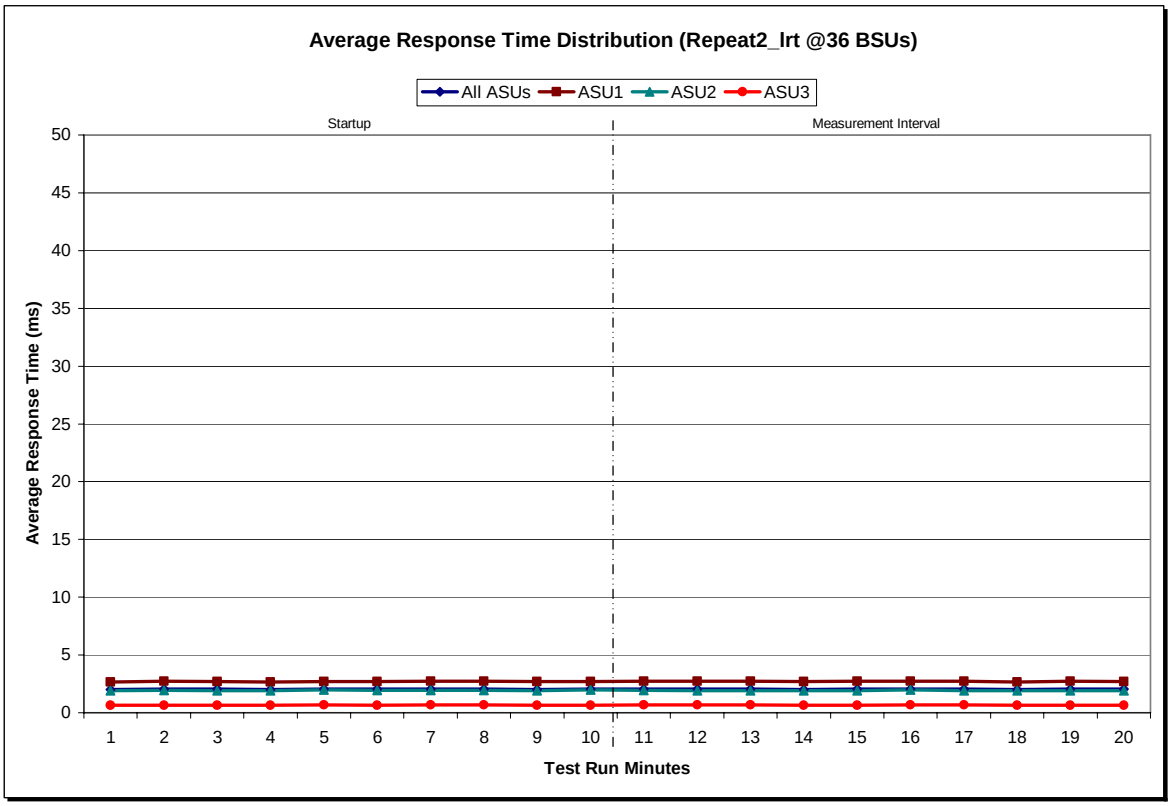
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

36 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:10:49	16:20:49	0-9	0:10:00
Measurement Interval	16:20:49	16:30:49	9-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.01	2.66	1.92	0.66
1	2.04	2.72	1.93	0.66
2	2.03	2.71	1.92	0.66
3	2.01	2.67	1.90	0.66
4	2.04	2.70	1.98	0.67
5	2.04	2.71	1.95	0.65
6	2.07	2.75	1.96	0.67
7	2.05	2.73	1.95	0.67
8	2.03	2.71	1.90	0.65
9	2.04	2.71	1.96	0.66
10	2.05	2.72	1.96	0.67
11	2.05	2.73	1.92	0.67
12	2.05	2.72	1.91	0.67
13	2.03	2.70	1.89	0.65
14	2.05	2.73	1.90	0.66
15	2.07	2.73	1.99	0.67
16	2.06	2.74	1.92	0.67
17	2.01	2.67	1.92	0.65
18	2.04	2.73	1.91	0.65
19	2.03	2.70	1.90	0.66
Average	2.04	2.72	1.92	0.66

