



# SPC BENCHMARK 1™
# FULL DISCLOSURE REPORT

## 3PAR INC.
## 3PAR INSERV® T800 STORAGE SERVER

**SPC-1 V1.10.1**

**Submitted for Review: September 2, 2008**
**Submission Identifier: A00069**

**First Edition – September 2008**



**Trademarks**

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# AUDIT CERTIFICATION



Bill McCormack
3PAR Inc.
4609 Technology Drive
Fremont, CA 94538

August 29, 2008

The SPC Benchmark 1™ results listed below for the 3PAR InServ® T800 Storage Server were produced in compliance with the SPC Benchmark 1™ V1.10.1 Onsite Audit requirements.

| SPC Benchmark 1™ V1.10.1 Results | |
|---|---|
| **Tested Storage Configuration (TSC) Name:** 3PAR InServ® T800 Storage Server | |
| **Metric** | **Reported Result** |
| SPC-1 IOPS™ | 224,989.65 |
| SPC-1 Price-Performance | $9.30/SPC-1 IOPS™ |
| Total ASU Capacity | 77,824.000 GB |
| Data Protection Level | Mirroring |
| Total TSC Price (including three-year maintenance) | $2,091,667 |

The following SPC Benchmark 1™ Onsite Audit requirements were reviewed and found compliant with V1.10.1 of the SPC Benchmark 1™ specification:

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

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

## AUDIT CERTIFICATION *(CONT.)*

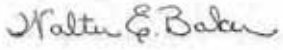


- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters that were changed from default values.
- SPC-1 Workload Generator commands and parameters used for the audited SPC Test Runs.
- The following Host System requirements were verified by physical inspection and information supplied by 3PAR Inc.:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the SPC-1 Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The execution of each Test, Test Phase, and Test Run was observed and found compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification.
- The Test Results Files and resultant Summary Results Files received from 3PAR Inc. for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification:
  - ✓ Data Persistence Test
  - ✓ Sustainability Test Phase
  - ✓ IOPS Test Phase
  - ✓ Response Time Ramp Test Phase
  - ✓ Repeatability Test
- There were no differences between the Tested Storage Configuration (TSC) used for the benchmark and Priced Storage Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 8 of the SPC-1 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 9 of the SPC-1 Benchmark Specification.
- This successfully audited SPC measurement is not subject to an SPC Confidential Review.

**Audit Notes:**

There were no audit notes or exceptions.

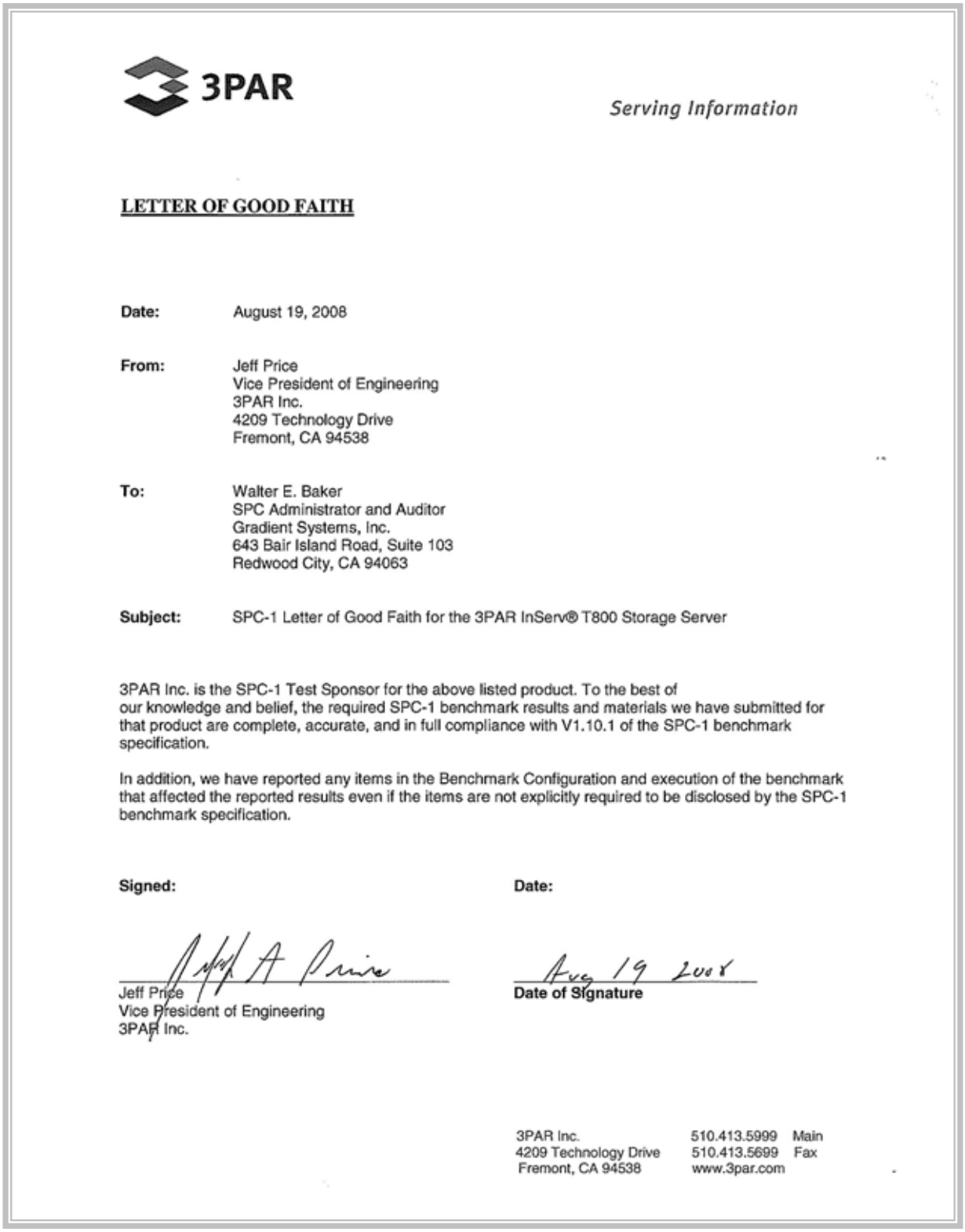
Respectfully,



Walter E. Baker
SPC Auditor

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

# LETTER OF GOOD FAITH



3PAR

*Serving Information*

**LETTER OF GOOD FAITH**

**Date:** August 19, 2008

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

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

**Subject:** SPC-1 Letter of Good Faith for the 3PAR InServ® T800 Storage Server

3PAR Inc. is the SPC-1 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V1.10.1 of the SPC-1 benchmark specification.

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

**Signed:** **Date:**

Jeff Price
Vice President of Engineering
3PAR Inc.

Aug 19 2008
**Date of Signature**

3PAR Inc. 510.413.5999 Main
4209 Technology Drive 510.413.5699 Fax
Fremont, CA 94538 www.3par.com

# EXECUTIVE SUMMARY

## Test Sponsor and Contact Information

| Test Sponsor and Contact Information | |
|---|---|
| **Test Sponsor Primary Contact** | 3PAR Inc. – http://www.3par.com<br>Bill McCormack – bill.mccormack@3par.com<br>4609 Technology Drive<br>Fremont, CA 94538<br>Phone: (510) 897-2784<br>FAX: (510) 413-5998 |
| **Test Sponsor Alternate Contact** | 3PAR Inc. – http://www.3par.com<br>John Cooper – john.cooper@3par.com<br>4609 Technology Drive<br>Fremont, CA 94538<br>Phone: (510) 668-9310<br>FAX: (510) 413-5998 |
| **Test Sponsor Alternate Contact** | 3PAR Inc. – http://www.3par.com<br>Geoff Hough – geoff.hough@3par.com<br>4609 Technology Drive<br>Fremont, CA 94538<br>Phone: (510) 668-9213<br>FAX: (510) 413-5699 |
| **Auditor** | Storage Performance Council – http://www.storageperformance.org<br>Walter E. Baker – AuditService@StoragePerformance.org<br>643 Bair Island Road, Suite 103<br>Redwood City, CA 94063<br>Phone: (650) 556-9384<br>FAX: (650) 556-9385 |

## Revision Information and Key Dates

| Revision Information and Key Dates | |
|---|---|
| **SPC-1 Specification revision number** | V1.10.1 |
| **SPC-1 Workload Generator revision number** | V2.00.04a |
| **Date Results were first used publicly** | September 2, 2008 |
| **Date the FDR was submitted to the SPC** | September 2, 2008 |
| **Date the TSC is available for shipment to customers** | September 2, 2008 |
| **Date the TSC completed audit certification** | August 29, 2008 |

## Tested Storage Product (TSP) Description

3PAR® designed the 3PAR InServ® T800 Storage Server to deliver high levels of performance and consolidation simply and affordably, so that customers don't have to overprovision capacity or resort to overly complex administration to increase performance and improve capacity utilization.

3PAR's unique and tightly-clustered InSpire® Architecture was designed to ensure high and predictable levels of performance for all workloads, as well as high utilization rates for purchased resources. Central to the InSpire design is a high-bandwidth, low-latency backplane that unifies cost-effective, modular, and scalable components into a highly available and autonomically load-balanced cluster. The 3PAR Gen3 ASIC featured by 3PAR's T-Class storage arrays was also designed to alleviate performance concerns and cut traditional array costs by allowing the InServ to deliver mixed workload support, whereby transaction- and throughput-intensive workloads run without contention on the same storage resources.

## Summary of Results

| SPC-1 Results | |
|---|---|
| **Tested Storage Configuration (TSC) Name:** 3PAR InServ® T800 Storage Server | |
| **Metric** | **Reported Result** |
| **SPC-1 IOPS™** | 224,989.65 |
| **SPC-1 Price-Performance** | $9.30/SPC-1 IOPS™ |
| **Total ASU Capacity** | 77,824.000 GB |
| **Data Protection Level** | Mirroring |
| **Total TSC Price (including three-year maintenance)** | $2,091,667 |

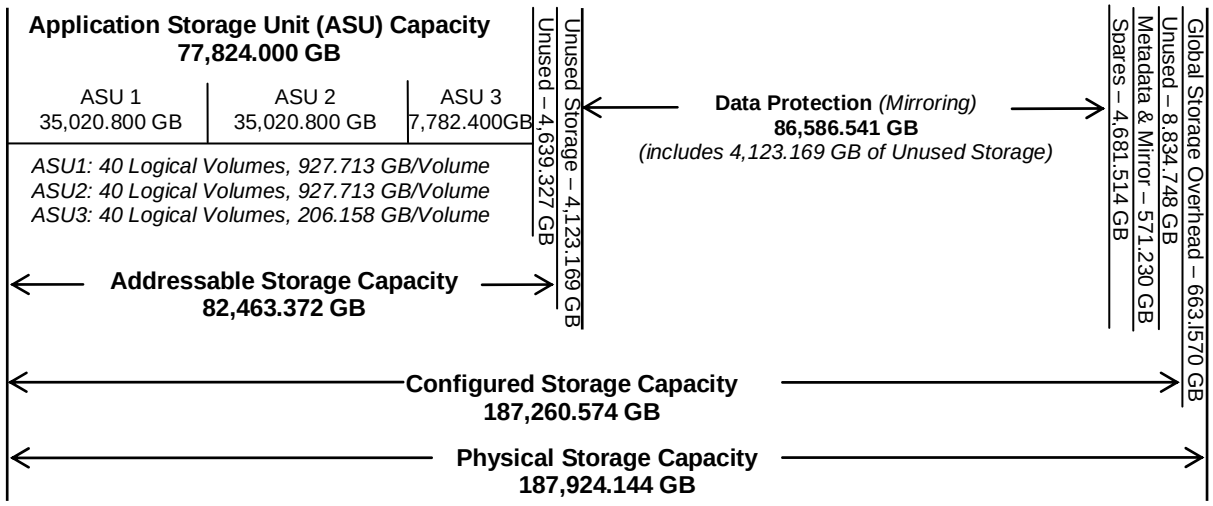
**SPC-1 IOPS™** represents the maximum I/O Request Throughput at the 100% load point.

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

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

## Storage Capacities and Relationships

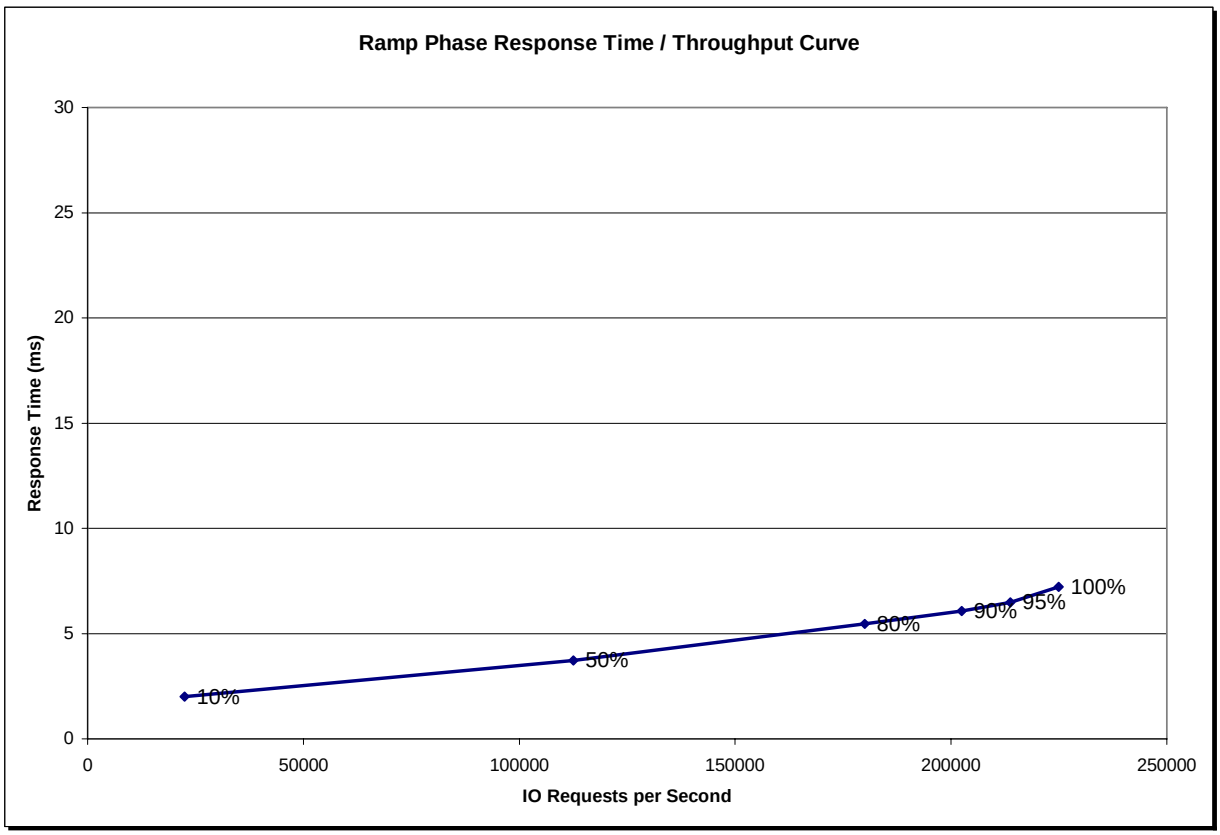
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



## Response Time – Throughput Curve

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

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




## Response Time – Throughput Data

| | 10% Load | 50% Load | 80% Load | 90% Load | 95% Load | 100% Load |
|---|---|---|---|---|---|---|
| **I/O Request Throughput** | 22,500.27 | 112,523.81 | 180,038.31 | 202,489.84 | 213,739.77 | 224,989.65 |
| ***Average Response Time (ms):*** | | | | | | |
| **All ASUs** | 1.99 | 3.72 | 5.47 | 6.08 | 6.49 | 7.22 |
| **ASU-1** | 2.73 | 4.78 | 6.69 | 7.31 | 7.72 | 8.40 |
| **ASU-2** | 2.04 | 5.03 | 7.70 | 8.61 | 9.13 | 9.94 |
| **ASU-3** | 0.42 | 0.88 | 1.90 | 2.36 | 2.74 | 3.54 |
| **Reads** | 4.51 | 8.26 | 11.38 | 12.34 | 12.89 | 13.72 |
| **Writes** | 0.36 | 0.76 | 1.62 | 2.00 | 2.32 | 3.00 |

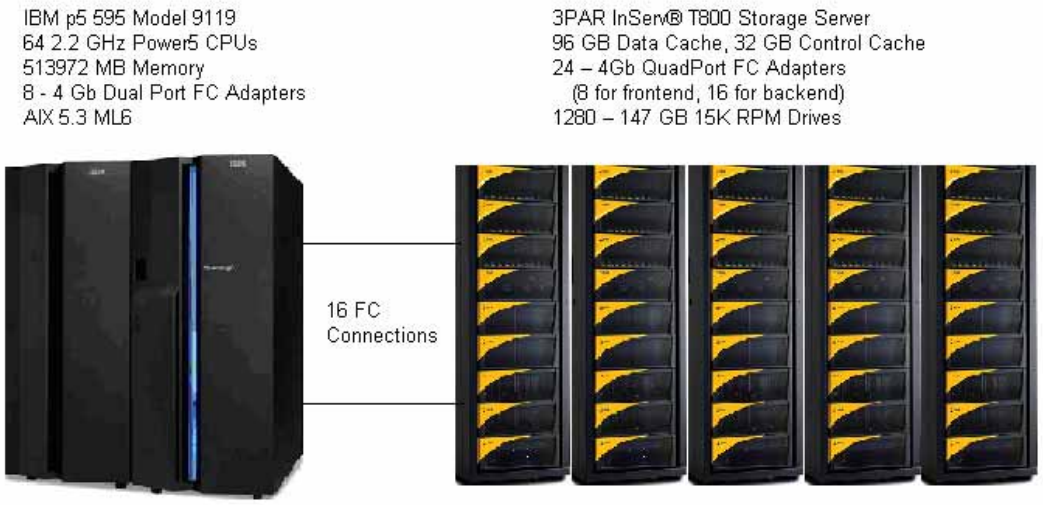
## Tested Storage Configuration Pricing *(Priced Storage Configuration)*

| Item | Description | Qty | Price |
|---|---|---|---|
| 980-200008 | 2.33GHZ T-SERIES CONTROLLER NODE | 6 | |
| 980-200009 | 4GB CONTROL CACHE (2 x 2GB DIMMS) | 8 | |
| 980-200010 | 6GB DATA CACHE (3 x 2GB DIMMS) | 16 | |
| 980-0037 | 4-PORT FIBRE CHANNEL ADAPTER (4 GBIT) | 24 | |
| 980-200007 | INSERV T800 BASE CONFIGURATION | 1 | |
| 981-200004 | DRIVE CHASSIS (40-DISK, 4 GBIT/S) | 32 | |
| 981-200005 | 4 x 146GB DRIVE MAGAZINE (15K RPM, 4 GBIT/S) | 320 | |
| 982-200000 | 2M FIBER CABLE 50/125 (LC-LC) | 8 | |
| 982-0021 | 10M FIBER CABLE 50/125 (LC-LC) | 56 | |
| 982-0023 | 50M FIBER CABLE 50/125 (LC-LC) | 16 | |
| 982-0008 | 2M CABINET KIT (WITH REDUNDANT PDU PAIR) | 4 | |
| 982-0014 | REGIONAL KIT, NORTH AMERICA | 5 | |
| 985-0001 | SERVICE PROCESSOR | 1 | |
| 987-200096 | INFORM SUITE (T800) - 4 x 146GB 15K RPM MAGAZINE LTU | 320 | |
| 987-0122 | 3PAR MPIO FOR IBM AIX MEDIA KIT | 1 | |
| 985-200031 | INSTALLATION AND SET-UP 8 NODES T-SERIES | 1 | |
| 985-200052 | HW MAINT 24X7 4HR RESP, PRICE PER NODE FOR 4, 6, AND 8 NODES T-SERIES | 8 | |
| 985-200061 | INFORM SUITE SW MAINT, PRICE PER NODE FOR 4, 6, 8 NODES T-SERIES | 8 | |
| 985-200127 | 3PAR MPIO FOR IBM AIX SW MAINT (1-10 HOSTS) T-SERIES | 1 | |
| | **3PAR InServ T800 Storage Server Package**<br>--Includes 3-years Service (24x7 4 hour response) | 1 | $2,082,867 |
| 3rd Party: | IBM 5759 4 GB Dual-Port Fibre Channel Adapter | 8 | $8,800 |
| | **Total** | | **$2,091,667** |

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

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

## Benchmark Configuration/Tested Storage Configuration Diagram




## Benchmark Configuration/Tested Storage Configuration Components

| Host Systems: | Tested Storage Configuration (TSC): |
|---|---|
| ***UID=HS-1*** | 8 – IBM 4Gb Dual Port PCI-X HBAs *(9119-5759)* |
| IBM P5 595 Model 9119 | ***UID=SC-1:***<br>3PAR InServ® T800 Storage Server<br>8 – T-Series Controller Nodes<br>96 GB data cache<br>32 GB control cache<br>8 – 4Gb QuadPort FC Adapters<br>*(2 ports/adapter used for front-end)*<br>16 – 4Gb QuadPort FC Adapters<br>*(4 ports/adapter used for backend)* |
| 64 – 2.2 GHz CPUs – 2 CPUs/POWER5 chip<br>32 KB L1 cache, 960 KB L2 cache,<br>and 18 MB L3 cache per CPU | |
| 513972 MB main memory | |
| 3PAR® Multipath I/O 2.2 for IBM AIX | |
| AIX 5.3 ML6 | |
| PCI-X | 5 – 2M Cabinet Kits |
| WG | 1280 – 146 GB, 15K RPM disk drives |

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

# CONFIGURATION INFORMATION

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

*Clause 9.2.4.4.1*

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

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

## Storage Network Configuration

*Clause 9.2.4.4.1*

…

5. *If the TSC contains network storage, the diagram will include the network configuration. If a single diagram is not sufficient to illustrate both the Benchmark Configuration and network configuration in sufficient detail, the Benchmark Configuration diagram will include a high-level network illustration as shown in Figure 9-8. In that case, a separate, detailed network configuration diagram will also be included as described in Clause 9.2.4.4.2.*

*Clause 9.2.4.4.2*

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

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC), including the network configuration, is illustrated on page 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

## Host System Configuration

*Clause 9.2.4.4.3*

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

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

The details of the Host System configuration may be found on page 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

## Customer Tunable Parameters and Options

*Clause 9.2.4.5.1*

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

"Appendix B: Customer Tunable Parameters and Options" on page 58 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

## Tested Storage Configuration (TSC) Description

*Clause 9.2.4.5.2*

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

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

"Appendix C: Tested Storage Configuration (TSC) Creation" on page 59 contains the detailed information that describes how to create and configure the logical TSC.