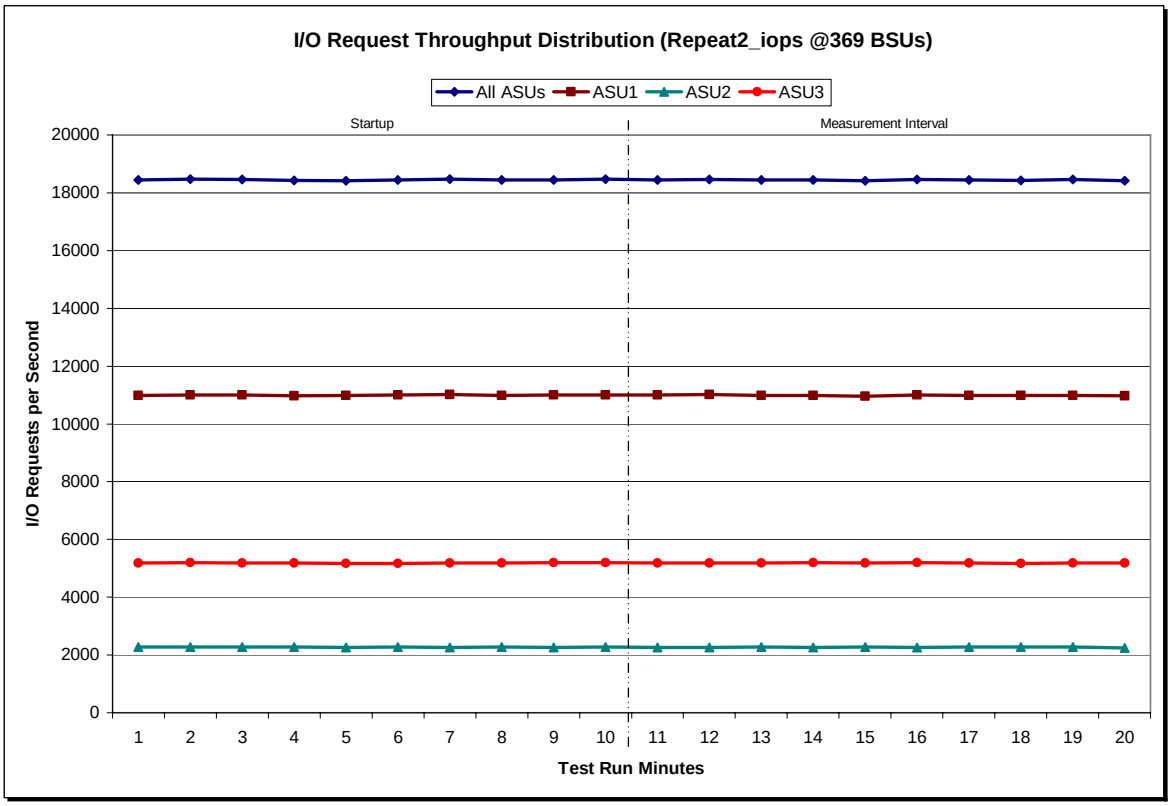
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

369 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:30:56	16:40:57	0-9	0:10:01
Measurement Interval	16:40:57	16:50:57	10-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	18,443.98	10,985.02	2,273.55	5,185.42
1	18,473.40	11,006.40	2,270.67	5,196.33
2	18,452.20	10,994.75	2,272.15	5,185.30
3	18,430.85	10,970.58	2,275.13	5,185.13
4	18,418.88	10,979.83	2,264.15	5,174.90
5	18,443.18	10,998.47	2,276.33	5,168.38
6	18,472.48	11,017.20	2,266.33	5,188.95
7	18,440.32	10,988.80	2,272.25	5,179.27
8	18,445.78	10,994.32	2,258.80	5,192.67
9	18,475.50	11,002.38	2,268.48	5,204.63
10	18,443.50	10,997.22	2,266.33	5,179.95
11	18,456.48	11,011.95	2,262.52	5,182.02
12	18,448.62	10,992.72	2,270.58	5,185.32
13	18,451.48	10,992.68	2,260.47	5,198.33
14	18,411.62	10,961.33	2,268.23	5,182.05
15	18,459.28	10,997.10	2,267.63	5,194.55
16	18,440.43	10,991.05	2,269.80	5,179.58
17	18,434.58	10,988.65	2,275.13	5,170.80
18	18,454.02	10,989.53	2,274.73	5,189.75
19	18,412.72	10,975.77	2,248.65	5,188.30
Average	18,441.27	10,989.80	2,266.41	5,185.07

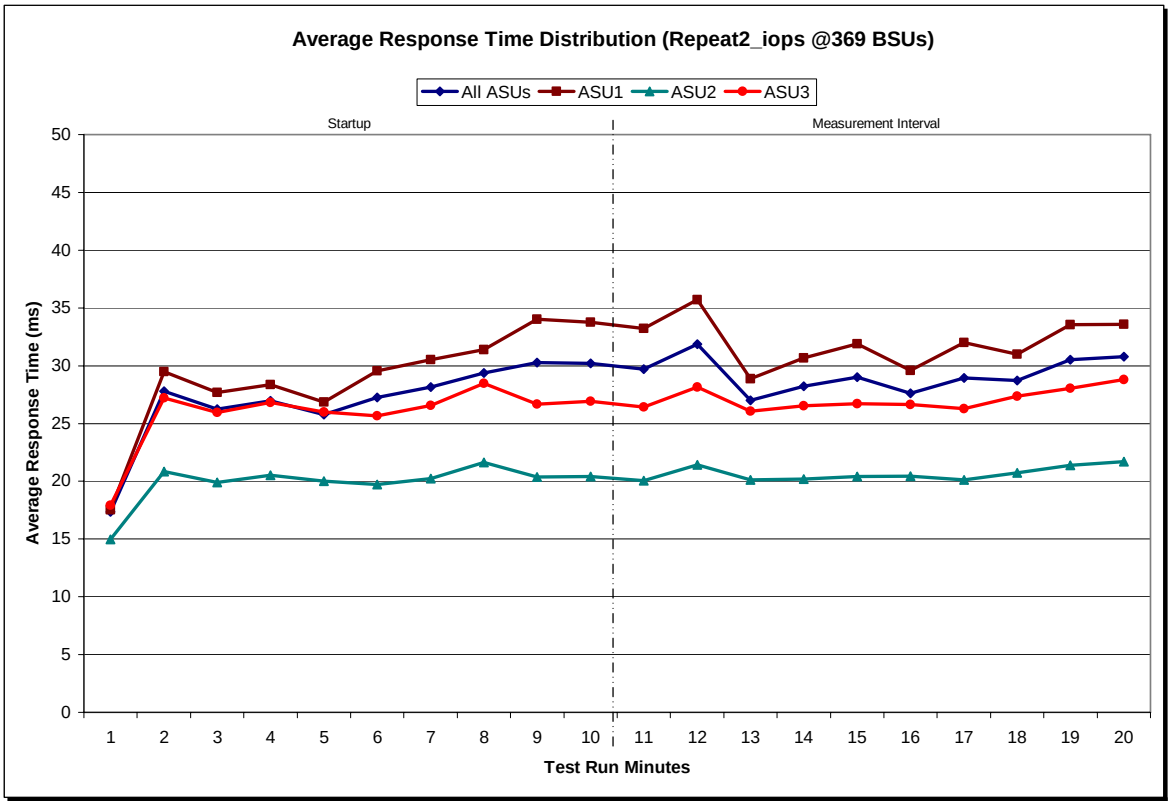
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

369 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:30:56	16:40:57	0-9	0:10:01
Measurement Interval	16:40:57	16:50:57	9-19	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	17.34	17.54	14.98	17.94
1	27.79	29.50	20.85	27.22
2	26.23	27.67	19.90	25.97
3	26.95	28.35	20.52	26.80
4	25.77	26.84	20.03	26.00
5	27.25	29.55	19.71	25.68
6	28.15	30.53	20.22	26.58
7	29.37	31.39	21.65	28.47
8	30.28	34.03	20.36	26.68
9	30.20	33.78	20.41	26.91
10	29.69	33.23	20.03	26.42
11	31.84	35.72	21.41	28.16
12	27.00	28.87	20.13	26.05
13	28.22	30.67	20.20	26.53
14	29.02	31.90	20.40	26.72
15	27.63	29.58	20.43	26.64
16	28.93	31.99	20.11	26.29
17	28.71	31.00	20.73	27.37
18	30.51	33.56	21.38	28.06
19	30.78	33.58	21.72	28.80
Average	29.23	32.01	20.65	27.10