## SPC-1 Workload Generator Storage Configuration

*Clause 9.2.4.5.3*

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

The SPC-1 Workload Generator storage configuration commands and parameters for this measurement appear in "Appendix D: SPC-1 Workload Generator Storage Commands and Parameters" on page 64.

# SPC-1 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1 storage capacities and mappings used in the Tested Storage Configuration. "SPC-1 Data Repository Definitions" on page 54 contains definitions of terms specific to the SPC-1 Data Repository.

## Storage Capacities and Relationships

*Clause 9.2.4.6.1*

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

### SPC-1 Storage Capacities

| SPC-1 Storage Capacities | | |
|---|---|---|
| **Storage Hierarchy Component** | **Units** | **Capacity** |
| Total ASU Capacity | Gigabytes (GB) | 77,824.000 |
| Addressable Storage Capacity | Gigabytes (GB) | 82,463.372 |
| Configured Storage Capacity | Gigabytes (GB) | 187,260.574 |
| Physical Storage Capacity | Gigabytes (GB) | 187,924.144 |
| Data Protection *(Mirrored)* | Gigabytes (GB) | 86,586.541 |
| Required Storage *(spares/metadata/overhead)* | Gigabytes (GB) | 5,252.744 |
| Global Storage Overhead | Gigabytes (GB) | 663.570 |
| Total Unused Storage | Gigabytes (GB) | 21,720.458 |

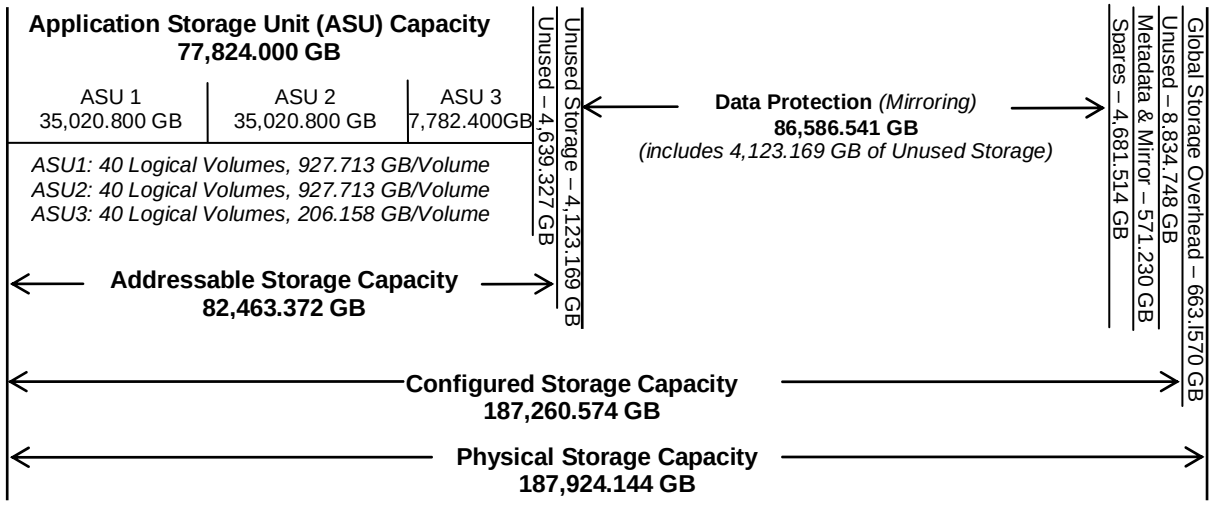
### SPC-1 Storage Hierarchy Ratios

| | **Addressable Storage Capacity** | **Configured Storage Capacity** | **Physical Storage Capacity** |
|---|---|---|---|
| **Total ASU Capacity** | 94.37% | 41.56.% | 41.41% |
| **Required for Data Protection *(Mirrored)*** | | 46.24% | 46.08% |
| **Addressable Storage Capacity** | | 44.04% | 43.88% |
| **Required Storage *(spares/metadata)*** | | 2.81% | 2.80% |
| **Configured Storage Capacity** | | | 99.65% |
| **Global Storage Overhead** | | | 0.35% |
| **Unused Storage:** | | | |
| **Addressable** | 5.63% | | |
| **Configured** | | 9.12% | |
| **Physical** | | | 0.00% |

The Physical Storage Capacity consisted of 187,924.144 GB distributed over 1,280 disk drives each with a formatted capacity of 146.816 GB. There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 663.570 GB (0.35%) of Physical Storage Capacity. There was 17,081.086 GB (9.12%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 94.37% of the Addressable Storage Capacity resulting in 4,639.372 GB (5.63%) of Unused Storage within the Addressable Storage Capacity.

### SPC-1 Storage Capacities and Relationships Illustration

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




## Logical Volume Capacity and ASU Mapping

*Clause 9.2.4.6.2*

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

| Logical Volume Capacity and Mapping | | |
|---|---|---|
| **ASU-1 (35,020.800 GB)** | **ASU-2 (35,020.800 GB)** | **ASU-3 (7,782.400 GB)** |
| 40 Logical Volumes<br>927.713 GB per Logical Volume<br>(875.520 GB used per Logical Volume) | 40 Logical Volumes<br>927.713 GB per Logical Volume<br>(875.520 GB used per Logical Volume) | 40 Logical Volumes<br>206.158 GB per Logical Volume<br>(194.560 GB used per Logical Volume) |

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

# SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. "SPC-1 Test Execution Definitions" on page 55 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

*Clause 5.4.3*

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

## SPC-1 Tests, Test Phases, and Test Runs

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

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

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

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

## Primary Metrics Test – Sustainability Test Phase

*Clause 5.4.4.1.1*

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

*Clause 5.4.4.1.2*

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

*Clause 5.4.4.1.4*

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

*Clause 9.2.4.7.1*

*For the Sustainability Test Phase the FDR shall contain:*

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

### SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 67.

### Sustainability Test Results File

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

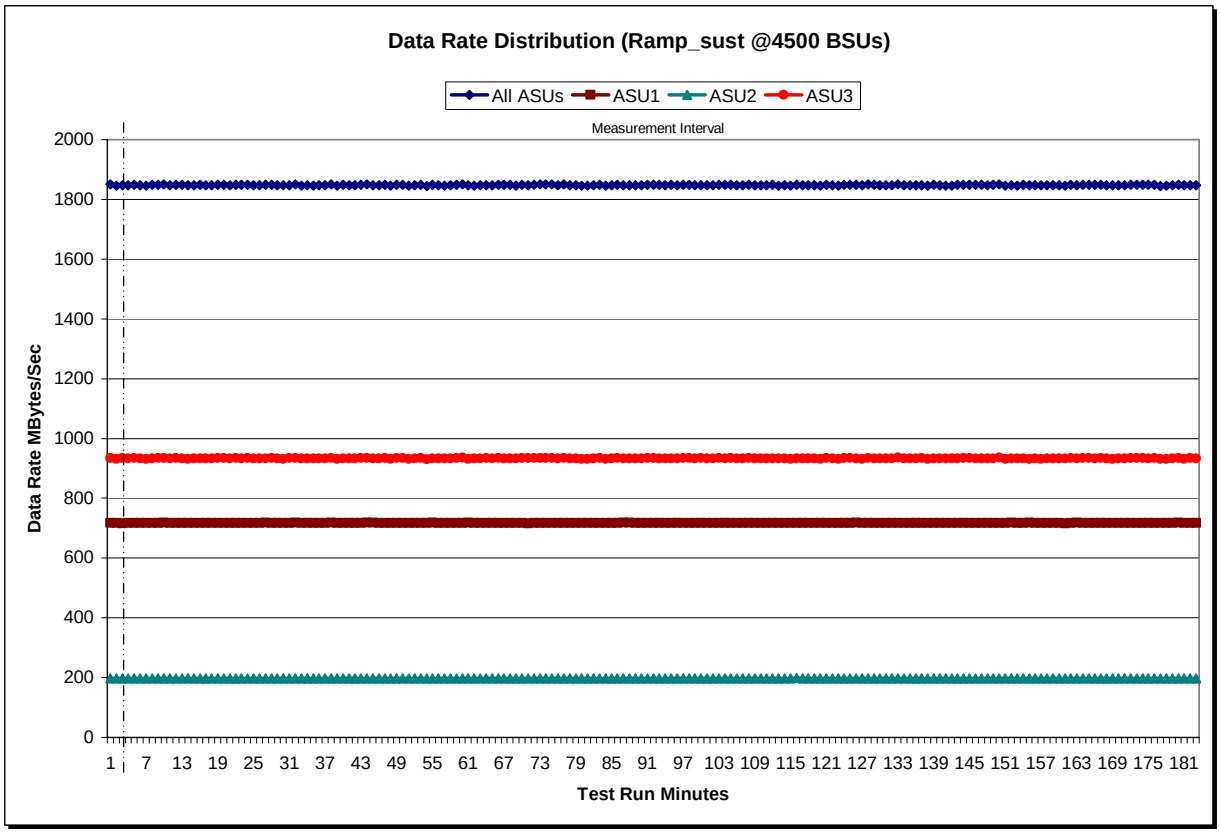
**Sustainability Test Results File**

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

| Start | Stop | Interval | Duration |
|---|---|---|---|
| 16:29:06 | 16:32:06 | 0-2 | 0:03:00 |
| 16:32:06 | 19:32:07 | 3-182 | 3:00:01 |

| ASU1 | ASU2 | ASU3 | Interval | All ASUs | ASU1 | ASU2 | ASU3 | Interval | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 717.63 | 197.61 | 934.76 | 63 | 1,847.74 | 716.65 | 197.18 | 933.91 | 126 | 1,846.91 | 717.70 | 197.12 | 932.09 |
| 717.18 | 197.52 | 931.24 | 64 | 1,847.28 | 717.38 | 197.49 | 932.41 | 127 | 1,849.62 | 717.43 | 197.45 | 934.75 |
| 716.31 | 197.26 | 933.78 | 65 | 1,849.01 | 717.53 | 197.39 | 934.09 | 128 | 1,848.11 | 717.13 | 197.36 | 933.61 |
| 716.76 | 197.53 | 933.10 | 66 | 1,848.32 | 717.61 | 197.34 | 933.37 | 129 | 1,847.74 | 717.40 | 196.88 | 933.46 |
| 717.42 | 197.32 | 934.17 | 67 | 1,848.40 | 717.77 | 197.09 | 933.54 | 130 | 1,847.88 | 717.46 | 197.24 | 933.18 |
| 716.90 | 197.38 | 933.30 | 68 | 1,846.47 | 716.70 | 197.12 | 932.66 | 131 | 1,847.97 | 717.74 | 197.59 | 932.63 |
| 716.35 | 197.38 | 931.49 | 69 | 1,849.09 | 716.99 | 197.70 | 934.40 | 132 | 1,850.36 | 717.21 | 197.47 | 935.68 |
| 717.48 | 197.35 | 933.64 | 70 | 1,847.69 | 716.34 | 197.53 | 933.81 | 133 | 1,847.25 | 717.10 | 196.67 | 933.48 |
| 717.19 | 197.33 | 934.52 | 71 | 1,849.09 | 717.29 | 197.38 | 934.42 | 134 | 1,848.00 | 717.00 | 197.57 | 933.43 |
| 718.13 | 197.50 | 935.01 | 72 | 1,850.05 | 717.26 | 197.79 | 935.00 | 135 | 1,847.64 | 717.02 | 197.20 | 933.42 |
| 716.95 | 196.99 | 932.91 | 73 | 1,849.56 | 717.46 | 197.15 | 934.95 | 136 | 1,848.08 | 716.47 | 197.47 | 934.15 |
| 717.58 | 196.60 | 934.62 | 74 | 1,850.05 | 717.25 | 197.85 | 934.95 | 137 | 1,845.45 | 716.88 | 197.41 | 931.15 |
| 717.27 | 197.62 | 933.47 | 75 | 1,847.02 | 717.40 | 197.07 | 932.55 | 138 | 1,848.26 | 717.51 | 197.56 | 933.19 |
| 716.98 | 197.63 | 932.16 | 76 | 1,849.64 | 717.41 | 197.71 | 934.52 | 139 | 1,847.31 | 717.07 | 197.29 | 932.94 |
| 717.08 | 197.22 | 933.17 | 77 | 1,847.89 | 717.07 | 197.32 | 933.49 | 140 | 1,846.63 | 716.91 | 197.19 | 932.53 |
| 717.21 | 197.31 | 933.65 | 78 | 1,846.77 | 716.92 | 197.23 | 932.62 | 141 | 1,846.40 | 716.56 | 197.40 | 932.43 |
| 716.88 | 197.39 | 933.34 | 79 | 1,846.55 | 717.75 | 196.97 | 931.83 | 142 | 1,848.64 | 717.42 | 197.51 | 933.71 |
| 716.75 | 197.54 | 933.03 | 80 | 1,846.56 | 716.93 | 197.54 | 932.10 | 143 | 1,849.09 | 717.15 | 197.19 | 934.76 |
| 717.68 | 197.29 | 934.16 | 81 | 1,847.04 | 716.50 | 197.35 | 933.20 | 144 | 1,849.38 | 717.65 | 197.27 | 934.45 |
| 717.70 | 197.45 | 933.82 | 82 | 1,848.86 | 717.45 | 197.52 | 933.90 | 145 | 1,848.36 | 717.52 | 197.26 | 933.58 |
| 717.69 | 196.80 | 932.77 | 83 | 1,845.57 | 716.66 | 197.09 | 931.82 | 146 | 1,848.21 | 717.46 | 197.53 | 933.22 |
| 717.12 | 197.66 | 934.02 | 84 | 1,847.87 | 717.54 | 197.35 | 932.99 | 147 | 1,847.46 | 717.29 | 197.37 | 932.79 |
| 717.58 | 197.87 | 933.56 | 85 | 1,848.37 | 717.29 | 197.16 | 933.92 | 148 | 1,848.35 | 717.40 | 197.65 | 933.30 |
| 717.01 | 197.55 | 933.80 | 86 | 1,847.59 | 717.81 | 197.37 | 932.40 | 149 | 1,849.91 | 717.56 | 197.12 | 935.23 |
| 716.98 | 197.29 | 932.65 | 87 | 1,848.03 | 717.89 | 196.85 | 933.28 | 150 | 1,846.04 | 717.54 | 197.15 | 931.35 |
| 717.52 | 197.60 | 932.57 | 88 | 1,847.33 | 717.41 | 197.01 | 932.91 | 151 | 1,847.64 | 717.90 | 197.28 | 932.46 |
| 718.02 | 197.60 | 933.08 | 89 | 1,847.90 | 717.22 | 196.95 | 933.73 | 152 | 1,846.33 | 717.27 | 196.71 | 932.35 |
| 717.25 | 197.46 | 933.87 | 90 | 1,849.14 | 717.45 | 197.35 | 934.34 | 153 | 1,848.42 | 717.63 | 197.22 | 933.57 |
| 717.27 | 197.52 | 932.92 | 91 | 1,848.67 | 716.95 | 197.45 | 934.26 | 154 | 1,846.96 | 717.95 | 197.18 | 931.83 |
| 717.54 | 197.36 | 932.31 | 92 | 1,849.21 | 717.74 | 197.79 | 933.68 | 155 | 1,847.07 | 717.27 | 197.24 | 932.56 |
| 716.42 | 197.42 | 933.86 | 93 | 1,847.96 | 717.14 | 197.65 | 933.17 | 156 | 1,846.96 | 717.35 | 197.52 | 932.08 |
| 718.51 | 197.21 | 934.06 | 94 | 1,848.57 | 717.36 | 197.75 | 933.46 | 157 | 1,847.98 | 717.53 | 197.18 | 933.27 |
| 716.69 | 197.01 | 932.79 | 95 | 1,847.32 | 717.39 | 197.28 | 932.66 | 158 | 1,847.51 | 716.78 | 197.34 | 933.38 |
| 717.25 | 197.42 | 933.08 | 96 | 1,848.95 | 717.37 | 197.29 | 934.28 | 159 | 1,847.63 | 716.96 | 197.70 | 932.97 |
| 717.08 | 196.79 | 932.37 | 97 | 1,848.92 | 717.54 | 197.06 | 934.33 | 160 | 1,846.30 | 716.10 | 197.40 | 932.79 |
| 716.99 | 196.94 | 933.66 | 98 | 1,847.63 | 717.01 | 197.28 | 933.34 | 161 | 1,849.38 | 717.53 | 197.37 | 934.48 |
| 717.32 | 197.43 | 932.56 | 99 | 1,847.88 | 716.89 | 197.04 | 933.95 | 162 | 1,847.79 | 717.91 | 196.75 | 933.13 |
| 717.99 | 197.86 | 934.68 | 100 | 1,847.14 | 717.42 | 196.78 | 932.93 | 163 | 1,849.32 | 717.15 | 197.19 | 934.98 |
| 716.60 | 197.12 | 931.92 | 101 | 1,847.37 | 717.50 | 197.06 | 932.81 | 164 | 1,848.76 | 717.74 | 196.94 | 934.07 |
| 717.13 | 197.51 | 933.53 | 102 | 1,849.49 | 717.32 | 197.90 | 934.28 | 165 | 1,848.39 | 717.42 | 197.77 | 933.20 |
| 717.40 | 196.88 | 932.83 | 103 | 1,848.85 | 717.66 | 197.52 | 933.68 | 166 | 1,848.85 | 717.35 | 197.24 | 934.26 |
| 717.35 | 196.81 | 933.20 | 104 | 1,848.61 | 717.62 | 197.18 | 933.80 | 167 | 1,846.98 | 716.64 | 197.29 | 933.05 |
| 717.27 | 197.44 | 933.98 | 105 | 1,847.48 | 716.84 | 197.22 | 933.43 | 168 | 1,846.93 | 717.44 | 197.59 | 931.91 |
| 717.88 | 197.22 | 934.55 | 106 | 1,847.91 | 717.57 | 197.09 | 933.25 | 169 | 1,847.03 | 717.04 | 197.02 | 932.97 |
| 717.99 | 197.21 | 932.49 | 107 | 1,849.42 | 717.67 | 197.28 | 934.47 | 170 | 1,846.72 | 716.99 | 197.27 | 932.46 |
| 717.18 | 197.10 | 933.64 | 108 | 1,846.72 | 716.81 | 196.80 | 933.10 | 171 | 1,849.09 | 717.56 | 197.60 | 933.94 |
| 717.04 | 197.33 | 934.50 | 109 | 1,847.01 | 716.73 | 197.87 | 932.41 | 172 | 1,848.16 | 717.20 | 197.13 | 933.83 |
| 716.83 | 197.53 | 932.13 | 110 | 1,847.23 | 717.38 | 196.89 | 932.96 | 173 | 1,849.29 | 717.73 | 197.69 | 933.87 |
| 717.63 | 196.98 | 934.15 | 111 | 1,848.12 | 717.31 | 197.29 | 933.52 | 174 | 1,848.86 | 717.72 | 197.43 | 933.71 |
| 717.12 | 197.98 | 934.05 | 112 | 1,846.46 | 716.89 | 197.12 | 932.44 | 175 | 1,849.12 | 717.12 | 197.13 | 934.87 |
| 717.27 | 197.43 | 931.83 | 113 | 1,847.03 | 716.83 | 197.39 | 932.81 | 176 | 1,845.11 | 716.71 | 197.26 | 931.14 |
| 716.74 | 197.58 | 933.62 | 114 | 1,846.62 | 717.27 | 197.26 | 932.09 | 177 | 1,846.33 | 717.41 | 197.38 | 931.53 |
| 717.52 | 197.35 | 933.85 | 115 | 1,848.13 | 716.49 | 198.05 | 933.59 | 178 | 1,847.29 | 717.20 | 196.99 | 933.10 |
| 717.36 | 196.87 | 930.42 | 116 | 1,847.22 | 716.74 | 197.40 | 933.08 | 179 | 1,849.24 | 718.03 | 196.97 | 934.25 |
| 717.85 | 197.48 | 933.14 | 117 | 1,847.45 | 717.04 | 197.13 | 933.28 | 180 | 1,847.01 | 717.42 | 197.42 | 932.17 |
| 717.16 | 197.12 | 932.56 | 118 | 1,847.67 | 717.09 | 197.35 | 933.23 | 181 | 1,847.90 | 716.68 | 197.42 | 933.81 |
| 716.40 | 197.32 | 932.58 | 119 | 1,846.11 | 717.22 | 197.32 | 931.58 | 182 | 1,847.93 | 717.33 | 197.13 | 933.47 |
| 716.97 | 197.23 | 933.39 | 120 | 1,849.38 | 717.46 | 197.65 | 934.27 | | | | | |
| 717.61 | 197.08 | 934.19 | 121 | 1,847.85 | 716.79 | 197.46 | 933.60 | | | | | |
| 717.70 | 197.36 | 935.58 | 122 | 1,846.46 | 717.52 | 197.04 | 931.91 | | | | | |
| 717.96 | 196.86 | 932.01 | 123 | 1,848.32 | 716.90 | 197.52 | 933.90 | | | | | |
| 717.06 | 197.02 | 932.49 | 124 | 1,848.28 | 716.63 | 197.38 | 934.26 | | | | | |
| 717.45 | 197.46 | 932.55 | 125 | 1,848.38 | 717.79 | 197.31 | 933.28 | | | | | |