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



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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	*0.0350*	*0.2810*	*0.0700*	*0.2100*	*0.0180*	*0.0700*	*0.0350*	*0.2810*
MIM	0.0351	0.2800	0.0698	0.2108	0.0180	0.0704	0.0352	0.2806
COV	0.019	0.006	0.013	0.006	0.029	0.012	0.010	0.006

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	0.0349	0.2810	0.0700	0.2100	0.0180	0.0699	0.0350	0.2811
COV	0.008	0.001	0.002	0.002	0.006	0.002	0.006	0.002

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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	*0.0350*	*0.2810*	*0.0700*	*0.2100*	*0.0180*	*0.0700*	*0.0350*	*0.2810*
MIM	0.0351	0.2819	0.0702	0.2097	0.0179	0.0702	0.0349	0.2801
COV	0.021	0.003	0.012	0.002	0.024	0.009	0.012	0.004

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	0.0351	0.2810	0.0700	0.2098	0.0180	0.0699	0.0349	0.2812
COV	0.006	0.001	0.003	0.002	0.006	0.004	0.004	0.002

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 -Xmx256m -Xms256m persist1 -b 369

java -Xmx256m -Xms256m 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	44,134,528
Total Number of Logical Blocks Verified	37,896,720
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.

TESTED STORAGE CONFIGURATION (TSC) AVAILABILITY DATE

Clause 9.2.4.9

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

The IBM TotalStorage DS4500 *(mirrored write cache)*, as documented in this Full Disclosure Report will become available for customer purchase and shipment on September 12, 2003.

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 IBM TotalStorage DS4500 *(mirrored write cache)*.

APPENDIX A: SPC-1 WORKLOAD GENERATOR STORAGE CONFIGURATION COMMANDS AND PARAMETERS

Master Host System:

```
host=master
slaves=(bm6650a_1,bm6650a_2,bm6650a_3,bm6650c_1,bm6650c_2,bm6650c_3)

javaparms="-Xmx64m -Xms64m"

sd=asu1_1,lun=\\.\PhysicalDrive1,size=13456048128
sd=asu1_2,lun=\\.\PhysicalDrive21,size=13456048128
sd=asu1_3,lun=\\.\PhysicalDrive2,size=13456048128
sd=asu1_4,lun=\\.\PhysicalDrive22,size=13456048128
sd=asu1_5,lun=\\.\PhysicalDrive3,size=13456048128
sd=asu1_6,lun=\\.\PhysicalDrive23,size=13456048128
sd=asu1_7,lun=\\.\PhysicalDrive4,size=13456048128
sd=asu1_8,lun=\\.\PhysicalDrive24,size=13456048128
sd=asu1_9,lun=\\.\PhysicalDrive5,size=13456048128
sd=asu1_10,lun=\\.\PhysicalDrive25,size=13456048128

sd=asu1_11,lun=\\.\PhysicalDrive6,size=13456048128
sd=asu1_12,lun=\\.\PhysicalDrive26,size=13456048128
sd=asu1_13,lun=\\.\PhysicalDrive7,size=13456048128
sd=asu1_14,lun=\\.\PhysicalDrive27,size=13456048128
sd=asu1_15,lun=\\.\PhysicalDrive8,size=13456048128
sd=asu1_16,lun=\\.\PhysicalDrive28,size=13456048128
sd=asu1_17,lun=\\.\PhysicalDrive9,size=13456048128
sd=asu1_18,lun=\\.\PhysicalDrive29,size=13456048128
sd=asu1_19,lun=\\.\PhysicalDrive10,size=13456048128
sd=asu1_20,lun=\\.\PhysicalDrive30,size=13456048128

sd=asu1_21,lun=\\.\PhysicalDrive11,size=13456048128
sd=asu1_22,lun=\\.\PhysicalDrive31,size=13456048128
sd=asu1_23,lun=\\.\PhysicalDrive12,size=13456048128
sd=asu1_24,lun=\\.\PhysicalDrive32,size=13456048128
sd=asu1_25,lun=\\.\PhysicalDrive13,size=13456048128
sd=asu1_26,lun=\\.\PhysicalDrive33,size=13456048128
sd=asu1_27,lun=\\.\PhysicalDrive14,size=13456048128
sd=asu1_28,lun=\\.\PhysicalDrive34,size=13456048128
sd=asu1_29,lun=\\.\PhysicalDrive15,size=13456048128
sd=asu1_30,lun=\\.\PhysicalDrive35,size=13456048128

sd=asu1_31,lun=\\.\PhysicalDrive16,size=13456048128
sd=asu1_32,lun=\\.\PhysicalDrive36,size=13456048128
sd=asu1_33,lun=\\.\PhysicalDrive17,size=13456048128
sd=asu1_34,lun=\\.\PhysicalDrive37,size=13456048128
sd=asu1_35,lun=\\.\PhysicalDrive18,size=13456048128
sd=asu1_36,lun=\\.\PhysicalDrive38,size=13456048128
sd=asu1_37,lun=\\.\PhysicalDrive19,size=13456048128
sd=asu1_38,lun=\\.\PhysicalDrive39,size=13456048128
sd=asu1_39,lun=\\.\PhysicalDrive20,size=13456048128
sd=asu1_40,lun=\\.\PhysicalDrive40,size=13456048128
```

```
sd=asu2_1,lun=\\.\PhysicalDrive41,size=538241925120

sd=asu3_1,lun=\\.\PhysicalDrive42,size=119609316693
```