## Sustainability – Data Rate Distribution Graph

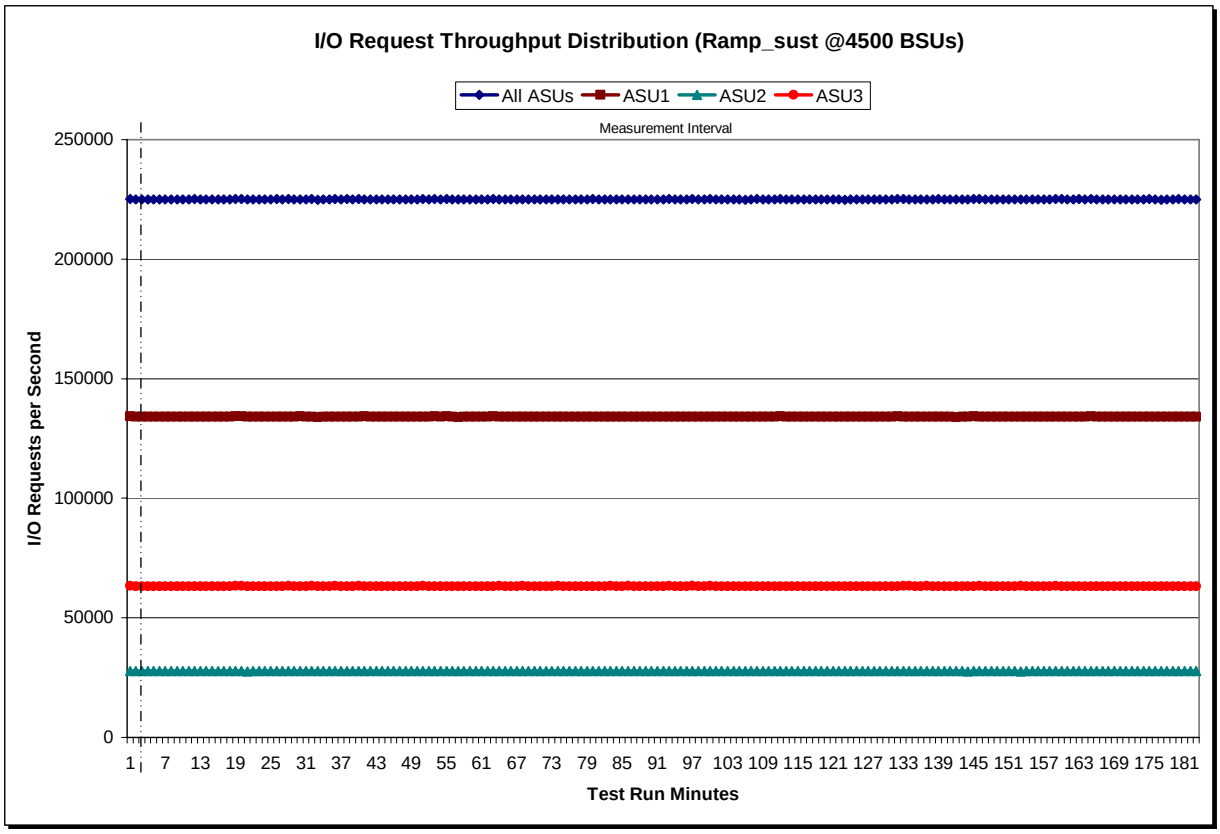


## Sustainability – I/O Request Throughput Distribution Data

| Start | Stop | Interval | Duration |
|---|---|---|---|
| 16:29:06 | 16:32:06 | 0-2 | 0:03:00 |
| 16:32:06 | 19:32:07 | 3-182 | 3:00:01 |

| ASU1 | ASU2 | ASU3 | Interval | All ASUs | ASU1 | ASU2 | ASU3 | Interval | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 134,212.60 | 27,706.35 | 63,287.50 | 63 | 225,028.43 | 134,068.42 | 27,674.57 | 63,285.45 | 126 | 225,008.13 | 134,133.88 | 27,671.17 | 63,203.08 |
| 134,163.78 | 27,695.75 | 63,166.33 | 64 | 224,960.33 | 134,073.03 | 27,681.60 | 63,205.70 | 127 | 224,967.00 | 134,068.78 | 27,672.28 | 63,225.93 |
| 134,017.75 | 27,666.73 | 63,259.43 | 65 | 225,019.97 | 134,092.78 | 27,676.45 | 63,250.73 | 128 | 224,968.33 | 134,078.90 | 27,680.18 | 63,209.25 |
| 134,107.42 | 27,684.75 | 63,219.08 | 66 | 225,006.10 | 134,112.18 | 27,665.37 | 63,228.55 | 129 | 224,985.87 | 134,101.55 | 27,650.85 | 63,233.47 |
| 134,078.87 | 27,673.20 | 63,220.12 | 67 | 225,069.98 | 134,137.55 | 27,661.70 | 63,270.73 | 130 | 225,025.97 | 134,135.72 | 27,691.57 | 63,198.68 |
| 134,131.70 | 27,667.52 | 63,196.22 | 68 | 224,927.17 | 134,048.25 | 27,667.83 | 63,211.08 | 131 | 225,207.12 | 134,254.63 | 27,687.75 | 63,264.73 |
| 134,070.37 | 27,685.40 | 63,189.30 | 69 | 225,069.07 | 134,125.38 | 27,698.52 | 63,245.17 | 132 | 225,111.40 | 134,143.32 | 27,691.88 | 63,276.20 |
| 134,108.32 | 27,679.12 | 63,220.02 | 70 | 224,956.67 | 134,008.25 | 27,693.68 | 63,254.73 | 133 | 225,002.60 | 134,073.70 | 27,648.08 | 63,280.82 |
| 134,100.98 | 27,688.57 | 63,254.03 | 71 | 224,984.12 | 134,082.82 | 27,677.40 | 63,223.90 | 134 | 224,970.68 | 134,046.75 | 27,711.78 | 63,212.15 |
| 134,084.67 | 27,671.47 | 63,204.05 | 72 | 225,052.15 | 134,126.70 | 27,690.57 | 63,234.88 | 135 | 224,961.27 | 134,076.10 | 27,675.25 | 63,209.92 |
| 134,070.58 | 27,669.43 | 63,203.73 | 73 | 225,032.60 | 134,112.27 | 27,648.27 | 63,272.07 | 136 | 225,052.25 | 134,073.30 | 27,675.05 | 63,303.90 |
| 134,170.17 | 27,649.70 | 63,257.82 | 74 | 225,039.85 | 134,074.52 | 27,725.92 | 63,239.42 | 137 | 224,931.28 | 134,054.78 | 27,669.37 | 63,207.13 |
| 134,038.67 | 27,713.50 | 63,261.38 | 75 | 224,992.78 | 134,068.68 | 27,670.70 | 63,253.40 | 138 | 225,075.12 | 134,147.95 | 27,730.47 | 63,196.70 |
| 134,037.10 | 27,715.23 | 63,218.37 | 76 | 225,045.47 | 134,114.10 | 27,682.78 | 63,248.58 | 139 | 225,004.98 | 134,145.87 | 27,694.83 | 63,164.28 |
| 134,075.05 | 27,675.33 | 63,187.52 | 77 | 224,938.72 | 134,080.37 | 27,639.63 | 63,218.72 | 140 | 224,960.13 | 134,059.92 | 27,667.02 | 63,233.20 |
| 134,054.35 | 27,638.18 | 63,212.70 | 78 | 224,962.32 | 134,070.60 | 27,636.85 | 63,254.87 | 141 | 224,902.30 | 133,986.92 | 27,698.27 | 63,217.12 |
| 134,013.90 | 27,685.38 | 63,213.33 | 79 | 225,074.60 | 134,166.68 | 27,697.58 | 63,210.33 | 142 | 225,027.97 | 134,096.05 | 27,680.55 | 63,251.37 |
| 134,063.28 | 27,709.00 | 63,216.65 | 80 | 224,955.88 | 134,105.32 | 27,673.68 | 63,176.88 | 143 | 224,968.65 | 134,125.62 | 27,614.05 | 63,228.98 |
| 134,195.37 | 27,678.80 | 63,266.58 | 81 | 225,038.95 | 134,102.75 | 27,686.52 | 63,249.68 | 144 | 225,096.70 | 134,188.45 | 27,671.40 | 63,236.85 |
| 134,208.33 | 27,682.98 | 63,277.48 | 82 | 225,008.70 | 134,076.23 | 27,665.05 | 63,267.42 | 145 | 225,095.23 | 134,125.05 | 27,702.93 | 63,267.25 |
| 134,112.75 | 27,619.55 | 63,192.52 | 83 | 224,953.45 | 134,101.60 | 27,661.48 | 63,190.37 | 146 | 225,020.72 | 134,145.72 | 27,667.42 | 63,207.58 |
| 134,016.50 | 27,682.47 | 63,262.03 | 84 | 225,009.70 | 134,118.02 | 27,673.45 | 63,218.23 | 147 | 224,960.73 | 134,049.47 | 27,689.20 | 63,222.07 |
| 134,105.70 | 27,711.77 | 63,253.60 | 85 | 224,999.18 | 134,044.00 | 27,666.42 | 63,288.77 | 148 | 225,067.22 | 134,149.78 | 27,669.08 | 63,248.35 |
| 134,033.28 | 27,713.25 | 63,238.47 | 86 | 225,051.65 | 134,167.65 | 27,670.68 | 63,213.32 | 149 | 225,022.38 | 134,049.70 | 27,710.93 | 63,261.75 |
| 134,084.47 | 27,647.80 | 63,214.67 | 87 | 225,029.70 | 134,138.50 | 27,664.12 | 63,227.08 | 150 | 224,950.57 | 134,104.42 | 27,675.37 | 63,170.78 |
| 134,162.58 | 27,665.28 | 63,251.03 | 88 | 224,982.68 | 134,096.70 | 27,641.75 | 63,244.23 | 151 | 225,001.98 | 134,090.27 | 27,679.53 | 63,232.18 |
| 134,159.25 | 27,690.68 | 63,221.12 | 89 | 224,964.87 | 134,110.77 | 27,656.35 | 63,197.75 | 152 | 225,041.97 | 134,142.93 | 27,624.13 | 63,274.90 |
| 134,076.12 | 27,690.05 | 63,309.27 | 90 | 224,901.47 | 134,048.92 | 27,641.13 | 63,211.42 | 153 | 224,938.40 | 134,032.10 | 27,676.87 | 63,229.43 |
| 134,144.93 | 27,696.72 | 63,201.45 | 91 | 224,931.45 | 134,026.80 | 27,666.03 | 63,238.62 | 154 | 225,071.88 | 134,154.32 | 27,673.87 | 63,243.70 |
| 134,185.73 | 27,670.07 | 63,209.67 | 92 | 225,100.93 | 134,168.20 | 27,659.38 | 63,273.35 | 155 | 225,009.90 | 134,119.90 | 27,663.70 | 63,226.30 |
| 134,093.55 | 27,694.65 | 63,250.88 | 93 | 225,017.25 | 134,100.60 | 27,697.55 | 63,219.10 | 156 | 224,940.58 | 134,110.35 | 27,678.95 | 63,151.28 |
| 134,162.18 | 27,649.15 | 63,268.50 | 94 | 225,029.28 | 134,126.30 | 27,702.40 | 63,200.58 | 157 | 225,049.22 | 134,150.93 | 27,648.00 | 63,250.28 |
| 133,979.50 | 27,676.23 | 63,208.90 | 95 | 224,982.93 | 134,131.37 | 27,635.98 | 63,215.58 | 158 | 225,105.65 | 134,135.83 | 27,679.63 | 63,290.18 |
| 134,069.93 | 27,673.55 | 63,208.27 | 96 | 225,092.70 | 134,127.80 | 27,673.73 | 63,291.17 | 159 | 225,130.90 | 134,170.68 | 27,711.42 | 63,248.80 |
| 134,077.90 | 27,645.73 | 63,197.95 | 97 | 225,004.85 | 134,122.00 | 27,644.75 | 63,238.10 | 160 | 224,952.50 | 134,053.57 | 27,668.00 | 63,230.93 |
| 134,138.82 | 27,664.22 | 63,269.28 | 98 | 225,043.48 | 134,140.62 | 27,685.67 | 63,217.20 | 161 | 225,025.10 | 134,107.73 | 27,687.55 | 63,229.82 |
| 134,124.17 | 27,696.17 | 63,221.78 | 99 | 225,087.02 | 134,112.62 | 27,690.85 | 63,283.55 | 162 | 225,086.88 | 134,170.32 | 27,664.85 | 63,251.72 |
| 134,175.80 | 27,721.32 | 63,196.92 | 100 | 224,958.20 | 134,123.57 | 27,637.52 | 63,197.12 | 163 | 224,964.37 | 134,068.83 | 27,657.50 | 63,238.03 |
| 134,056.42 | 27,708.62 | 63,231.05 | 101 | 224,991.23 | 134,092.32 | 27,667.73 | 63,231.18 | 164 | 225,084.17 | 134,183.53 | 27,680.33 | 63,220.30 |
| 134,118.82 | 27,669.28 | 63,286.63 | 102 | 225,024.15 | 134,065.30 | 27,729.77 | 63,229.08 | 165 | 225,022.60 | 134,092.02 | 27,684.48 | 63,246.10 |
| 134,184.93 | 27,648.95 | 63,235.80 | 103 | 225,003.37 | 134,083.33 | 27,682.80 | 63,237.23 | 166 | 224,985.10 | 134,123.13 | 27,641.98 | 63,219.98 |
| 134,099.03 | 27,685.85 | 63,161.78 | 104 | 225,070.05 | 134,158.55 | 27,675.65 | 63,235.85 | 167 | 224,997.97 | 134,056.72 | 27,685.65 | 63,255.60 |
| 134,060.48 | 27,670.47 | 63,260.25 | 105 | 224,873.65 | 134,012.57 | 27,638.32 | 63,222.77 | 168 | 225,011.95 | 134,135.15 | 27,683.80 | 63,193.00 |
| 134,074.37 | 27,672.80 | 63,192.47 | 106 | 225,010.67 | 134,127.88 | 27,641.62 | 63,241.17 | 169 | 224,944.02 | 134,095.75 | 27,640.88 | 63,207.38 |
| 134,147.68 | 27,694.98 | 63,197.95 | 107 | 225,112.55 | 134,170.00 | 27,691.63 | 63,250.92 | 170 | 225,007.53 | 134,090.02 | 27,679.58 | 63,237.93 |
| 134,104.87 | 27,707.57 | 63,161.90 | 108 | 224,950.47 | 134,114.48 | 27,662.10 | 63,173.88 | 171 | 224,916.45 | 134,060.82 | 27,672.97 | 63,182.67 |
| 134,088.67 | 27,654.65 | 63,258.42 | 109 | 224,983.47 | 134,081.93 | 27,703.12 | 63,198.42 | 172 | 224,960.60 | 134,025.87 | 27,694.28 | 63,240.45 |
| 134,108.60 | 27,659.78 | 63,216.60 | 110 | 224,947.05 | 134,104.83 | 27,635.15 | 63,207.07 | 173 | 224,957.87 | 134,065.23 | 27,671.12 | 63,221.52 |
| 134,100.23 | 27,674.80 | 63,259.25 | 111 | 225,117.08 | 134,183.07 | 27,698.53 | 63,235.48 | 174 | 225,082.37 | 134,173.08 | 27,694.88 | 63,214.40 |
| 134,090.30 | 27,692.17 | 63,226.72 | 112 | 224,994.57 | 134,076.53 | 27,671.32 | 63,246.72 | 175 | 224,997.27 | 134,080.50 | 27,671.15 | 63,245.62 |
| 134,115.88 | 27,697.97 | 63,266.70 | 113 | 225,038.03 | 134,100.98 | 27,703.80 | 63,233.25 | 176 | 224,865.03 | 134,017.13 | 27,659.82 | 63,188.08 |
| 134,045.18 | 27,682.70 | 63,182.50 | 114 | 224,907.30 | 134,055.73 | 27,658.23 | 63,193.33 | 177 | 225,062.77 | 134,177.32 | 27,702.93 | 63,182.52 |
| 134,192.53 | 27,668.08 | 63,242.47 | 115 | 225,007.03 | 134,070.85 | 27,690.30 | 63,245.88 | 178 | 224,976.05 | 134,082.60 | 27,665.05 | 63,228.40 |
| 134,173.32 | 27,630.57 | 63,220.92 | 116 | 224,995.15 | 134,083.08 | 27,674.17 | 63,237.90 | 179 | 225,077.87 | 134,165.88 | 27,676.20 | 63,235.78 |
| 134,231.22 | 27,675.30 | 63,250.37 | 117 | 225,011.28 | 134,103.83 | 27,662.05 | 63,245.40 | 180 | 225,016.87 | 134,134.72 | 27,682.32 | 63,199.83 |
| 134,130.05 | 27,670.55 | 63,232.90 | 118 | 224,966.00 | 134,055.12 | 27,665.50 | 63,245.38 | 181 | 224,930.63 | 134,014.77 | 27,688.22 | 63,227.65 |
| 133,988.33 | 27,684.57 | 63,223.38 | 119 | 224,998.80 | 134,139.33 | 27,660.95 | 63,198.52 | 182 | 225,024.15 | 134,137.83 | 27,664.90 | 63,221.42 |
| 134,078.45 | 27,669.55 | 63,204.10 | 120 | 225,054.40 | 134,099.90 | 27,696.13 | 63,258.37 | Average | 225,006.67 | 134,102.92 | 27,674.87 | 63,228.88 |
| 134,134.47 | 27,668.58 | 63,212.92 | 121 | 224,937.53 | 134,041.17 | 27,678.63 | 63,217.73 | | | | | |
| 134,081.10 | 27,673.98 | 63,233.43 | 122 | 224,891.50 | 134,063.95 | 27,641.22 | 63,186.33 | | | | | |
| 134,172.07 | 27,663.75 | 63,196.82 | 123 | 224,910.42 | 134,060.35 | 27,649.15 | 63,200.92 | | | | | |
| 134,091.78 | 27,648.47 | 63,233.78 | 124 | 224,947.78 | 134,075.62 | 27,654.17 | 63,218.00 | | | | | |
| 134,187.02 | 27,685.87 | 63,217.83 | 125 | 224,961.70 | 134,047.92 | 27,672.55 | 63,241.23 | | | | | |

## Sustainability – I/O Request Throughput Distribution Graph

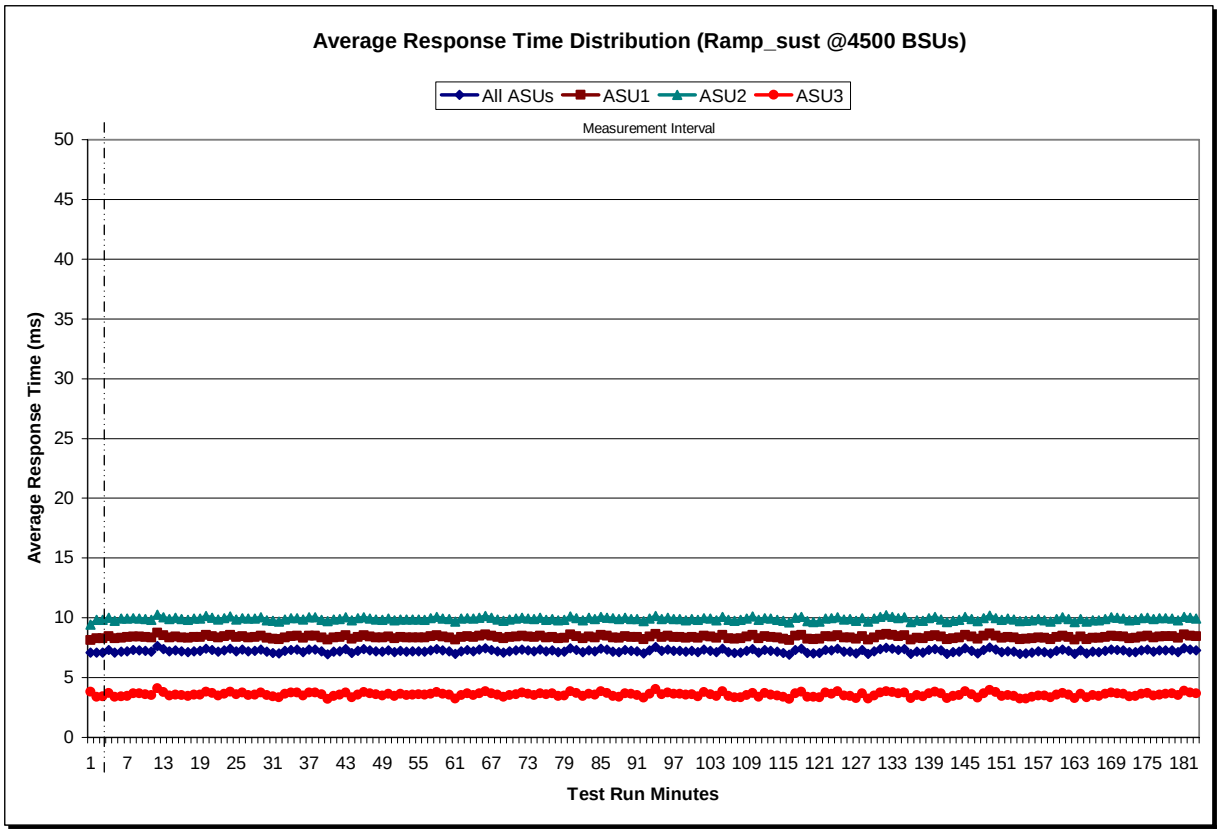


## Sustainability – Average Response Time (ms) Distribution Data

| Start | Stop | Interval | Duration |
|---|---|---|---|
| 16:29:06 | 16:32:06 | 0-2 | 0:03:00 |
| 16:32:06 | 19:32:07 | 3-182 | 3:00:01 |