Slave Host System 1:

The SPC-1 Workload Generator commands and parameters listed below were used for all three instances executing on the Slave Host System. The only difference in the commands for each instance was the "host=..." command, which differed for each individual instance.

```
host=bm6650c_1
master=bm6650c

javaparms="-Xmx64m -Xms64m"

sd=asu1_1,lun=\\.\PhysicalDrive1,size=13456048128
sd=asu1_2,lun=\\.\PhysicalDrive21,size=13456048128
sd=asu1_3,lun=\\.\PhysicalDrive2,size=13456048128
sd=asu1_4,lun=\\.\PhysicalDrive22,size=13456048128
sd=asu1_5,lun=\\.\PhysicalDrive3,size=13456048128
sd=asu1_6,lun=\\.\PhysicalDrive23,size=13456048128
sd=asu1_7,lun=\\.\PhysicalDrive4,size=13456048128
sd=asu1_8,lun=\\.\PhysicalDrive24,size=13456048128
sd=asu1_9,lun=\\.\PhysicalDrive5,size=13456048128
sd=asu1_10,lun=\\.\PhysicalDrive25,size=13456048128

sd=asu1_11,lun=\\.\PhysicalDrive6,size=13456048128
sd=asu1_12,lun=\\.\PhysicalDrive26,size=13456048128
sd=asu1_13,lun=\\.\PhysicalDrive7,size=13456048128
sd=asu1_14,lun=\\.\PhysicalDrive27,size=13456048128
sd=asu1_15,lun=\\.\PhysicalDrive8,size=13456048128
sd=asu1_16,lun=\\.\PhysicalDrive28,size=13456048128
sd=asu1_17,lun=\\.\PhysicalDrive9,size=13456048128
sd=asu1_18,lun=\\.\PhysicalDrive29,size=13456048128
sd=asu1_19,lun=\\.\PhysicalDrive10,size=13456048128
sd=asu1_20,lun=\\.\PhysicalDrive30,size=13456048128

sd=asu1_21,lun=\\.\PhysicalDrive11,size=13456048128
sd=asu1_22,lun=\\.\PhysicalDrive31,size=13456048128
sd=asu1_23,lun=\\.\PhysicalDrive12,size=13456048128
sd=asu1_24,lun=\\.\PhysicalDrive32,size=13456048128
sd=asu1_25,lun=\\.\PhysicalDrive13,size=13456048128
sd=asu1_26,lun=\\.\PhysicalDrive33,size=13456048128
sd=asu1_27,lun=\\.\PhysicalDrive14,size=13456048128
sd=asu1_28,lun=\\.\PhysicalDrive34,size=13456048128
sd=asu1_29,lun=\\.\PhysicalDrive15,size=13456048128
sd=asu1_30,lun=\\.\PhysicalDrive35,size=13456048128

sd=asu1_31,lun=\\.\PhysicalDrive16,size=13456048128
sd=asu1_32,lun=\\.\PhysicalDrive36,size=13456048128
sd=asu1_33,lun=\\.\PhysicalDrive17,size=13456048128
sd=asu1_34,lun=\\.\PhysicalDrive37,size=13456048128
```

```
sd=asu1_35,lun=\\.\PhysicalDrive18,size=13456048128
sd=asu1_36,lun=\\.\PhysicalDrive38,size=13456048128
sd=asu1_37,lun=\\.\PhysicalDrive19,size=13456048128
sd=asu1_38,lun=\\.\PhysicalDrive39,size=13456048128
sd=asu1_39,lun=\\.\PhysicalDrive20,size=13456048128
sd=asu1_40,lun=\\.\PhysicalDrive40,size=13456048128

sd=asu2_1,lun=\\.\PhysicalDrive41,size=538241925120

sd=asu3_1,lun=\\.\PhysicalDrive42,size=119609316693
```