| ASU1 | ASU2 | ASU3 | Interval | All ASUs | ASU1 | ASU2 | ASU3 | Interval | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.12 | 9.44 | 3.83 | 63 | 7.21 | 8.39 | 9.93 | 3.53 | 126 | 7.04 | 8.25 | 9.76 | 3.26 |
| 8.29 | 9.83 | 3.38 | 64 | 7.33 | 8.49 | 10.02 | 3.67 | 127 | 7.31 | 8.47 | 9.98 | 3.69 |
| 8.29 | 9.82 | 3.40 | 65 | 7.45 | 8.60 | 10.15 | 3.84 | 128 | 6.98 | 8.19 | 9.68 | 3.23 |
| 8.47 | 10.00 | 3.71 | 66 | 7.32 | 8.48 | 10.01 | 3.66 | 129 | 7.19 | 8.36 | 9.93 | 3.50 |
| 8.27 | 9.77 | 3.38 | 67 | 7.20 | 8.37 | 9.88 | 3.55 | 130 | 7.39 | 8.56 | 10.10 | 3.73 |
| 8.33 | 9.92 | 3.42 | 68 | 7.10 | 8.29 | 9.77 | 3.40 | 131 | 7.48 | 8.62 | 10.21 | 3.86 |
| 8.39 | 9.95 | 3.46 | 69 | 7.19 | 8.37 | 9.88 | 3.52 | 132 | 7.40 | 8.56 | 10.08 | 3.77 |
| 8.44 | 9.98 | 3.69 | 70 | 7.26 | 8.43 | 9.94 | 3.61 | 133 | 7.30 | 8.47 | 9.98 | 3.66 |
| 8.43 | 9.92 | 3.66 | 71 | 7.34 | 8.49 | 10.00 | 3.74 | 134 | 7.38 | 8.54 | 10.06 | 3.76 |
| 8.40 | 9.90 | 3.60 | 72 | 7.27 | 8.43 | 9.93 | 3.63 | 135 | 6.98 | 8.18 | 9.65 | 3.27 |
| 8.34 | 9.84 | 3.54 | 73 | 7.20 | 8.38 | 9.90 | 3.54 | 136 | 7.15 | 8.33 | 9.78 | 3.51 |
| 8.74 | 10.27 | 4.09 | 74 | 7.33 | 8.49 | 10.00 | 3.69 | 137 | 7.09 | 8.27 | 9.77 | 3.41 |
| 8.53 | 10.05 | 3.76 | 75 | 7.20 | 8.36 | 9.84 | 3.61 | 138 | 7.29 | 8.45 | 9.98 | 3.67 |
| 8.37 | 9.89 | 3.50 | 76 | 7.26 | 8.40 | 9.89 | 3.68 | 139 | 7.39 | 8.52 | 10.08 | 3.80 |
| 8.44 | 10.01 | 3.57 | 77 | 7.12 | 8.29 | 9.80 | 3.47 | 140 | 7.27 | 8.42 | 9.87 | 3.68 |
| 8.37 | 9.90 | 3.54 | 78 | 7.15 | 8.33 | 9.84 | 3.47 | 141 | 7.00 | 8.20 | 9.64 | 3.29 |
| 8.31 | 9.82 | 3.46 | 79 | 7.45 | 8.60 | 10.10 | 3.85 | 142 | 7.11 | 8.29 | 9.76 | 3.47 |
| 8.37 | 9.93 | 3.58 | 80 | 7.31 | 8.45 | 9.96 | 3.71 | 143 | 7.17 | 8.34 | 9.84 | 3.53 |
| 8.40 | 9.95 | 3.55 | 81 | 7.12 | 8.30 | 9.80 | 3.46 | 144 | 7.43 | 8.57 | 10.08 | 3.86 |
| 8.58 | 10.15 | 3.80 | 82 | 7.27 | 8.43 | 10.00 | 3.62 | 145 | 7.25 | 8.42 | 9.91 | 3.61 |
| 8.47 | 10.00 | 3.69 | 83 | 7.20 | 8.37 | 9.89 | 3.55 | 146 | 7.03 | 8.24 | 9.73 | 3.30 |
| 8.34 | 9.87 | 3.49 | 84 | 7.42 | 8.56 | 10.08 | 3.83 | 147 | 7.32 | 8.48 | 9.99 | 3.69 |
| 8.44 | 9.95 | 3.63 | 85 | 7.33 | 8.48 | 10.01 | 3.72 | 148 | 7.54 | 8.67 | 10.19 | 3.97 |
| 8.56 | 10.12 | 3.83 | 86 | 7.17 | 8.36 | 9.96 | 3.44 | 149 | 7.35 | 8.50 | 9.97 | 3.77 |
| 8.37 | 9.87 | 3.60 | 87 | 7.13 | 8.33 | 9.89 | 3.39 | 150 | 7.14 | 8.32 | 9.84 | 3.44 |
| 8.47 | 9.98 | 3.74 | 88 | 7.30 | 8.46 | 9.99 | 3.67 | 151 | 7.21 | 8.38 | 9.92 | 3.53 |
| 8.36 | 9.92 | 3.53 | 89 | 7.24 | 8.39 | 9.89 | 3.64 | 152 | 7.15 | 8.34 | 9.87 | 3.45 |
| 8.39 | 9.94 | 3.57 | 90 | 7.20 | 8.38 | 9.91 | 3.52 | 153 | 6.99 | 8.20 | 9.72 | 3.23 |
| 8.50 | 10.04 | 3.76 | 91 | 7.01 | 8.21 | 9.71 | 3.31 | 154 | 7.03 | 8.25 | 9.77 | 3.25 |
| 8.30 | 9.81 | 3.53 | 92 | 7.26 | 8.41 | 9.94 | 3.63 | 155 | 7.10 | 8.28 | 9.80 | 3.40 |
| 8.25 | 9.74 | 3.41 | 93 | 7.54 | 8.66 | 10.17 | 4.03 | 156 | 7.18 | 8.36 | 9.89 | 3.50 |
| 8.19 | 9.70 | 3.35 | 94 | 7.22 | 8.39 | 9.89 | 3.58 | 157 | 7.13 | 8.31 | 9.78 | 3.48 |
| 8.37 | 9.85 | 3.64 | 95 | 7.34 | 8.48 | 10.02 | 3.74 | 158 | 7.03 | 8.22 | 9.69 | 3.34 |
| 8.46 | 9.97 | 3.75 | 96 | 7.22 | 8.37 | 9.89 | 3.62 | 159 | 7.22 | 8.39 | 9.90 | 3.57 |
| 8.50 | 9.98 | 3.75 | 97 | 7.25 | 8.40 | 9.89 | 3.65 | 160 | 7.34 | 8.50 | 10.03 | 3.71 |
| 8.31 | 9.85 | 3.48 | 98 | 7.18 | 8.33 | 9.80 | 3.58 | 161 | 7.23 | 8.40 | 9.91 | 3.58 |
| 8.51 | 10.04 | 3.74 | 99 | 7.23 | 8.39 | 9.91 | 3.61 | 162 | 6.98 | 8.17 | 9.64 | 3.28 |
| 8.50 | 10.04 | 3.74 | 100 | 7.12 | 8.30 | 9.83 | 3.44 | 163 | 7.27 | 8.43 | 9.90 | 3.65 |
| 8.37 | 9.84 | 3.61 | 101 | 7.34 | 8.48 | 9.97 | 3.76 | 164 | 7.04 | 8.23 | 9.69 | 3.35 |
| 8.17 | 9.71 | 3.21 | 102 | 7.25 | 8.41 | 9.93 | 3.61 | 165 | 7.15 | 8.31 | 9.80 | 3.53 |
| 8.34 | 9.86 | 3.44 | 103 | 7.13 | 8.30 | 9.80 | 3.46 | 166 | 7.13 | 8.30 | 9.80 | 3.47 |
| 8.38 | 9.90 | 3.57 | 104 | 7.43 | 8.57 | 10.09 | 3.85 | 167 | 7.24 | 8.40 | 9.91 | 3.62 |
| 8.52 | 10.06 | 3.74 | 105 | 7.12 | 8.30 | 9.83 | 3.45 | 168 | 7.35 | 8.50 | 10.03 | 3.73 |
| 8.25 | 9.80 | 3.34 | 106 | 7.05 | 8.24 | 9.74 | 3.35 | 169 | 7.31 | 8.47 | 10.00 | 3.68 |
| 8.39 | 9.97 | 3.55 | 107 | 7.07 | 8.26 | 9.82 | 3.35 | 170 | 7.26 | 8.41 | 9.93 | 3.64 |
| 8.52 | 10.03 | 3.79 | 108 | 7.23 | 8.41 | 9.93 | 3.54 | 171 | 7.12 | 8.30 | 9.80 | 3.43 |
| 8.44 | 9.94 | 3.67 | 109 | 7.39 | 8.55 | 10.10 | 3.72 | 172 | 7.13 | 8.31 | 9.83 | 3.44 |
| 8.36 | 9.87 | 3.59 | 110 | 7.10 | 8.29 | 9.82 | 3.38 | 173 | 7.28 | 8.43 | 9.98 | 3.64 |
| 8.34 | 9.84 | 3.48 | 111 | 7.32 | 8.47 | 9.98 | 3.71 | 174 | 7.35 | 8.51 | 10.00 | 3.72 |
| 8.42 | 9.94 | 3.62 | 112 | 7.23 | 8.40 | 9.94 | 3.58 | 175 | 7.18 | 8.36 | 9.90 | 3.48 |
| 8.29 | 9.81 | 3.46 | 113 | 7.17 | 8.35 | 9.84 | 3.50 | 176 | 7.26 | 8.43 | 9.99 | 3.58 |
| 8.39 | 9.87 | 3.64 | 114 | 7.07 | 8.26 | 9.74 | 3.38 | 177 | 7.28 | 8.44 | 9.99 | 3.63 |
| 8.34 | 9.85 | 3.53 | 115 | 6.93 | 8.12 | 9.62 | 3.22 | 178 | 7.29 | 8.44 | 9.94 | 3.67 |
| 8.35 | 9.88 | 3.55 | 116 | 7.32 | 8.48 | 10.01 | 3.68 | 179 | 7.14 | 8.30 | 9.80 | 3.52 |
| 8.36 | 9.87 | 3.60 | 117 | 7.42 | 8.56 | 10.08 | 3.82 | 180 | 7.45 | 8.59 | 10.08 | 3.89 |
| 8.34 | 9.84 | 3.55 | 118 | 7.05 | 8.23 | 9.71 | 3.37 | 181 | 7.34 | 8.48 | 10.00 | 3.75 |
| 8.44 | 9.98 | 3.65 | 119 | 7.03 | 8.20 | 9.66 | 3.38 | 182 | 7.29 | 8.44 | 9.95 | 3.67 |
| 8.52 | 10.07 | 3.79 | 120 | 7.04 | 8.23 | 9.69 | 3.34 | Average | 7.23 | 8.39 | 9.91 | 3.58 |
| 8.43 | 9.95 | 3.64 | 121 | 7.31 | 8.46 | 9.93 | 3.73 | | | | | |
| 8.36 | 9.89 | 3.57 | 122 | 7.28 | 8.43 | 9.98 | 3.65 | | | | | |
| 8.16 | 9.67 | 3.25 | 123 | 7.41 | 8.55 | 10.05 | 3.84 | | | | | |
| 8.39 | 9.94 | 3.54 | 124 | 7.16 | 8.33 | 9.85 | 3.49 | | | | | |
| 8.45 | 9.96 | 3.66 | 125 | 7.16 | 8.35 | 9.89 | 3.46 | | | | | |

## Sustainability – Average Response Time (ms) Distribution Graph



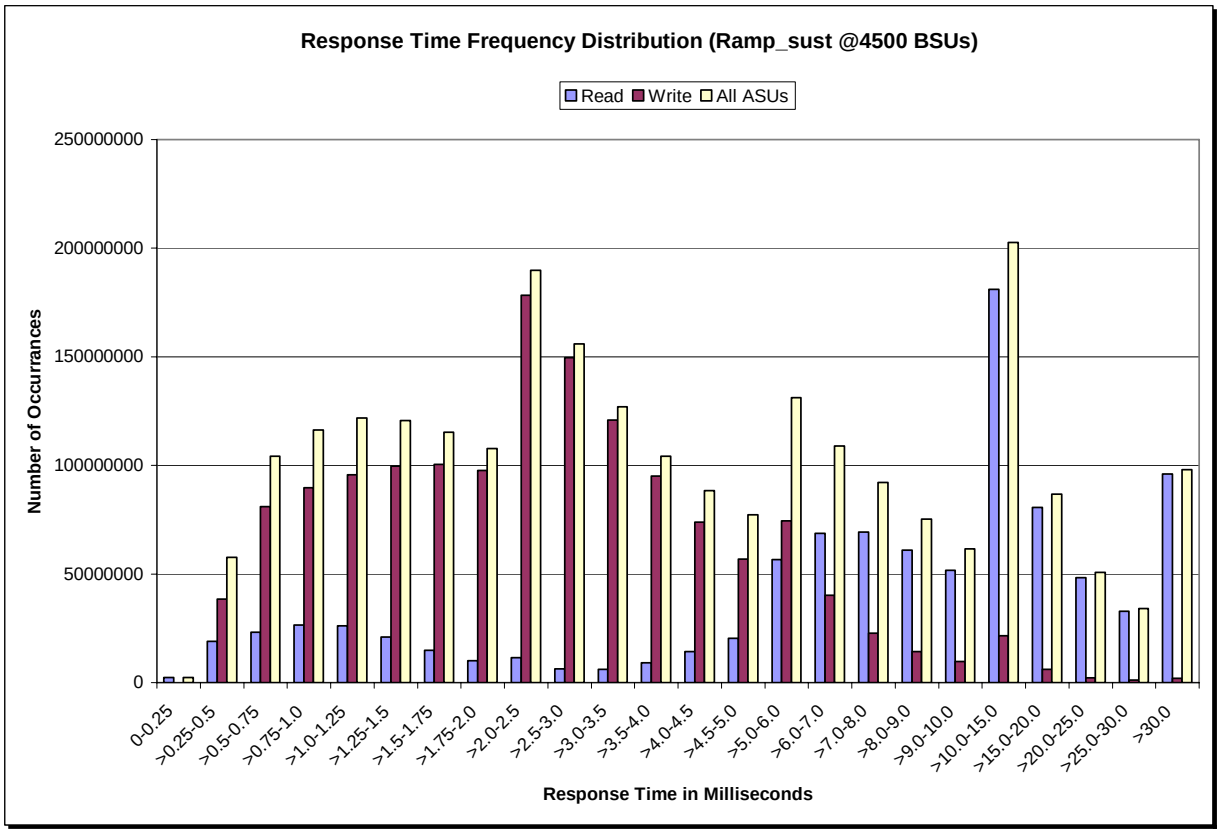
## Sustainability – Response Time Frequency Distribution Data

| Response Time (ms) | 0-0.25 | >0.25-0.5 | >0.5-0.75 | >0.75-1.0 | >1.0-1.25 | >1.25-1.5 | >1.5-1.75 | >1.75-2.0 |
|---|---|---|---|---|---|---|---|---|
| Read | 2,426,572 | 19,115,672 | 23,250,386 | 26,455,974 | 26,184,660 | 21,022,833 | 14,860,975 | 10,066,995 |
| Write | 899 | 38,481,644 | 81,000,281 | 89,772,081 | 95,712,438 | 99,647,514 | 100,389,326 | 97,731,354 |
| All ASUs | 2,427,471 | 57,597,316 | 104,250,667 | 116,228,055 | 121,897,098 | 120,670,347 | 115,250,301 | 107,798,349 |
| ASU1 | 1,877,122 | 37,762,419 | 60,116,063 | 65,982,217 | 69,055,227 | 67,364,115 | 62,808,640 | 57,015,483 |
| ASU2 | 550,243 | 10,029,446 | 15,514,050 | 17,089,026 | 17,829,184 | 17,138,497 | 15,692,591 | 14,021,549 |
| ASU3 | 106 | 9,805,451 | 28,620,554 | 33,156,812 | 35,012,687 | 36,167,735 | 36,749,070 | 36,761,317 |

| 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 | 11,510,236 | 6,369,499 | 6,109,644 | 9,055,704 | 14,287,438 | 20,485,081 | 56,614,350 | 68,756,420 |
| Write | 178,331,194 | 149,601,319 | 120,794,500 | 95,171,587 | 73,968,005 | 56,841,915 | 74,581,274 | 40,173,227 |
| All ASUs | 189,841,430 | 155,970,818 | 126,904,144 | 104,227,291 | 88,255,443 | 77,326,996 | 131,195,624 | 108,929,647 |
| ASU1 | 95,248,312 | 72,103,302 | 54,272,485 | 42,740,287 | 37,171,566 | 35,627,272 | 71,609,515 | 72,157,508 |
| ASU2 | 22,956,639 | 16,864,973 | 11,977,643 | 8,390,487 | 6,085,464 | 4,855,894 | 8,855,444 | 9,178,103 |
| ASU3 | 71,636,479 | 67,002,543 | 60,654,016 | 53,096,517 | 44,998,413 | 36,843,830 | 50,730,665 | 27,594,036 |

| 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 | 69,390,603 | 60,928,316 | 51,736,646 | 181,072,756 | 80,650,157 | 48,420,274 | 32,812,816 | 96,137,483 |
| Write | 22,815,520 | 14,348,227 | 9,775,332 | 21,672,535 | 6,103,262 | 2,247,408 | 1,171,568 | 2,016,220 |
| All ASUs | 92,206,123 | 75,276,543 | 61,511,978 | 202,745,291 | 86,753,419 | 50,667,682 | 33,984,384 | 98,153,703 |
| ASU1 | 67,576,998 | 56,915,806 | 47,173,333 | 160,026,475 | 70,668,419 | 41,914,334 | 28,052,894 | 73,070,425 |
| ASU2 | 9,243,951 | 8,782,263 | 7,800,073 | 27,858,792 | 11,888,736 | 7,257,805 | 5,167,752 | 23,859,632 |
| ASU3 | 15,385,174 | 9,578,474 | 6,538,572 | 14,860,024 | 4,196,264 | 1,495,543 | 763,738 | 1,223,646 |

## Sustainability – Response Time Frequency Distribution Graph



## Sustainability – Measured Intensity Multiplier and Coefficient of Variation

*Clause 3.4.3*

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

*Clauses 5.1.0 and 5.3.13.2*

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

*Clause 5.3.13.3*

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

| | 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 | 0.001 | 0.000 | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.000 |

## Primary Metrics Test – IOPS Test Phase

*Clause 5.4.2.2*

*The IOPS Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of ten (10) minutes. The IOPS Test Phase immediately follows the Sustainability Test Phase without any interruption or manual intervention.*

*The IOPS Test Run generates the SPC-1 IOPS™ primary metric, which is computed as the I/O Request Throughput for the Measurement Interval of the IOPS Test Run.*

*The Average Response Time is computed for the IOPS Test Run and cannot exceed 30 milliseconds. If the Average Response Time exceeds the 30 millisecond constraint, the measurement is invalid.*

*Clause 9.2.4.7.2*

*For the IOPS Test Phase the FDR shall contain:*

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

### SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 67.

### IOPS Test Results File

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

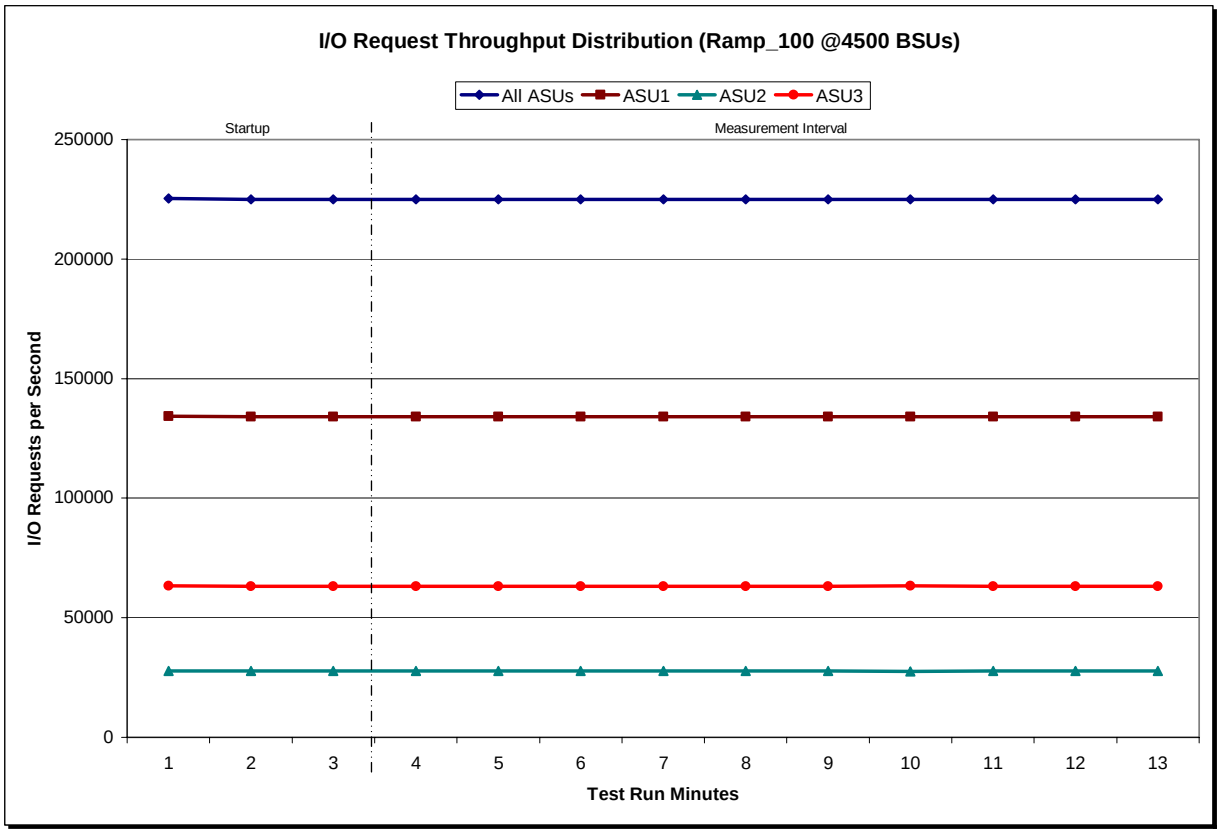
**IOPS Test Results File**

## IOPS Test Run – I/O Request Throughput Distribution Data

| 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 19:35:05 | 19:38:06 | 0-2 | 0:03:01 |
| *Measurement Interval* | 19:38:06 | 19:48:07 | 3-12 | 0:10:01 |

| 60 second intervals | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|
| 0 | 225,273.00 | 134,276.93 | 27,722.15 | 63,273.92 |
| 1 | 225,013.83 | 134,123.52 | 27,687.90 | 63,202.42 |
| 2 | 224,975.65 | 134,076.10 | 27,672.60 | 63,226.95 |
| 3 | 224,985.65 | 134,074.72 | 27,674.90 | 63,236.03 |
| 4 | 225,042.65 | 134,136.22 | 27,666.33 | 63,240.10 |
| 5 | 225,009.20 | 134,113.28 | 27,686.02 | 63,209.90 |
| 6 | 224,981.88 | 134,045.15 | 27,705.77 | 63,230.97 |
| 7 | 224,997.38 | 134,108.05 | 27,653.42 | 63,235.92 |
| 8 | 225,070.70 | 134,163.68 | 27,682.03 | 63,224.98 |
| 9 | 224,967.83 | 134,071.47 | 27,619.55 | 63,276.82 |
| 10 | 224,896.12 | 134,041.40 | 27,645.82 | 63,208.90 |
| 11 | 225,013.72 | 134,074.32 | 27,688.60 | 63,250.80 |
| 12 | 224,931.40 | 134,029.85 | 27,660.45 | 63,241.10 |
| Average | 224,989.65 | 134,085.81 | 27,668.29 | 63,235.55 |

## IOPS Test Run – I/O Request Throughput Distribution Graph

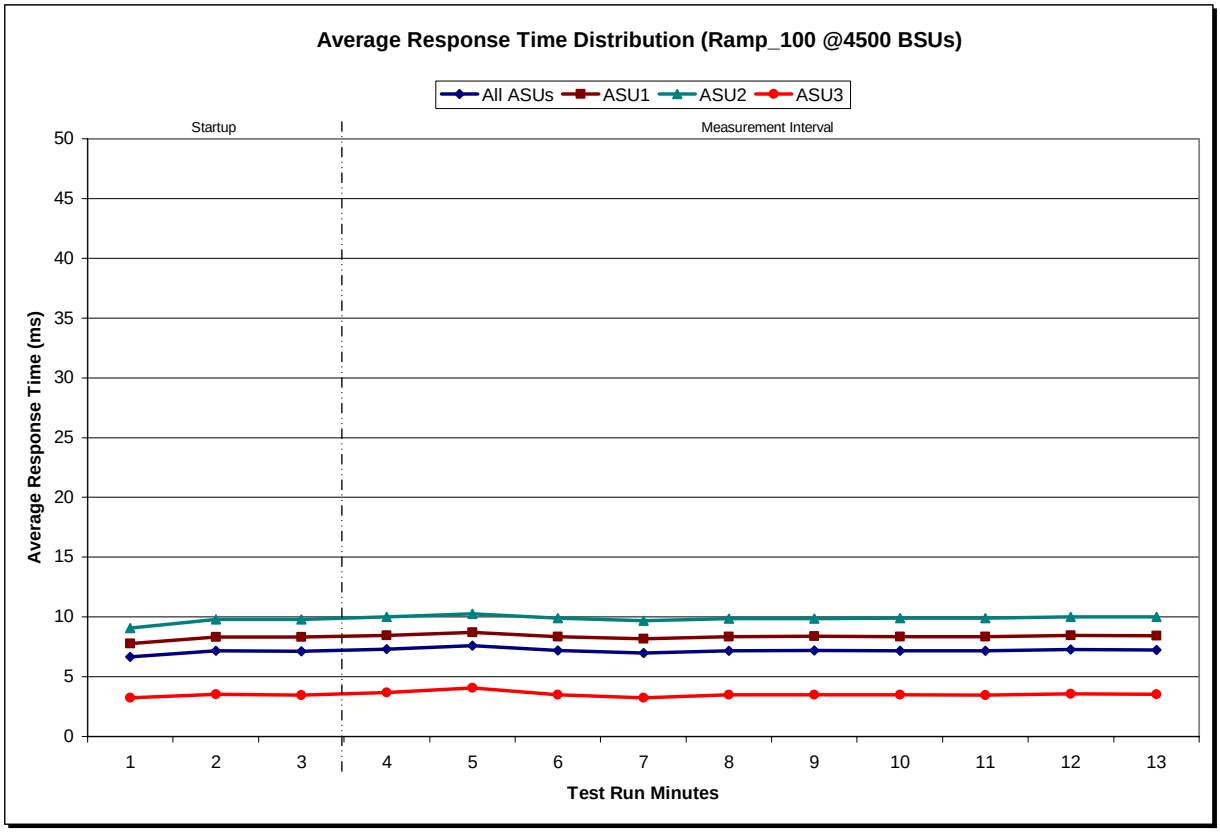


## IOPS Test Run – Average Response Time (ms) Distribution Data

| 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 19:35:05 | 19:38:06 | 0-2 | 0:03:01 |
| *Measurement Interval* | 19:38:06 | 19:48:07 | 3-12 | 0:10:01 |

| 60 second intervals | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|
| **0** | 6.66 | 7.77 | 9.07 | 3.24 |
| **1** | 7.15 | 8.31 | 9.78 | 3.54 |
| **2** | 7.13 | 8.31 | 9.78 | 3.46 |
| **3** | 7.31 | 8.46 | 10.02 | 3.68 |
| **4** | 7.59 | 8.71 | 10.25 | 4.05 |
| **5** | 7.19 | 8.36 | 9.91 | 3.50 |
| **6** | 6.97 | 8.17 | 9.68 | 3.23 |
| **7** | 7.16 | 8.34 | 9.86 | 3.47 |
| **8** | 7.19 | 8.37 | 9.86 | 3.49 |
| **9** | 7.17 | 8.35 | 9.89 | 3.49 |
| **10** | 7.16 | 8.34 | 9.90 | 3.44 |
| **11** | 7.27 | 8.46 | 10.02 | 3.56 |
| **12** | 7.23 | 8.41 | 9.99 | 3.51 |
| **Average** | 7.22 | 8.40 | 9.94 | 3.54 |

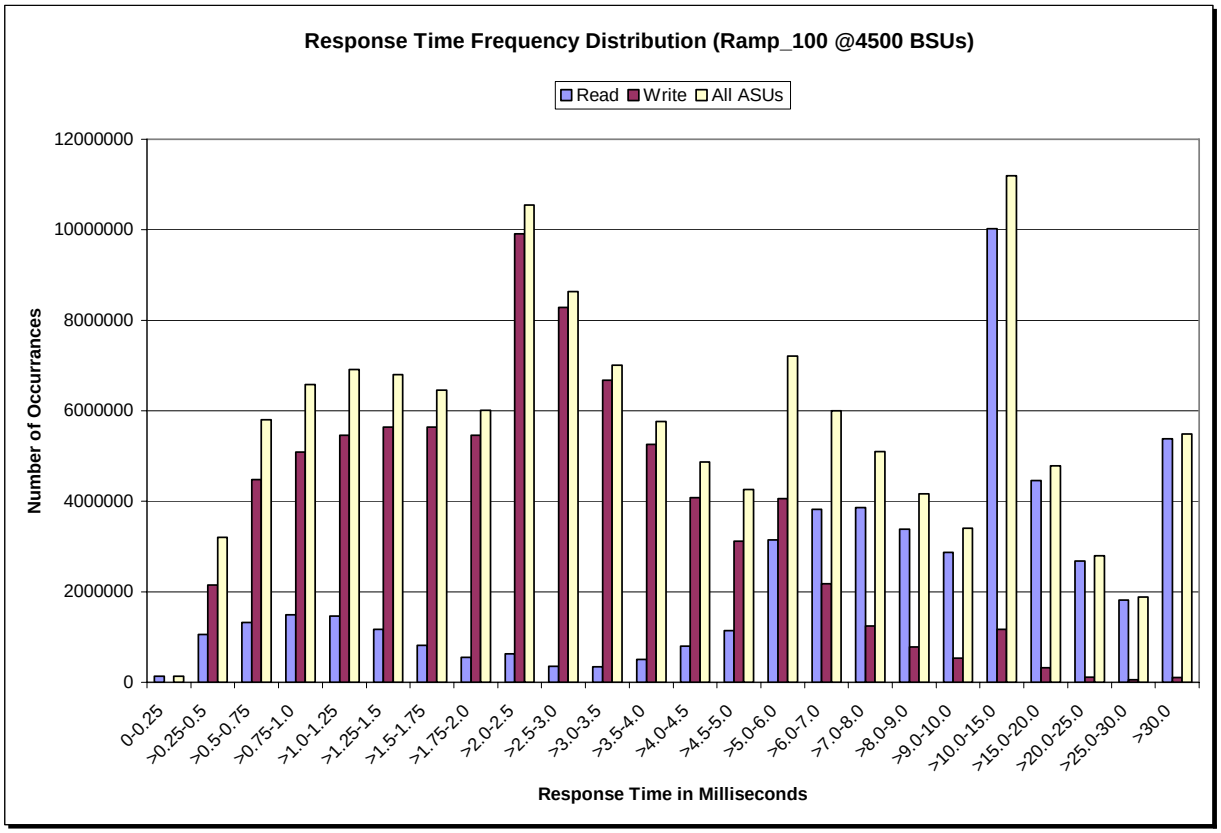
## IOPS Test Run – Average Response Time (ms) Distribution Graph



## IOPS Test Run – Response Time Frequency Distribution Data

| Response Time (ms) | 0-0.25 | >0.25-0.5 | >0.5-0.75 | >0.75-1.0 | >1.0-1.25 | >1.25-1.5 | >1.5-1.75 | >1.75-2.0 |
|---|---|---|---|---|---|---|---|---|
| Read | 137354 | 1,057,278 | 1,320,293 | 1,490,466 | 1,461,561 | 1,165,087 | 818,087 | 552,298 |
| Write | 51 | 2,146,321 | 4,481,565 | 5,090,982 | 5,454,648 | 5,638,329 | 5,640,279 | 5,455,044 |
| All ASUs | 137405 | 3,203,599 | 5,801,858 | 6,581,448 | 6,916,209 | 6,803,416 | 6,458,366 | 6,007,342 |
| ASU1 | 106383 | 2,096,311 | 3,355,733 | 3,751,793 | 3,918,887 | 3,790,514 | 3,505,955 | 3,164,117 |
| ASU2 | 31014 | 555,618 | 866,084 | 970,157 | 1,008,144 | 960,747 | 874,095 | 778,209 |
| ASU3 | 8 | 551,670 | 1,580,041 | 1,859,498 | 1,989,178 | 2,052,155 | 2,078,316 | 2,065,016 |
| **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 | 631,802 | 350,557 | 338,168 | 503,675 | 794,018 | 1,139,795 | 3,147,200 | 3,821,038 |
| Write | 9,909,047 | 8,282,794 | 6,674,093 | 5,259,205 | 4,075,776 | 3,122,418 | 4,060,757 | 2,175,365 |
| All ASUs | 10,540,849 | 8,633,351 | 7,012,261 | 5,762,880 | 4,869,794 | 4,262,213 | 7,207,957 | 5,996,403 |
| ASU1 | 5,271,630 | 3,976,600 | 2,985,924 | 2,352,088 | 2,044,572 | 1,964,422 | 3,953,871 | 3,991,918 |
| ASU2 | 1,269,441 | 929,181 | 658,018 | 460,024 | 333,468 | 266,542 | 485,825 | 506,267 |
| ASU3 | 3,999,778 | 3,727,570 | 3,368,319 | 2,950,768 | 2,491,754 | 2,031,249 | 2,768,261 | 1,498,218 |
| **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 | 3,857,441 | 3,381,643 | 2,870,013 | 10,018,461 | 4,455,425 | 2,679,461 | 1,819,548 | 5,377,723 |
| Write | 1,243,529 | 778,434 | 533,399 | 1,169,647 | 327,746 | 118,565 | 61,524 | 104,204 |
| All ASUs | 5,100,970 | 4,160,077 | 3,403,412 | 11,188,108 | 4,783,171 | 2,798,026 | 1,881,072 | 5,481,927 |
| ASU1 | 3,749,373 | 3,151,797 | 2,613,322 | 8,844,253 | 3,902,449 | 2,318,629 | 1,555,431 | 4,084,338 |
| ASU2 | 512,537 | 487,301 | 432,837 | 1,539,315 | 654,941 | 400,712 | 285,657 | 1,334,561 |
| ASU3 | 839,060 | 520,979 | 357,253 | 804,540 | 225,781 | 78,685 | 39,984 | 63,028 |

## IOPS Test Run –Response Time Frequency Distribution Graph



## IOPS Test Run – I/O Request Information

| I/O Requests Completed in the Measurement Interval | I/O Requests Completed with Response Time = or < 30 ms | I/O Requests Completed with Response Time > 30 ms |
|---|---|---|
| 134,992,114 | 129,510,187 | 5,481,927 |

## IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

*Clause 3.4.3*

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

*Clauses 5.1.0 and 5.3.13.2*

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

*Clause 5.3.13.3*

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

| | 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 | 0.2811 |
| COV | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |

## Primary Metrics Test – Response Time Ramp Test Phase

*Clause 5.4.2.3*

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

*The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 12.*

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

*Clause 9.2.4.7.3*

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

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

### SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 67.

### Response Time Ramp Test Results File

A link to each test result file generated from each Response Time Ramp Test Run list listed below.

**95% Load Level**

**90% Load Level**

**80% Load Level**

**50% Load Level**

**10% Load Level**

## Response Time Ramp Distribution (IOPS) Data

The five Test Runs that comprise the Response Time Ramp Phase are executed at 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit (BSU) load level used to produce the SPC-1 IOPS™ primary metric. The 100% BSU load level is included in the following Response Time Ramp data tables and graphs for completeness.

| 100% Load Level - 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| Start-Up/Ramp-Up | 19:35:05 | 19:38:06 | 0-2 | 0:03:01 |
| Measurement Interval | 19:38:06 | 19:48:07 | 3-12 | 0:10:01 |

| (60 second intervals) | All ASUs | ASU-1 | ASU-2 | ASU-3 |
|---|---|---|---|---|
| 0 | 225,273.00 | 134,276.93 | 27,722.15 | 63,273.92 |
| 1 | 225,013.83 | 134,123.52 | 27,687.90 | 63,202.42 |
| 2 | 224,975.65 | 134,076.10 | 27,672.60 | 63,226.95 |
| 3 | 224,985.65 | 134,074.72 | 27,674.90 | 63,236.03 |
| 4 | 225,042.65 | 134,136.22 | 27,666.33 | 63,240.10 |
| 5 | 225,009.20 | 134,113.28 | 27,686.02 | 63,209.90 |
| 6 | 224,981.88 | 134,045.15 | 27,705.77 | 63,230.97 |
| 7 | 224,997.38 | 134,108.05 | 27,653.42 | 63,235.92 |
| 8 | 225,070.70 | 134,163.68 | 27,682.03 | 63,224.98 |
| 9 | 224,967.83 | 134,071.47 | 27,619.55 | 63,276.82 |
| 10 | 224,896.12 | 134,041.40 | 27,645.82 | 63,208.90 |
| 11 | 225,013.72 | 134,074.32 | 27,688.60 | 63,250.80 |
| 12 | 224,931.40 | 134,029.85 | 27,660.45 | 63,241.10 |
| Average | 224,989.65 | 134,085.81 | 27,668.29 | 63,235.55 |

| 95% Load Level - 4275 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| Start-Up/Ramp-Up | 19:50:38 | 19:53:39 | 0-2 | 0:03:01 |
| Measurement Interval | 19:53:39 | 20:03:40 | 3-12 | 0:10:01 |

| (60 second intervals) | All ASUs | ASU-1 | ASU-2 | ASU-3 |
|---|---|---|---|---|
| 0 | 213,902.67 | 127,526.45 | 26,314.18 | 60,062.03 |
| 1 | 213,759.13 | 127,443.70 | 26,275.32 | 60,040.12 |
| 2 | 213,809.65 | 127,446.48 | 26,279.17 | 60,084.00 |
| 3 | 213,740.68 | 127,419.62 | 26,293.87 | 60,027.20 |
| 4 | 213,718.88 | 127,401.67 | 26,300.50 | 60,016.72 |
| 5 | 213,816.27 | 127,455.62 | 26,296.27 | 60,064.38 |
| 6 | 213,747.57 | 127,363.20 | 26,289.63 | 60,094.73 |
| 7 | 213,787.25 | 127,399.60 | 26,301.82 | 60,085.83 |
| 8 | 213,786.78 | 127,444.78 | 26,268.02 | 60,073.98 |
| 9 | 213,755.27 | 127,335.40 | 26,313.90 | 60,105.97 |
| 10 | 213,710.28 | 127,380.17 | 26,282.72 | 60,047.40 |
| 11 | 213,635.47 | 127,299.07 | 26,306.38 | 60,030.02 |
| 12 | 213,699.25 | 127,409.65 | 26,270.35 | 60,019.25 |
| Average | 213,739.77 | 127,390.88 | 26,292.35 | 60,056.55 |

| 90% Load Level - 4050 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| Start-Up/Ramp-Up | 20:06:01 | 20:09:02 | 0-2 | 0:03:01 |
| Measurement Interval | 20:09:02 | 20:19:03 | 3-12 | 0:10:01 |

| (60 second intervals) | All ASUs | ASU-1 | ASU-2 | ASU-3 |
|---|---|---|---|---|
| 0 | 202,538.08 | 120,681.17 | 24,914.22 | 56,942.70 |
| 1 | 202,585.72 | 120,736.30 | 24,923.45 | 56,925.97 |
| 2 | 202,457.67 | 120,640.25 | 24,929.30 | 56,888.12 |
| 3 | 202,497.20 | 120,649.45 | 24,909.22 | 56,938.53 |
| 4 | 202,477.35 | 120,667.63 | 24,921.37 | 56,888.35 |
| 5 | 202,534.43 | 120,709.02 | 24,944.63 | 56,880.78 |
| 6 | 202,533.53 | 120,713.63 | 24,901.98 | 56,917.92 |
| 7 | 202,488.07 | 120,739.32 | 24,920.87 | 56,827.88 |
| 8 | 202,555.35 | 120,735.48 | 24,901.15 | 56,918.72 |
| 9 | 202,425.65 | 120,647.38 | 24,887.95 | 56,890.32 |
| 10 | 202,538.77 | 120,691.90 | 24,919.50 | 56,927.37 |
| 11 | 202,421.70 | 120,655.95 | 24,881.30 | 56,884.45 |
| 12 | 202,426.35 | 120,623.90 | 24,893.53 | 56,908.92 |
| Average | 202,489.84 | 120,683.37 | 24,908.15 | 56,898.32 |

| 80% Load Level - 3600 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| Start-Up/Ramp-Up | 20:21:23 | 20:24:24 | 0-2 | 0:03:01 |
| Measurement Interval | 20:24:24 | 20:34:25 | 3-12 | 0:10:01 |

| (60 second intervals) | All ASUs | ASU-1 | ASU-2 | ASU-3 |
|---|---|---|---|---|
| 0 | 180,095.98 | 107,356.57 | 22,128.02 | 50,611.40 |
| 1 | 180,041.63 | 107,304.53 | 22,143.37 | 50,593.73 |
| 2 | 180,014.65 | 107,225.95 | 22,150.05 | 50,638.65 |
| 3 | 179,988.53 | 107,270.57 | 22,128.37 | 50,589.60 |
| 4 | 180,125.13 | 107,328.70 | 22,181.60 | 50,614.83 |
| 5 | 180,070.72 | 107,359.20 | 22,137.88 | 50,573.63 |
| 6 | 180,017.00 | 107,290.95 | 22,126.43 | 50,599.62 |
| 7 | 180,048.25 | 107,260.27 | 22,140.40 | 50,647.58 |
| 8 | 180,095.17 | 107,337.62 | 22,153.87 | 50,603.68 |
| 9 | 180,028.65 | 107,334.08 | 22,116.38 | 50,578.18 |
| 10 | 180,022.60 | 107,311.90 | 22,101.22 | 50,609.48 |
| 11 | 179,976.55 | 107,257.53 | 22,129.50 | 50,589.52 |
| 12 | 180,010.45 | 107,287.00 | 22,157.57 | 50,565.88 |
| Average | 180,038.31 | 107,303.78 | 22,137.32 | 50,597.20 |

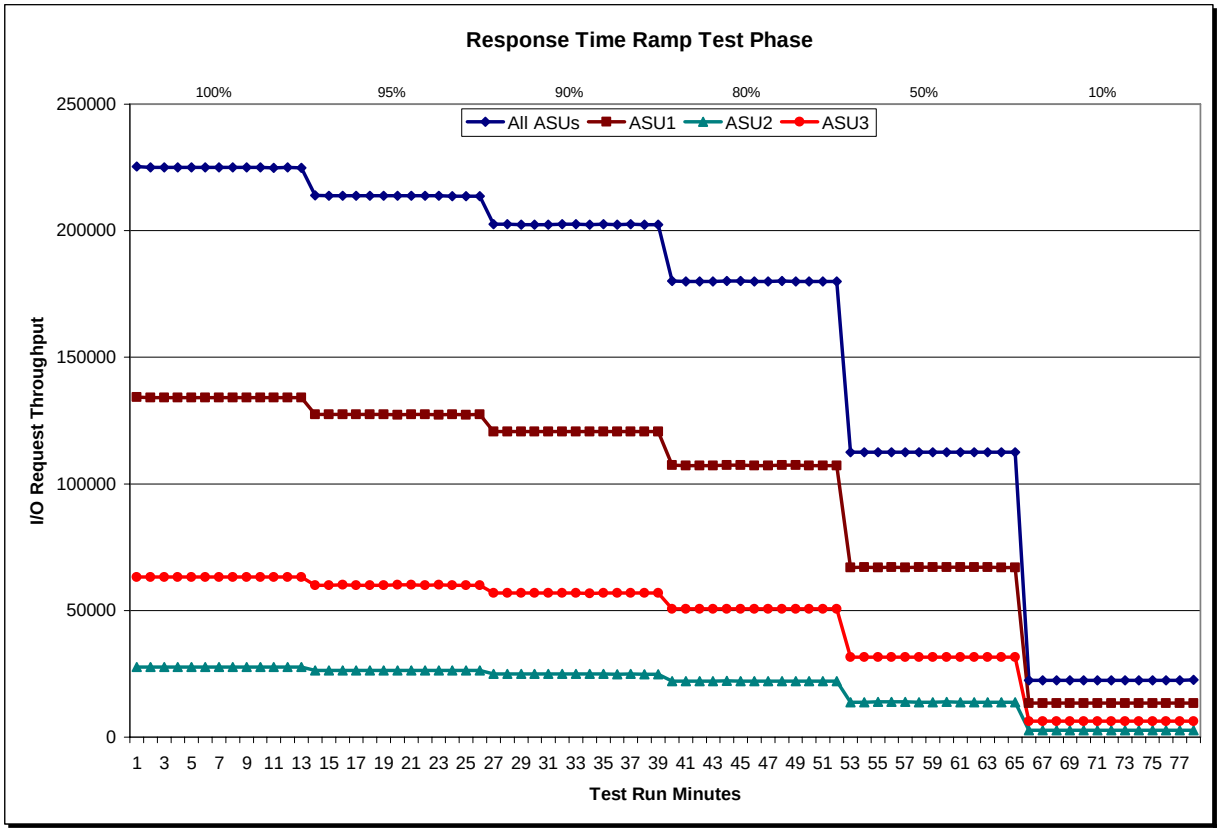
| 50% Load Level - 2250 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| Start-Up/Ramp-Up | 20:36:18 | 20:39:19 | 0-2 | 0:03:01 |
| Measurement Interval | 20:39:19 | 20:49:20 | 3-12 | 0:10:01 |

| (60 second intervals) | All ASUs | ASU-1 | ASU-2 | ASU-3 |
|---|---|---|---|---|
| 0 | 112,509.73 | 67,038.90 | 13,846.05 | 31,624.78 |
| 1 | 112,488.32 | 67,059.32 | 13,844.45 | 31,584.55 |
| 2 | 112,512.67 | 67,022.52 | 13,867.37 | 31,622.78 |
| 3 | 112,569.02 | 67,085.23 | 13,859.17 | 31,624.62 |
| 4 | 112,453.72 | 66,982.77 | 13,857.82 | 31,613.13 |
| 5 | 112,479.68 | 67,067.72 | 13,829.53 | 31,582.43 |
| 6 | 112,554.57 | 67,071.50 | 13,839.17 | 31,643.90 |
| 7 | 112,583.55 | 67,100.85 | 13,854.75 | 31,627.95 |
| 8 | 112,536.88 | 67,087.45 | 13,837.40 | 31,612.03 |
| 9 | 112,554.38 | 67,094.47 | 13,848.35 | 31,611.57 |
| 10 | 112,561.63 | 67,068.52 | 13,849.37 | 31,643.75 |
| 11 | 112,481.42 | 67,031.40 | 13,828.02 | 31,622.00 |
| 12 | 112,463.25 | 66,991.75 | 13,834.45 | 31,637.05 |
| Average | 112,523.81 | 67,058.17 | 13,843.80 | 31,621.84 |

| 10% Load Level - 450 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| Start-Up/Ramp-Up | 20:50:49 | 20:53:50 | 0-2 | 0:03:01 |
| Measurement Interval | 20:53:50 | 21:03:51 | 3-12 | 0:10:01 |

| (60 second intervals) | All ASUs | ASU-1 | ASU-2 | ASU-3 |
|---|---|---|---|---|
| 0 | 22,488.90 | 13,403.65 | 2,753.22 | 6,332.03 |
| 1 | 22,467.82 | 13,400.25 | 2,756.27 | 6,311.30 |
| 2 | 22,510.92 | 13,422.27 | 2,768.92 | 6,319.73 |
| 3 | 22,513.40 | 13,417.15 | 2,771.92 | 6,324.33 |
| 4 | 22,511.55 | 13,418.12 | 2,762.82 | 6,330.62 |
| 5 | 22,475.10 | 13,404.43 | 2,765.78 | 6,304.88 |
| 6 | 22,474.87 | 13,392.05 | 2,765.12 | 6,317.70 |
| 7 | 22,497.37 | 13,394.17 | 2,767.55 | 6,335.65 |
| 8 | 22,516.03 | 13,409.35 | 2,772.93 | 6,333.75 |
| 9 | 22,511.77 | 13,406.33 | 2,777.17 | 6,328.27 |
| 10 | 22,489.60 | 13,405.50 | 2,759.20 | 6,324.90 |
| 11 | 22,480.92 | 13,402.65 | 2,760.62 | 6,317.65 |
| 12 | 22,532.07 | 13,427.62 | 2,774.22 | 6,330.23 |
| Average | 22,500.27 | 13,407.74 | 2,767.73 | 6,324.80 |