Slave Host System 2:

The SPC-1 Workload Generator commands and parameters listed below were used for all three instances executing on the Slave Host System. The only difference in the commands for each instance was the "host=..." command, which differed for each individual instance.

```
host=bm6650a_1
master=bm6650a

javaparms="-Xmx64m -Xms64m"

sd=asu1_1,lun=\\.\PhysicalDrive1,size=13456048128
sd=asu1_2,lun=\\.\PhysicalDrive21,size=13456048128
sd=asu1_3,lun=\\.\PhysicalDrive2,size=13456048128
sd=asu1_4,lun=\\.\PhysicalDrive22,size=13456048128
sd=asu1_5,lun=\\.\PhysicalDrive3,size=13456048128
sd=asu1_6,lun=\\.\PhysicalDrive23,size=13456048128
sd=asu1_7,lun=\\.\PhysicalDrive4,size=13456048128
sd=asu1_8,lun=\\.\PhysicalDrive24,size=13456048128
sd=asu1_9,lun=\\.\PhysicalDrive5,size=13456048128
sd=asu1_10,lun=\\.\PhysicalDrive25,size=13456048128

sd=asu1_11,lun=\\.\PhysicalDrive6,size=13456048128
sd=asu1_12,lun=\\.\PhysicalDrive26,size=13456048128
sd=asu1_13,lun=\\.\PhysicalDrive7,size=13456048128
sd=asu1_14,lun=\\.\PhysicalDrive27,size=13456048128
sd=asu1_15,lun=\\.\PhysicalDrive8,size=13456048128
sd=asu1_16,lun=\\.\PhysicalDrive28,size=13456048128
sd=asu1_17,lun=\\.\PhysicalDrive9,size=13456048128
sd=asu1_18,lun=\\.\PhysicalDrive29,size=13456048128
sd=asu1_19,lun=\\.\PhysicalDrive10,size=13456048128
sd=asu1_20,lun=\\.\PhysicalDrive30,size=13456048128

sd=asu1_21,lun=\\.\PhysicalDrive11,size=13456048128
sd=asu1_22,lun=\\.\PhysicalDrive31,size=13456048128
sd=asu1_23,lun=\\.\PhysicalDrive12,size=13456048128
sd=asu1_24,lun=\\.\PhysicalDrive32,size=13456048128
sd=asu1_25,lun=\\.\PhysicalDrive13,size=13456048128
sd=asu1_26,lun=\\.\PhysicalDrive33,size=13456048128
sd=asu1_27,lun=\\.\PhysicalDrive14,size=13456048128
sd=asu1_28,lun=\\.\PhysicalDrive34,size=13456048128
sd=asu1_29,lun=\\.\PhysicalDrive15,size=13456048128
sd=asu1_30,lun=\\.\PhysicalDrive35,size=13456048128
```

```
sd=asu1_31,lun=\\.\PhysicalDrive16,size=13456048128
sd=asu1_32,lun=\\.\PhysicalDrive36,size=13456048128
sd=asu1_33,lun=\\.\PhysicalDrive17,size=13456048128
sd=asu1_34,lun=\\.\PhysicalDrive37,size=13456048128
sd=asu1_35,lun=\\.\PhysicalDrive18,size=13456048128
sd=asu1_36,lun=\\.\PhysicalDrive38,size=13456048128
sd=asu1_37,lun=\\.\PhysicalDrive19,size=13456048128
sd=asu1_38,lun=\\.\PhysicalDrive39,size=13456048128
sd=asu1_39,lun=\\.\PhysicalDrive20,size=13456048128
sd=asu1_40,lun=\\.\PhysicalDrive40,size=13456048128

sd=asu2_1,lun=\\.\PhysicalDrive41,size=538241925120

sd=asu3_1,lun=\\.\PhysicalDrive42,size=119609316693
```