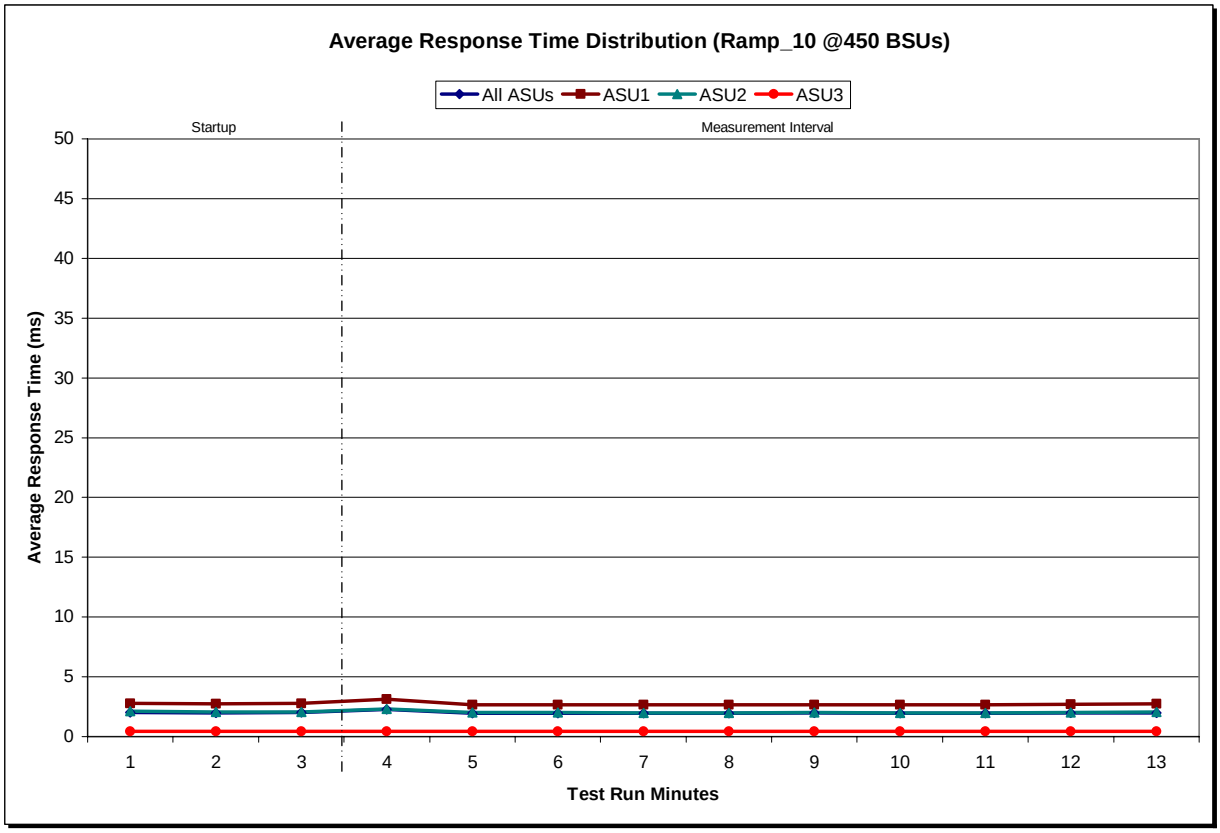
## Response Time Ramp Distribution (IOPS) Graph



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

| 450 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 20:50:49 | 20:53:50 | 0-2 | 0:03:01 |
| *Measurement Interval* | 20:53:50 | 21:03:51 | 3-12 | 0:10:01 |
| **60 second intervals** | **All ASUs** | **ASU1** | **ASU2** | **ASU3** |
| **0** | 2.02 | 2.76 | 2.13 | 0.43 |
| **1** | 2.00 | 2.73 | 2.04 | 0.42 |
| **2** | 2.02 | 2.76 | 2.05 | 0.42 |
| **3** | 2.28 | 3.14 | 2.32 | 0.42 |
| **4** | 1.96 | 2.68 | 2.00 | 0.42 |
| **5** | 1.95 | 2.66 | 2.00 | 0.42 |
| **6** | 1.95 | 2.66 | 1.99 | 0.42 |
| **7** | 1.96 | 2.68 | 1.98 | 0.42 |
| **8** | 1.96 | 2.68 | 2.01 | 0.42 |
| **9** | 1.96 | 2.68 | 2.00 | 0.42 |
| **10** | 1.96 | 2.67 | 1.99 | 0.42 |
| **11** | 1.98 | 2.71 | 2.02 | 0.42 |
| **12** | 1.99 | 2.72 | 2.06 | 0.42 |
| **Average** | 1.99 | 2.73 | 2.04 | 0.42 |

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



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

*Clause 3.4.3*

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

*Clauses 5.1.0 and 5.3.13.2*

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

*Clause 5.3.13.3*

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

| | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|---|---|---|---|---|---|---|---|---|
| ***IM*** | ***0.0350*** | ***0.2810*** | ***0.0700*** | ***0.2100*** | ***0.0180*** | ***0.0700*** | ***0.0350*** | ***0.2810*** |
| MIM | 0.0350 | 0.2809 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2811 |
| COV | 0.004 | 0.001 | 0.002 | 0.002 | 0.004 | 0.002 | 0.004 | 0.001 |

## Repeatability Test

*Clause 5.4.5*

*The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ primary metric and SPC-1 LRT™ metric generated in earlier Test Runs.*

*There are two identical Repeatability Test Phases. Each Test Phase contains two Test Runs. Each of the Test Runs will have a Measurement Interval of no less than ten (10) minutes. The two Test Runs in each Test Phase will be executed without interruption or any type of manual intervention.*

*The first Test Run in each Test Phase is executed at the 10% load point. The Average Response Time from each of the Test Runs is compared to the SPC-1 LRT™ metric. Each Average Response Time value must be less than the SPC-1 LRT™ metric plus 5%.*

*The second Test Run in each Test Phase is executed at the 100% load point. The I/O Request Throughput from the Test Runs is compared to the SPC-1 IOPS™ primary metric. Each I/O Request Throughput value must be greater than the SPC-1 IOPS™ primary metric minus 5%. In addition, the Average Response Time for each Test Run cannot exceed 30 milliseconds.*

*If any of the above constraints are not met, the benchmark measurement is invalid.*

*Clause 9.2.4.7.4*

*The following content shall appear in the FDR for each Test Run in the two Repeatability Test Phases:*

1. *A table containing the results of the Repeatability Test.*
2. *An I/O Request Throughput Distribution graph and table.*
3. *An Average Response Time Distribution graph and table.*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied to the Workload Generator.*

### SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 67.

### Repeatability Test Results File

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

| | SPC-1 IOPS™ |
|---|---|
| ***Primary Metrics*** | ***224,989.65*** |
| **Repeatability Test Phase 1** | 224,995.72 |
| **Repeatability Test Phase 2** | 224,994.81 |

The SPC-1 IOPS™ values in the above table were generated using 100% of the specified Business Scaling Unit (BSU) load level. Each of the Repeatability Test Phase values for SPC-1 IOPS™ must greater than 95% of the reported SPC-1 IOPS™ Primary Metric.

| | SPC-1 LRT™ |
|---|---|
| ***Primary Metrics*** | ***1.99 ms*** |
| **Repeatability Test Phase 1** | 1.99 ms |
| **Repeatability Test Phase 2** | 2.00 ms |

The average response time values in the SPC-1 LRT™ column were generated using 10% of the specified Business Scaling Unit (BSU) load level. Each of the Repeatability Test Phase values for SPC-1 LRT™ must be less than 105% of the reported SPC-1 LRT™ Primary Metric.

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

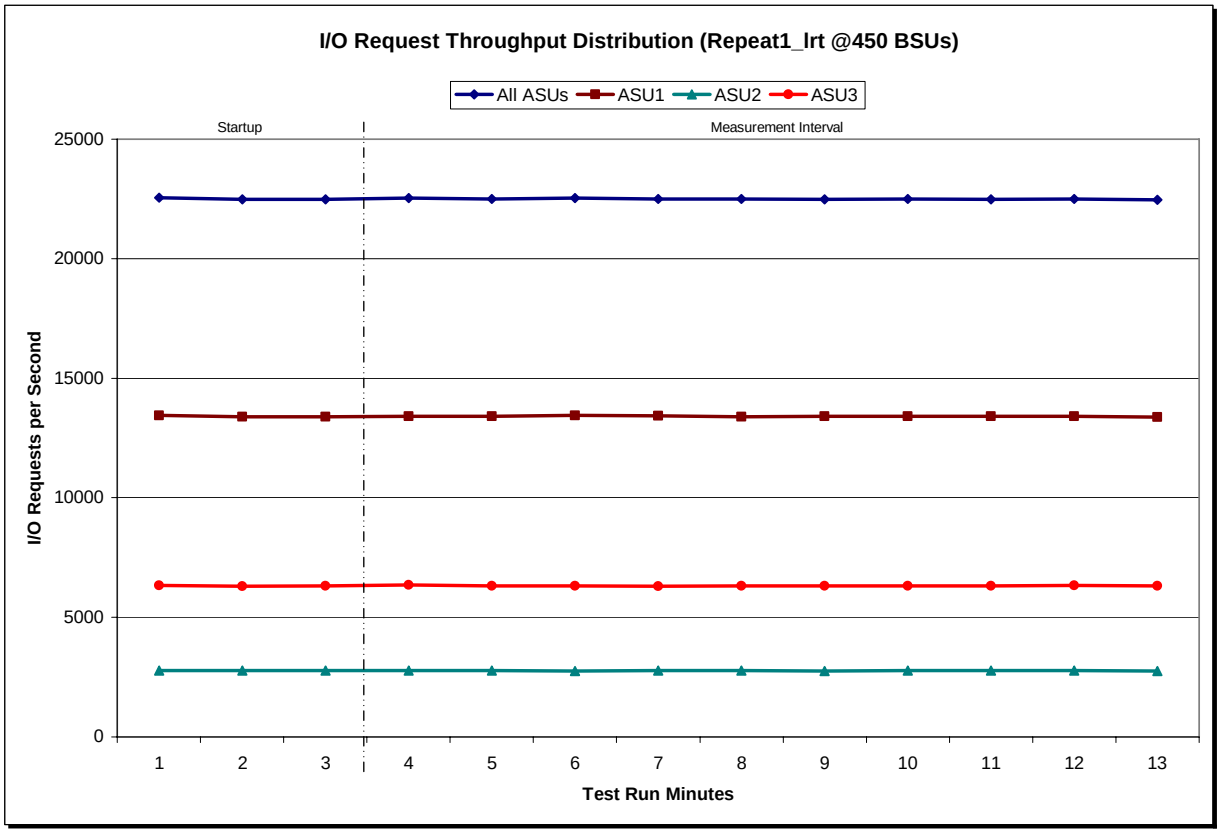
**Repeatability Test Phase 1, Test Run 1 (LRT)**
**Repeatability Test Phase 1, Test Run 2 (IOPS)**
**Repeatability Test Phase 2, Test Run 1 (LRT)**
**Repeatability Test Phase 2, Test Run 2 (IOPS)**

## Repeatability 1 LRT – I/O Request Throughput Distribution Data

| 450 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:06:51 | 21:09:51 | 0-2 | 0:03:00 |
| *Measurement Interval* | 21:09:51 | 21:19:52 | 3-12 | 0:10:01 |

| 60 second intervals | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|
| 0 | 22,549.88 | 13,444.15 | 2,772.62 | 6,333.12 |
| 1 | 22,475.77 | 13,399.10 | 2,773.07 | 6,303.60 |
| 2 | 22,477.60 | 13,392.30 | 2,768.90 | 6,316.40 |
| 3 | 22,526.62 | 13,415.88 | 2,765.15 | 6,345.58 |
| 4 | 22,493.25 | 13,412.43 | 2,767.00 | 6,313.82 |
| 5 | 22,528.25 | 13,441.40 | 2,761.57 | 6,325.28 |
| 6 | 22,495.05 | 13,419.12 | 2,767.72 | 6,308.22 |
| 7 | 22,489.47 | 13,398.33 | 2,772.05 | 6,319.08 |
| 8 | 22,473.10 | 13,405.92 | 2,758.12 | 6,309.07 |
| 9 | 22,491.90 | 13,400.38 | 2,772.20 | 6,319.32 |
| 10 | 22,487.92 | 13,403.82 | 2,768.08 | 6,316.02 |
| 11 | 22,506.28 | 13,400.97 | 2,767.92 | 6,337.40 |
| 12 | 22,459.83 | 13,377.85 | 2,761.58 | 6,320.40 |
| Average | 22,495.17 | 13,407.61 | 2,766.14 | 6,321.42 |

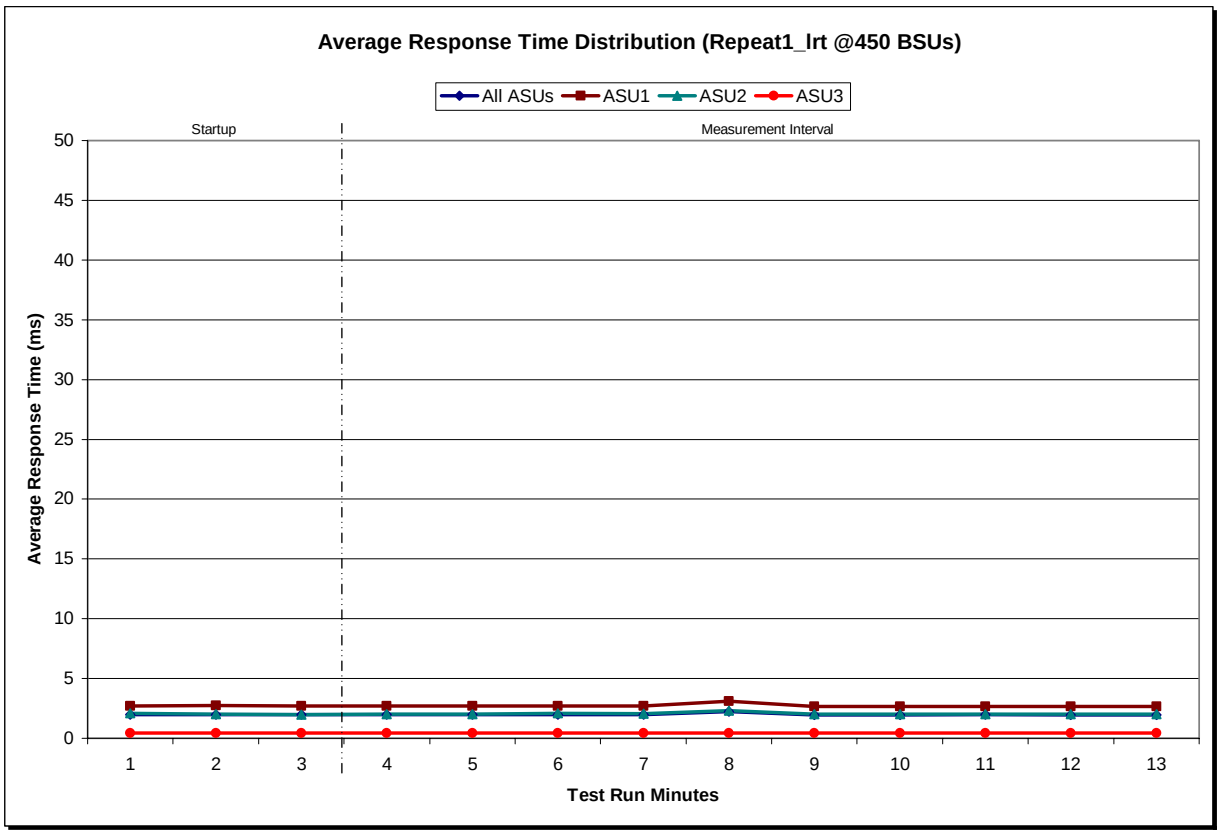
## Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

| 450 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:06:51 | 21:09:51 | 0-2 | 0:03:00 |
| *Measurement Interval* | 21:09:51 | 21:19:52 | 3-12 | 0:10:01 |
| **60 second intervals** | **All ASUs** | **ASU1** | **ASU2** | **ASU3** |
| **0** | 1.99 | 2.71 | 2.09 | 0.42 |
| **1** | 1.99 | 2.72 | 2.01 | 0.42 |
| **2** | 1.98 | 2.71 | 1.97 | 0.42 |
| **3** | 1.97 | 2.69 | 2.02 | 0.42 |
| **4** | 1.97 | 2.70 | 2.00 | 0.42 |
| **5** | 1.99 | 2.71 | 2.07 | 0.42 |
| **6** | 1.99 | 2.72 | 2.04 | 0.43 |
| **7** | 2.25 | 3.09 | 2.30 | 0.42 |
| **8** | 1.95 | 2.66 | 2.02 | 0.42 |
| **9** | 1.96 | 2.67 | 2.00 | 0.42 |
| **10** | 1.96 | 2.68 | 2.01 | 0.42 |
| **11** | 1.95 | 2.67 | 2.01 | 0.42 |
| **12** | 1.96 | 2.67 | 2.02 | 0.42 |
| **Average** | 1.99 | 2.73 | 2.05 | 0.42 |

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

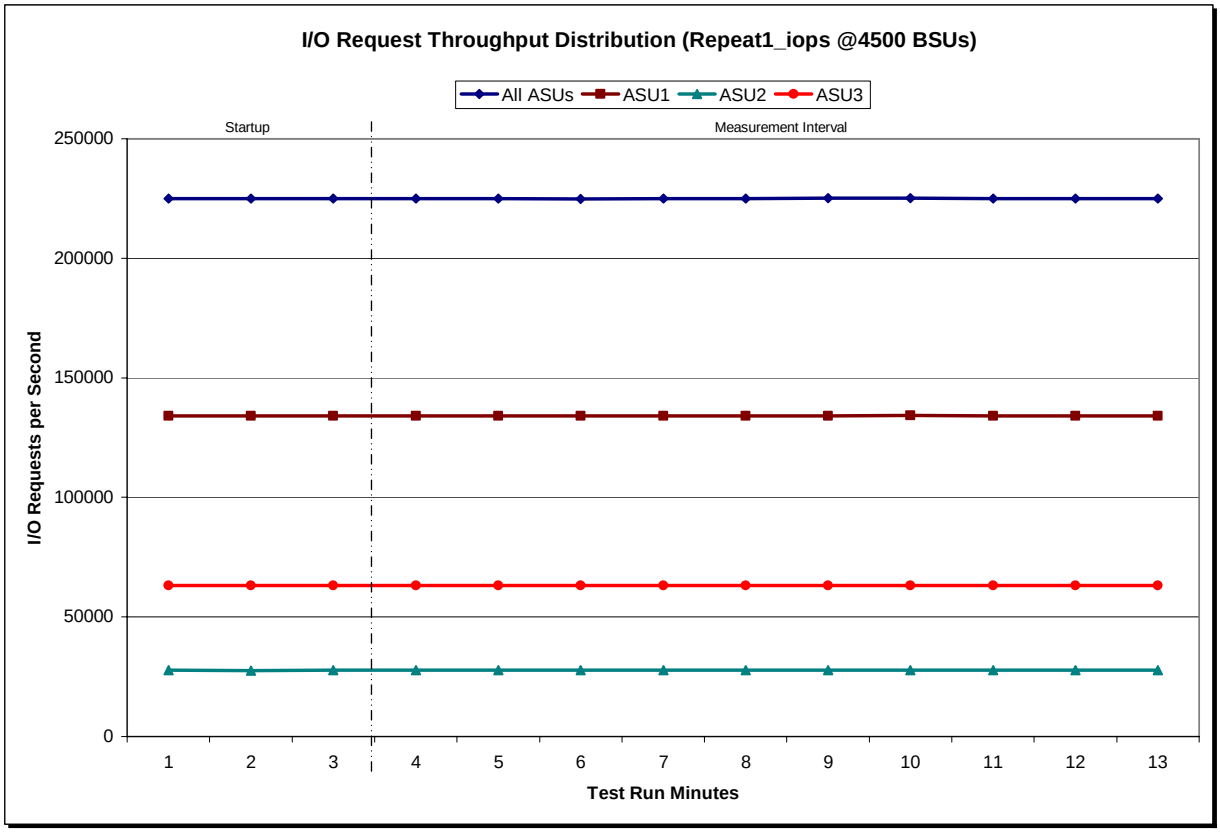


## Repeatability 1 IOPS – I/O Request Throughput Distribution Data

| 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:22:11 | 21:25:12 | 0-2 | 0:03:01 |
| *Measurement Interval* | 21:25:12 | 21:35:13 | 3-12 | 0:10:01 |

| 60 second intervals | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|
| 0 | 225,047.92 | 134,148.63 | 27,660.83 | 63,238.45 |
| 1 | 224,968.33 | 134,124.08 | 27,612.48 | 63,231.77 |
| 2 | 225,028.73 | 134,098.18 | 27,667.68 | 63,262.87 |
| 3 | 225,066.32 | 134,150.45 | 27,678.32 | 63,237.55 |
| 4 | 225,013.28 | 134,147.30 | 27,704.07 | 63,161.92 |
| 5 | 224,879.57 | 134,076.17 | 27,633.17 | 63,170.23 |
| 6 | 225,007.32 | 134,118.20 | 27,694.50 | 63,194.62 |
| 7 | 225,012.15 | 134,105.28 | 27,687.72 | 63,219.15 |
| 8 | 225,074.12 | 134,138.28 | 27,696.33 | 63,239.50 |
| 9 | 225,083.37 | 134,190.10 | 27,669.53 | 63,223.73 |
| 10 | 224,939.62 | 134,063.77 | 27,672.00 | 63,203.85 |
| 11 | 224,911.22 | 134,058.67 | 27,642.50 | 63,210.05 |
| 12 | 224,970.22 | 134,147.28 | 27,636.62 | 63,186.32 |
| Average | 224,995.72 | 134,119.55 | 27,671.48 | 63,204.69 |

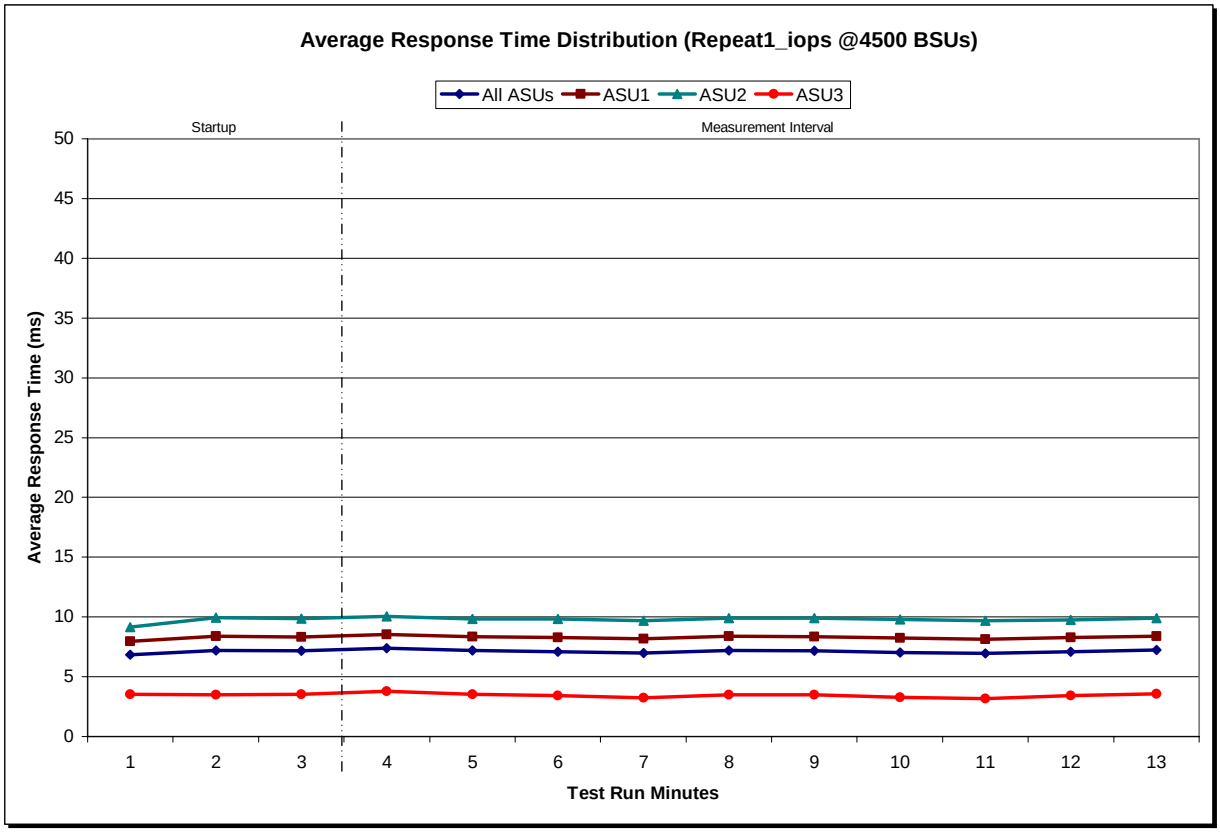
## Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

| 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:22:11 | 21:25:12 | 0-2 | 0:03:01 |
| *Measurement Interval* | 21:25:12 | 21:35:13 | 3-12 | 0:10:01 |
| **60 second intervals** | **All ASUs** | **ASU1** | **ASU2** | **ASU3** |
| **0** | 6.85 | 7.94 | 9.16 | 3.54 |
| **1** | 7.19 | 8.37 | 9.92 | 3.50 |
| **2** | 7.18 | 8.33 | 9.88 | 3.54 |
| **3** | 7.38 | 8.52 | 10.03 | 3.79 |
| **4** | 7.19 | 8.36 | 9.82 | 3.54 |
| **5** | 7.10 | 8.28 | 9.81 | 3.42 |
| **6** | 6.97 | 8.16 | 9.70 | 3.25 |
| **7** | 7.19 | 8.37 | 9.89 | 3.50 |
| **8** | 7.18 | 8.35 | 9.91 | 3.49 |
| **9** | 7.03 | 8.24 | 9.79 | 3.27 |
| **10** | 6.93 | 8.15 | 9.67 | 3.15 |
| **11** | 7.10 | 8.28 | 9.75 | 3.43 |
| **12** | 7.22 | 8.39 | 9.92 | 3.55 |
| **Average** | 7.13 | 8.31 | 9.83 | 3.44 |

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

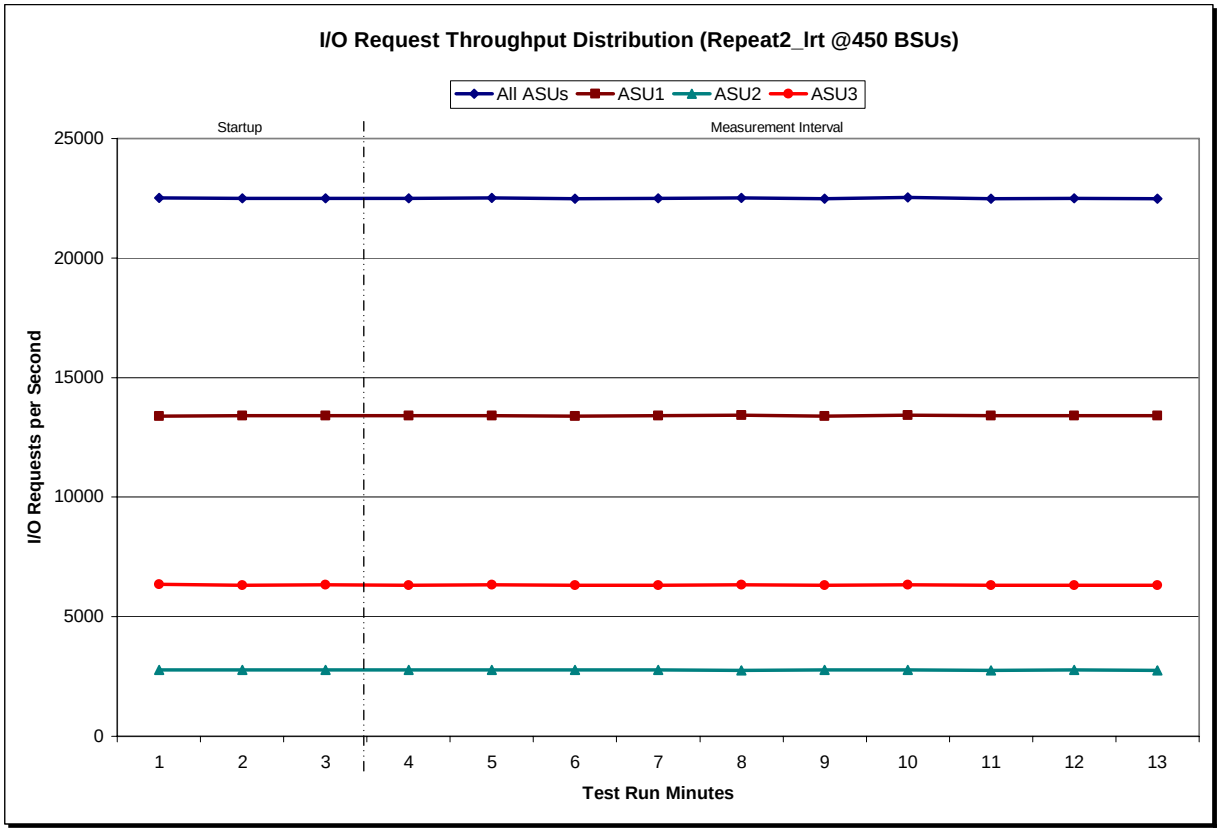


## Repeatability 2 LRT – I/O Request Throughput Distribution Data

| 450 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:38:52 | 21:41:52 | 0-2 | 0:03:00 |
| *Measurement Interval* | 21:41:52 | 21:51:53 | 3-12 | 0:10:01 |

| 60 second intervals | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|
| 0 | 22,514.85 | 13,398.12 | 2,771.37 | 6,345.37 |
| 1 | 22,494.70 | 13,406.87 | 2,763.55 | 6,324.28 |
| 2 | 22,503.52 | 13,411.83 | 2,762.88 | 6,328.80 |
| 3 | 22,491.13 | 13,402.75 | 2,771.28 | 6,317.10 |
| 4 | 22,509.45 | 13,408.38 | 2,773.42 | 6,327.65 |
| 5 | 22,479.00 | 13,395.88 | 2,770.17 | 6,312.95 |
| 6 | 22,502.90 | 13,409.02 | 2,774.40 | 6,319.48 |
| 7 | 22,518.57 | 13,423.65 | 2,761.77 | 6,333.15 |
| 8 | 22,480.30 | 13,391.02 | 2,773.73 | 6,315.55 |
| 9 | 22,534.52 | 13,427.22 | 2,776.68 | 6,330.62 |
| 10 | 22,475.60 | 13,402.92 | 2,760.30 | 6,312.38 |
| 11 | 22,501.52 | 13,411.80 | 2,771.47 | 6,318.25 |
| 12 | 22,476.25 | 13,401.08 | 2,760.12 | 6,315.05 |
| Average | 22,496.92 | 13,407.37 | 2,769.33 | 6,320.22 |

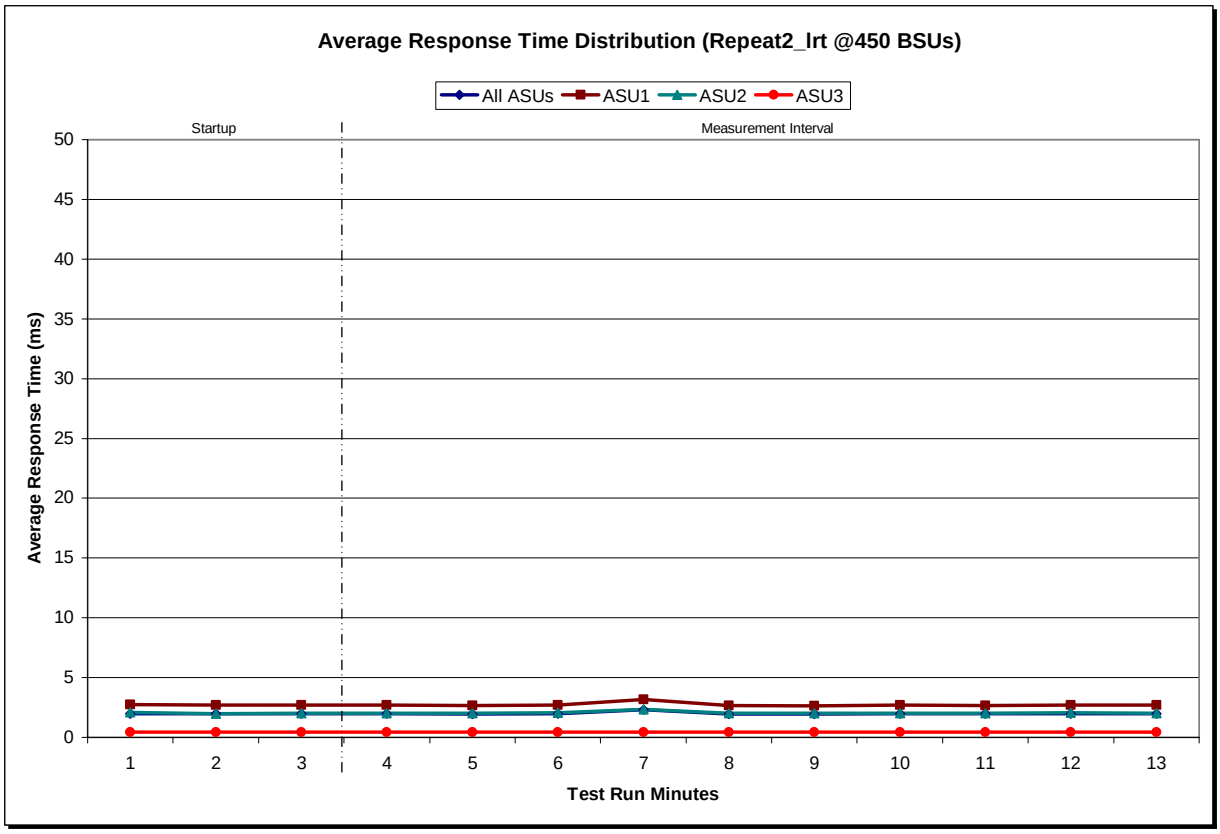
## Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

| 450 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:38:52 | 21:41:52 | 0-2 | 0:03:00 |
| *Measurement Interval* | 21:41:52 | 21:51:53 | 3-12 | 0:10:01 |
| **60 second intervals** | **All ASUs** | **ASU1** | **ASU2** | **ASU3** |
| **0** | 1.99 | 2.72 | 2.08 | 0.42 |
| **1** | 1.98 | 2.70 | 1.99 | 0.42 |
| **2** | 1.97 | 2.70 | 2.00 | 0.42 |
| **3** | 1.96 | 2.68 | 2.00 | 0.42 |
| **4** | 1.96 | 2.67 | 2.00 | 0.42 |
| **5** | 1.98 | 2.70 | 2.04 | 0.42 |
| **6** | 2.30 | 3.18 | 2.36 | 0.42 |
| **7** | 1.94 | 2.65 | 2.00 | 0.42 |
| **8** | 1.94 | 2.64 | 2.00 | 0.43 |
| **9** | 1.97 | 2.69 | 2.01 | 0.43 |
| **10** | 1.96 | 2.67 | 2.03 | 0.43 |
| **11** | 1.97 | 2.69 | 2.04 | 0.43 |
| **12** | 1.98 | 2.70 | 2.02 | 0.42 |
| **Average** | 2.00 | 2.73 | 2.05 | 0.42 |

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

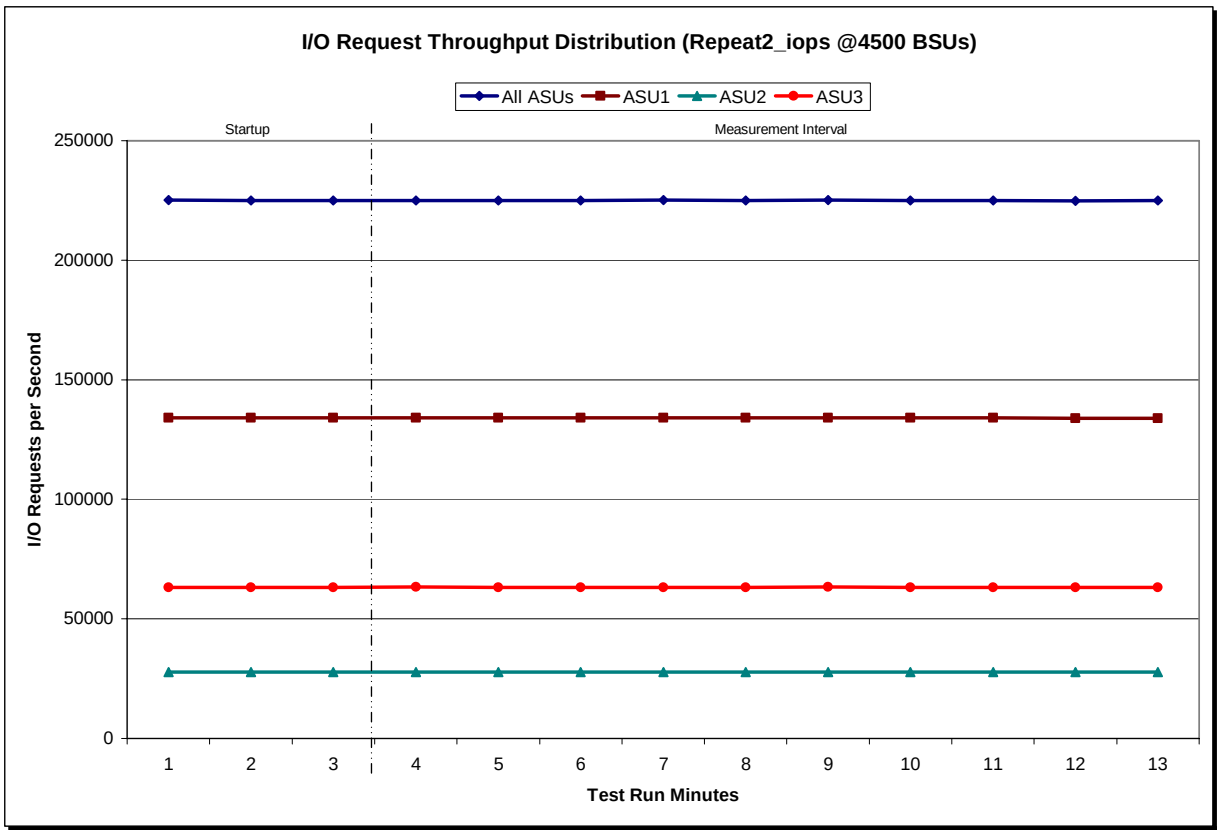


## Repeatability 2 IOPS – I/O Request Throughput Distribution Data

| 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:54:13 | 21:57:14 | 0-2 | 0:03:01 |
| *Measurement Interval* | 21:57:14 | 22:07:15 | 3-12 | 0:10:01 |

| 60 second intervals | All ASUs | ASU1 | ASU2 | ASU3 |
|---|---|---|---|---|
| 0 | 225,076.87 | 134,154.58 | 27,678.13 | 63,244.15 |
| 1 | 225,054.05 | 134,100.80 | 27,721.15 | 63,232.10 |
| 2 | 224,994.37 | 134,154.92 | 27,648.92 | 63,190.53 |
| 3 | 225,037.68 | 134,083.77 | 27,672.05 | 63,281.87 |
| 4 | 225,002.88 | 134,067.70 | 27,676.75 | 63,258.43 |
| 5 | 225,064.53 | 134,137.70 | 27,706.75 | 63,220.08 |
| 6 | 225,079.68 | 134,165.47 | 27,657.55 | 63,256.67 |
| 7 | 224,929.88 | 134,028.10 | 27,657.80 | 63,243.98 |
| 8 | 225,090.47 | 134,158.70 | 27,659.98 | 63,271.78 |
| 9 | 224,920.42 | 134,109.03 | 27,679.72 | 63,131.67 |
| 10 | 225,029.92 | 134,099.35 | 27,678.93 | 63,251.63 |
| 11 | 224,860.58 | 133,977.72 | 27,665.38 | 63,217.48 |
| 12 | 224,932.07 | 133,990.08 | 27,684.78 | 63,257.20 |
| Average | 224,994.81 | 134,081.76 | 27,673.97 | 63,239.08 |