APPENDIX B: TESTED STORAGE CONFIGURATION (TSC) CREATION/CONFIGURATION SCRIPT

```
/* SPC-1 configuration script     */
/* 108 drives - 8/07/03          */

set controller[a] mode = active;
set controller[b] mode = active;

create volume drives[ 0,1  0,2 10,1  10,2  0,3  0,4  10,3  10,4   0,5  0,6  10,5  10,6   0,7  0,8 10,7
                10,8 0,9 0,10  10,9 10,10 0,11  0,12 10,11 10,12 0,13  0,14 10,13 10,14 2,1 12,1 ]
RAIDLevel=1
segmentSize=128
userLabel="LUN 0"
capacity=13456048128
owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 1"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 2"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 3"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 4"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 5"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 6"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 7"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 8"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 9"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 10"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=512  userLabel="LUN 11"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 12"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 13"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 14"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 15"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 16"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 17"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 18"  capacity=13456048128  owner = A;
create volume volumeGroup=1  RAIDLevel=1  segmentSize=128  userLabel="LUN 19"  capacity=13456048128  owner = A;

create volume drives[ 1,1  1,2  11,1  11,2   1,3  1,4  11,3  11,4   1,5   1,6  11,5  11,6   1,7  1,8
                11,7 11,8  1,9   1,10 11,9 11,10  1,11  1,12 11,11 11,12  1,13  1,14 11,13 11,14 2,10 12,10 ]
RAIDLevel=1
segmentSize=128
userLabel="LUN 20"
capacity=13456048128
owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 21"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 22"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 23"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 24"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 25"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 26"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 27"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 28"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 29"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 30"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=512  userLabel="LUN 31"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 32"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 33"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 34"  capacity=13456048128  owner = A;
```

```
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 35"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 36"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 37"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 38"  capacity=13456048128  owner = A;
create volume volumeGroup=2  RAIDLevel=1  segmentSize=128  userLabel="LUN 39"  capacity=13456048128  owner = A;

create volume drives[ 2,2 12,2  2,3   2,4  12,3  12,4  2,5   2,6  12,5 12,6  2,7  2,8 12,7  12,8  2,9
                      12,9  2,11 2,12 12,11 12,12  2,13 2,14 12,13 12,14 3,1  3,2  13,1 13,2  3,3  13,3 ]
RAIDLevel=1
segmentSize=512
userLabel="LUN 40"
capacity=538241925120
owner = b;

create volume drives[ 3,4 13,4 3,5 3,6  13,5 13,6  3,7 3,8  13,7 13,8  3,9 3,10  13,9 13,10  3,11 3,12  13,11 13,12 ]
RAIDLevel=1
segmentSize=128
userLabel="LUN 41"
capacity=119609316864
owner = b;

set volume["LUN 0"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 1"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 2"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 3"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 4"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 5"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 6"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 7"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 8"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 9"]  mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 10"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 11"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 12"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 13"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 14"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 15"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 16"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 17"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 18"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 19"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 20"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 21"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 22"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 23"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 24"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 25"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 26"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 27"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 28"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 29"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 30"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 31"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 32"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 33"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 34"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 35"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 36"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 37"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 38"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 39"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
```

```
set volume["LUN 40"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 41"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;

set storageArray cacheFlushStop  = 70 cacheFlushStart = 70;

set storageArray defaultHostType = "Windows 2000/Server 2003 Non-Clustered";

set controller[a] HostNVSRAMByte[0x01, 0x17]=0x01;
set controller[b] HostNVSRAMByte[0x01, 0x17]=0x01;

/* Setup for RDAC failover environment */

set controller[a] HostNVSRAMByte[0x00, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x01, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x02, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x03, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x04, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x05, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x06, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x07, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x08, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x09, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0a, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0b, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0c, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0d, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0e, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0f, 0x24]=0x00;

set controller[b] HostNVSRAMByte[0x00, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x01, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x02, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x03, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x04, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x05, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x06, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x07, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x08, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x09, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0a, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0b, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0c, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0d, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0e, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0f, 0x24]=0x00;
```