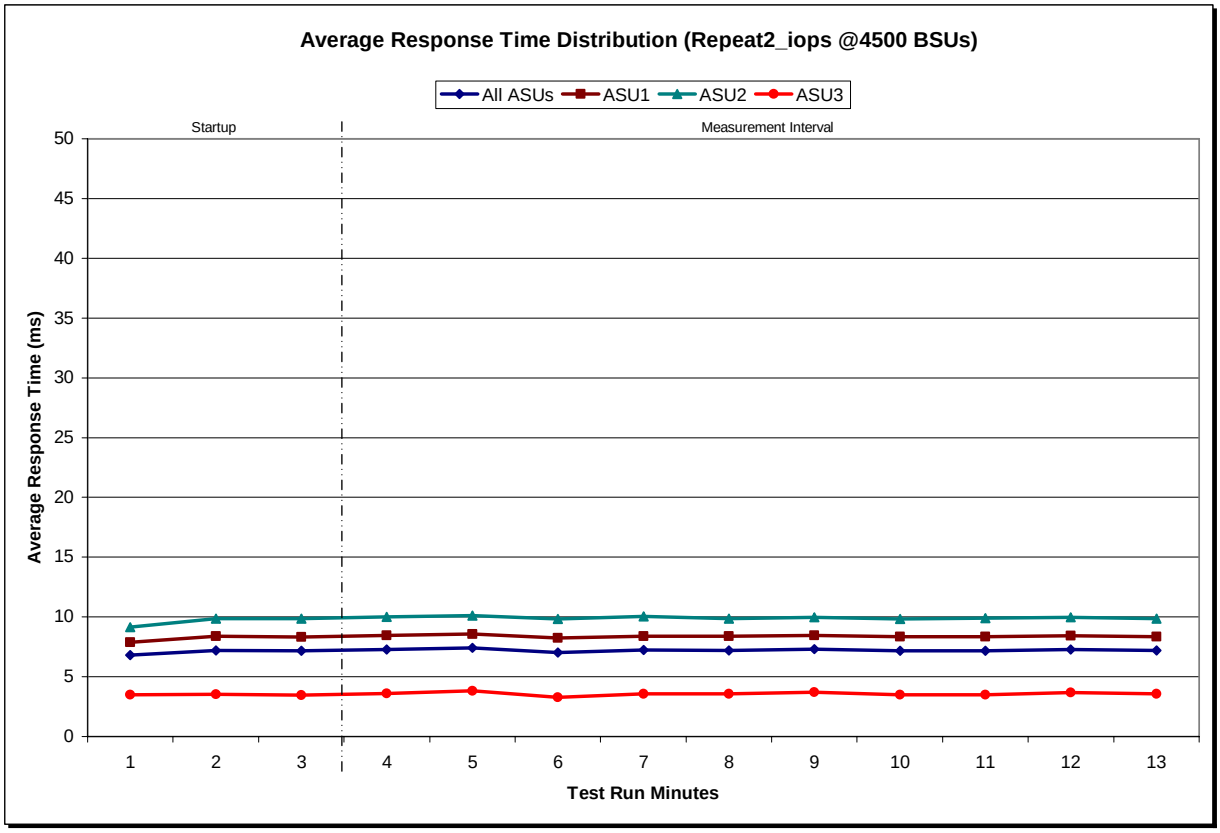
## Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

| 4500 BSUs | Start | Stop | Interval | Duration |
|---|---|---|---|---|
| *Start-Up/Ramp-Up* | 21:54:13 | 21:57:14 | 0-2 | 0:03:01 |
| *Measurement Interval* | 21:57:14 | 22:07:15 | 3-12 | 0:10:01 |
| **60 second intervals** | **All ASUs** | **ASU1** | **ASU2** | **ASU3** |
| **0** | 6.81 | 7.89 | 9.16 | 3.48 |
| **1** | 7.20 | 8.38 | 9.87 | 3.54 |
| **2** | 7.15 | 8.33 | 9.87 | 3.45 |
| **3** | 7.28 | 8.44 | 10.00 | 3.62 |
| **4** | 7.42 | 8.56 | 10.10 | 3.82 |
| **5** | 7.04 | 8.24 | 9.81 | 3.27 |
| **6** | 7.24 | 8.40 | 10.03 | 3.55 |
| **7** | 7.20 | 8.38 | 9.87 | 3.55 |
| **8** | 7.30 | 8.45 | 9.96 | 3.70 |
| **9** | 7.17 | 8.34 | 9.83 | 3.51 |
| **10** | 7.17 | 8.35 | 9.89 | 3.50 |
| **11** | 7.28 | 8.43 | 9.97 | 3.67 |
| **12** | 7.19 | 8.36 | 9.86 | 3.55 |
| **Average** | 7.23 | 8.39 | 9.93 | 3.57 |

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



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

*Clause 3.4.3*

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

*Clauses 5.1.0 and 5.3.13.2*

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

*Clause 5.3.13.3*

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

| | 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 | 0.0699 | 0.0351 | 0.2810 |
| COV | 0.003 | 0.001 | 0.002 | 0.002 | 0.006 | 0.003 | 0.005 | 0.001 |

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

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

## 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 | 0.0349 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0351 | 0.2809 |
| COV | 0.006 | 0.001 | 0.003 | 0.002 | 0.006 | 0.003 | 0.005 | 0.000 |

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

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

## Data Persistence Test

*Clause 6*

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

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

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

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

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

*Clause 9.2.4.8*

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

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

### SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 67.

### 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 | 138,707,248 |
| Total Number of Logical Blocks Verified | 106,432,448 |
| Total Number of Logical Blocks that Failed Verification | 0 |
| Time Duration for Writing Test Logical Blocks | 10 minutes |
| Size in Bytes of each Logical Block | 512 |
| Number of Failed I/O Requests in the process of the Test | 0 |

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

## PRICED STORAGE CONFIGURATION AVAILABILITY DATE

*Clause 9.2.4.9*

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

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

The 3PAR InServ® T800 Storage Server as documented in this Full Disclosure Report will become available September 2, 2008 for customer purchase and shipment.

## PRICING INFORMATION

*Clause 9.2.4.11*

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

*Clause 9.2.4.11.3*

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

Pricing information may found in the Tested Storage Configuration Pricing section on page 13. A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 13.

## ANOMALIES OR IRREGULARITIES

*Clause 9.2.4.10*

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

There were no anomalies or irregularities encountered during the SPC-1 Onsite Audit of the 3PAR InServ® T800 Storage Server.

# APPENDIX A: SPC-1 GLOSSARY

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

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

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

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

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

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

## SPC-1 Data Repository Definitions

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

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

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

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

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

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

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

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

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

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

## SPC-1 Data Protection Levels

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

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

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

**Unprotected:** There is no data protection provided.

## SPC-1 Test Execution Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

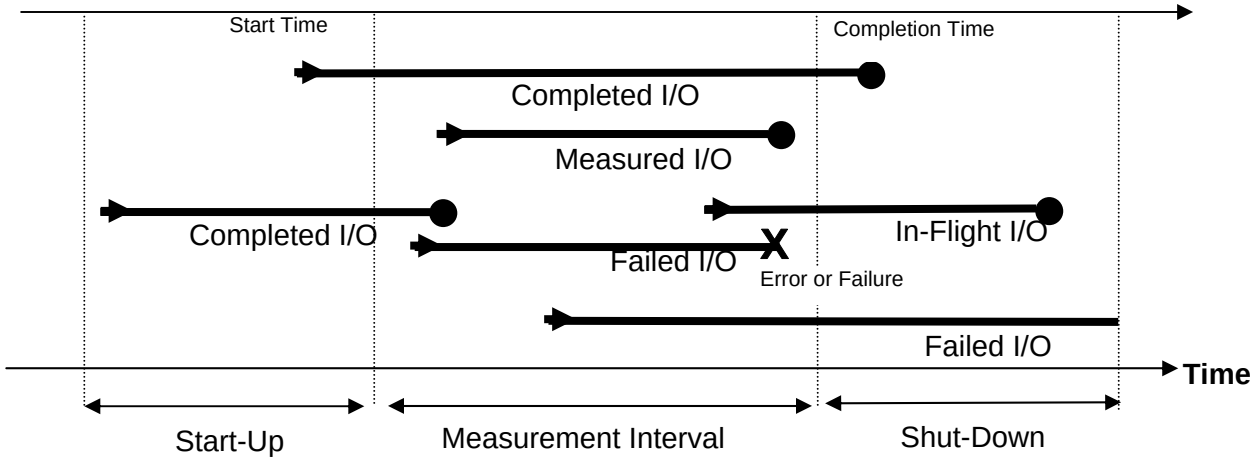
**Test**: A collection of Test Phases and or Test Runs sharing a common objective.

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

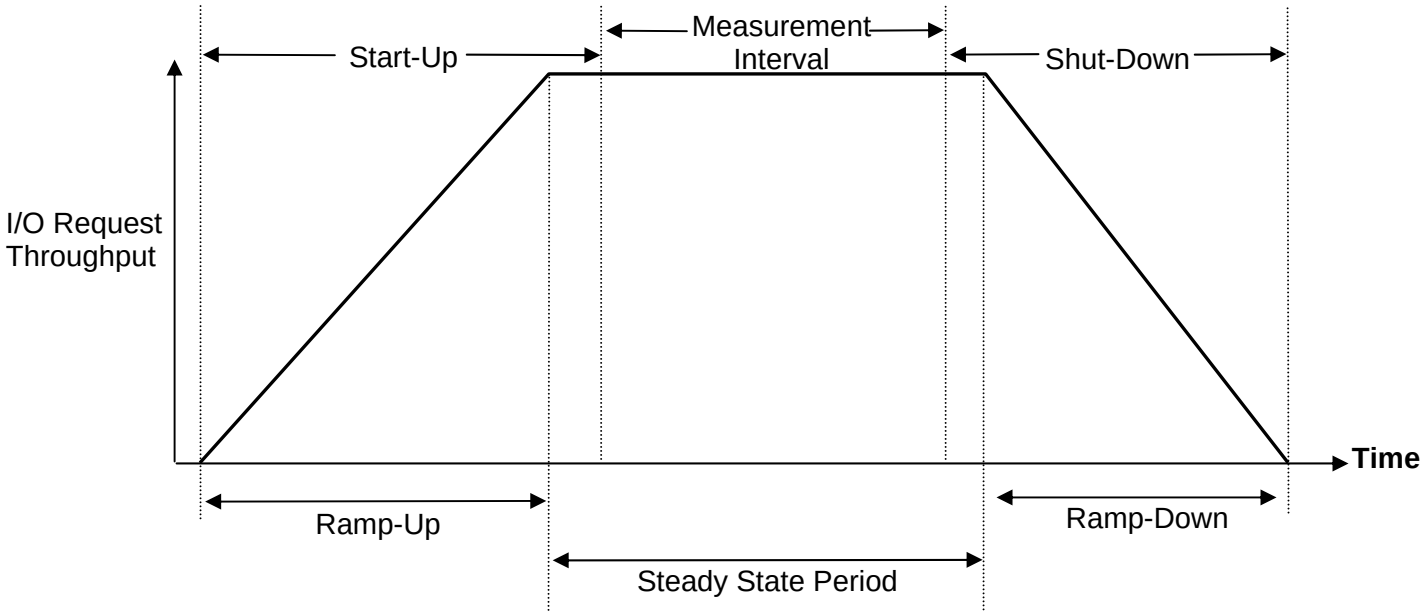
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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

### I/O Completion Types




### SPC-1 Test Run Components



# APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

The customer tunable parameters and options that were changed from their default values are documented in #5 and #6 of Appendix C: Tested Storage Configuration (TSC) Creation.

# APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

The following was done to create and configure the TSC:

1. Configure the InServ storage server ports to port personality 13 *(This is the recommended setting for Direct Connect when using IBM AIX 5.3 as described in "3PAR 2.2.x Best Practice, Direct Connect: IBM eServer AIX 5.3.").*

   The following script was used to change it for nodes 0 to 7 and for the two ports used on each node:

```
# cat do_chgpersona
  for n in 0 1 2 3 4 5 6 7
      do
         for p in  1 3
            do
            controlport persona 13 -f $n:5:$p
            done
      done
```

2. Create the host definitions (associating a hostname with WWNs). The following script was used for this:

```
# cat do_createhosts
createhost  n0p1 10000000C9562E64
createhost  n0p3 10000000C94AE2EE
createhost  n1p1 10000000C963D2AC
createhost  n1p3 10000000C967024C
createhost  n2p1 10000000C9560CA8
createhost  n2p3 10000000C9562460
createhost  n3p1 10000000C94CBF74
createhost  n3p3 10000000C9677C78
createhost  n4p1 10000000C9560CA9
createhost  n4p3 10000000C9562461
createhost  n5p1 10000000C94CBF75
createhost  n5p3 10000000C9677C79
createhost  n6p1 10000000C9562E65
createhost  n6p3 10000000C94AE2ED
createhost  n7p1 10000000C963D2AD
createhost  n7p3 10000000C967024D
```

3. Create the 224 Volumes and export the VLUNs to the host *(128 for ASU1, 64 for ASU2, and 32 for ASU3)*. The following script was used to do this:

```
# cat create_config
#!/bin/bash

SIZE[1]=286720
SIZE[2]=573440
SIZE[3]=286720

VVS[1]="0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15"
VVS[2]="0 1 2 3 4 5 6 7"
VVS[3]="0 1 2 3"
```

```
    for NODE in 0 1 2 3 4 5 6 7
    do
      PORT=1
      LUN[1]=0
      LUN[3]=0
      for ASU in 1 2 3
      do
        for COUNT in ${VVS[$ASU]}
        do
          createaldvv -p -nd $NODE ASU${ASU}-N${NODE}-$COUNT
${SIZE[$ASU]}
          createvlun ASU${ASU}-N${NODE}-$COUNT ${    LUN[$PORT]}
n${NODE}p${PORT}
          LUN[$PORT]=$((${LUN[$PORT]}+1))
          if(($PORT==1))
          then
            PORT=3
          else
            PORT=1
          fi
        done
      done
    done
```

The following steps were done on the Host System to discover the newly created VLUNs and to create the AIX logical volumes:

4. Use the AIX command **cfgmgr** to discover the newly created InServ LUNs. This discovered the 224 luns as hdisk31 to hdisk254.

5. To prevent any OS limits from being a bottleneck, we set the following values to unlimited (-1 denotes unlimited). The file "/etc/security/limits" was changed. These changes take effect at the next reboot.

   The following file was used, which shows the original values and new values:

```
-> cat /etc/security/limits

*
* Sizes are in multiples of 512 byte blocks, CPU time is in seconds
*
* fsize      - soft file size in blocks
* core       - soft core file size in blocks
* cpu        - soft per process CPU time limit in seconds
* data       - soft data segment size in blocks
* stack      - soft stack segment size in blocks
* rss        - soft real memory usage in blocks
* nofiles    - soft file descriptor limit
* fsize_hard - hard file size in blocks
* core_hard  - hard core file size in blocks
* cpu_hard   - hard per process CPU time limit in seconds
* data_hard  - hard data segment size in blocks
* stack_hard - hard stack segment size in blocks
* rss_hard   - hard real memory usage in blocks
```

```
        * nofiles_hard - hard file descriptor limit
        *
        * The following table contains the default hard values if the
        * hard values are not explicitly defined:
        *
        *   Attribute        Value
        *   ==========    ============
        *   fsize_hard    set to fsize
        *   cpu_hard      set to cpu
        *   core_hard         -1
        *   data_hard         -1
        *   stack_hard      8388608
        *   rss_hard          -1
        *   nofiles_hard      -1
        *
        * NOTE:  A value of -1 implies "unlimited"
        *
        *
        * Changed on 4-Aug-2008
        * Original values
        *
        * default:
        *       fsize = 2097151
        *       core = 2097151
        *       cpu = -1
        *       data = 262144
        *       rss = 65536
        *       stack = 65536
        *       nofiles = 2000

        default:
                fsize = -1
                core = -1
                cpu = -1
                data = -1
                rss = -1
                stack = -1
                nofiles = -1
                stack_hard = -1

        root:

        daemon:

        bin:

        sys:

        adm:

        uucp:

        guest:

        nobody:
```

```
lpd:


esaadmin:
        stack = 393216
        stack_hard = 393216
```

6. To prevent any host queue depth bottlenecks, we set the queuedepth to the maximum for the hdisks and for the Fibre Channel links. A reboot is necessary for the new queue depths to become effective. The following two scripts were used:

```
  -> cat sethdiskqd
#!/bin/bash
i=31
while [ $i -le   254 ]
do
   chdev -l hdisk$i -a q_type=simple -a queue_depth=255 -P
   (( i+=1))
done


  -> cat setfcsqd
#!/bin/bash
for i in 0 1 2 3 4 5 6 7 16 17 18 19 24 25 26 27
do
chdev -l fcs$i -P -a num_cmd_elems=1024
done
```

7. Reboot the Host System so changes to increase queue depths and ulimits become effective and are not a host bottleneck.

8. The following files contain the hdisks created for each ASU. These files are used in the next two steps.

```
-> cat forasu1
hdisk171 hdisk59 hdisk172 hdisk60 hdisk173 hdisk61
hdisk174 hdisk62 hdisk175 hdisk63 hdisk176 hdisk64
hdisk177 hdisk65 hdisk178 hdisk66 hdisk227 hdisk115
hdisk228 hdisk116 hdisk229 hdisk117 hdisk230 hdisk118
hdisk231 hdisk119 hdisk232 hdisk120 hdisk233 hdisk121
hdisk234 hdisk122 hdisk143 hdisk31 hdisk144 hdisk32
hdisk145 hdisk33 hdisk146 hdisk34 hdisk147 hdisk35
hdisk148 hdisk36 hdisk149 hdisk37 hdisk150 hdisk38
hdisk199 hdisk87 hdisk200 hdisk88 hdisk201 hdisk89
hdisk202 hdisk90 hdisk203 hdisk91 hdisk204 hdisk92
hdisk205 hdisk93 hdisk206 hdisk94 hdisk157 hdisk45
hdisk158 hdisk46 hdisk159 hdisk47 hdisk160 hdisk48
hdisk161 hdisk49 hdisk162 hdisk50 hdisk163 hdisk51
hdisk164 hdisk52 hdisk213 hdisk101 hdisk214 hdisk102
hdisk215 hdisk103 hdisk216 hdisk104 hdisk217 hdisk105
hdisk218 hdisk106 hdisk219 hdisk107 hdisk220 hdisk108
hdisk185 hdisk73 hdisk186 hdisk74 hdisk187 hdisk75
hdisk188 hdisk76 hdisk189 hdisk77 hdisk190 hdisk78
hdisk191 hdisk79 hdisk192 hdisk80 hdisk241 hdisk129
hdisk242 hdisk130 hdisk243 hdisk131 hdisk244 hdisk132
hdisk245 hdisk133 hdisk246 hdisk134 hdisk247 hdisk135
```

```
hdisk248 hdisk136

-> cat forasu2
hdisk179 hdisk67 hdisk180 hdisk68 hdisk181 hdisk69
hdisk182 hdisk70 hdisk235 hdisk123 hdisk236 hdisk124
hdisk237 hdisk125 hdisk238 hdisk126 hdisk151 hdisk39
hdisk152 hdisk40 hdisk153 hdisk41 hdisk154 hdisk42
hdisk207 hdisk95 hdisk208 hdisk96 hdisk209 hdisk97
hdisk210 hdisk98 hdisk165 hdisk53 hdisk166 hdisk54
hdisk167 hdisk55 hdisk168 hdisk56 hdisk221 hdisk109
hdisk222 hdisk110 hdisk223 hdisk111 hdisk224 hdisk112
hdisk193 hdisk81 hdisk194 hdisk82 hdisk195 hdisk83
hdisk196 hdisk84 hdisk249 hdisk137 hdisk250 hdisk138
hdisk251 hdisk139 hdisk252 hdisk140

-> cat forasu3
hdisk183 hdisk71 hdisk184 hdisk72 hdisk239 hdisk127
hdisk240 hdisk128 hdisk155 hdisk43 hdisk156 hdisk44
hdisk211 hdisk99 hdisk212 hdisk100 hdisk169 hdisk57
hdisk170 hdisk58 hdisk225 hdisk113 hdisk226 hdisk114
hdisk197 hdisk85 hdisk198 hdisk86 hdisk253 hdisk141
hdisk254 hdisk142
```

9. Create three volume groups. The following script was used:

```
-> cat domkvg
mkvg -S -f -y ASU1VG -s '256' `cat forasu1`
mkvg -S -f -y ASU2VG -s '256' `cat forasu2`
mkvg -S -f -y ASU3VG -s '256' `cat forasu3`
```

10. Create 40 logical volumes for ASU using the following script:

```
-> cat domklv40
for i in 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 \
   21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
do
mklv -y ASU1lv${i} -t 'rawio'  -w 'n' -S '1M' ASU1VG 875520m `cat
forasu1`
mklv -y ASU2lv${i} -t 'rawio'  -w 'n' -S '1M' ASU2VG 875520m `cat
forasu2`
mklv -y ASU3lv${i} -t 'rawio'  -w 'n' -S '1M' ASU3VG 194560m `cat
forasu3`
done
```

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

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

```
javaparms="-Xms1536m -Xmx1536m -Xss128k -Xgcpolicy:optavgpause"
*
*ASU1
sd=asu1_1,lun=/dev/rASU1lv1,size=875520m
sd=asu1_2,lun=/dev/rASU1lv2,size=875520m
sd=asu1_3,lun=/dev/rASU1lv3,size=875520m
sd=asu1_4,lun=/dev/rASU1lv4,size=875520m
sd=asu1_5,lun=/dev/rASU1lv5,size=875520m
sd=asu1_6,lun=/dev/rASU1lv6,size=875520m
sd=asu1_7,lun=/dev/rASU1lv7,size=875520m
sd=asu1_8,lun=/dev/rASU1lv8,size=875520m
sd=asu1_9,lun=/dev/rASU1lv9,size=875520m
sd=asu1_10,lun=/dev/rASU1lv10,size=875520m
sd=asu1_11,lun=/dev/rASU1lv11,size=875520m
sd=asu1_12,lun=/dev/rASU1lv12,size=875520m
sd=asu1_13,lun=/dev/rASU1lv13,size=875520m
sd=asu1_14,lun=/dev/rASU1lv14,size=875520m
sd=asu1_15,lun=/dev/rASU1lv15,size=875520m
sd=asu1_16,lun=/dev/rASU1lv16,size=875520m
sd=asu1_17,lun=/dev/rASU1lv17,size=875520m
sd=asu1_18,lun=/dev/rASU1lv18,size=875520m
sd=asu1_19,lun=/dev/rASU1lv19,size=875520m
sd=asu1_20,lun=/dev/rASU1lv20,size=875520m
sd=asu1_21,lun=/dev/rASU1lv21,size=875520m
sd=asu1_22,lun=/dev/rASU1lv22,size=875520m
sd=asu1_23,lun=/dev/rASU1lv23,size=875520m
sd=asu1_24,lun=/dev/rASU1lv24,size=875520m
sd=asu1_25,lun=/dev/rASU1lv25,size=875520m
sd=asu1_26,lun=/dev/rASU1lv26,size=875520m
sd=asu1_27,lun=/dev/rASU1lv27,size=875520m
sd=asu1_28,lun=/dev/rASU1lv28,size=875520m
sd=asu1_29,lun=/dev/rASU1lv29,size=875520m
sd=asu1_30,lun=/dev/rASU1lv30,size=875520m
sd=asu1_31,lun=/dev/rASU1lv31,size=875520m
sd=asu1_32,lun=/dev/rASU1lv32,size=875520m
sd=asu1_33,lun=/dev/rASU1lv33,size=875520m
sd=asu1_34,lun=/dev/rASU1lv34,size=875520m
sd=asu1_35,lun=/dev/rASU1lv35,size=875520m
sd=asu1_36,lun=/dev/rASU1lv36,size=875520m
sd=asu1_37,lun=/dev/rASU1lv37,size=875520m
sd=asu1_38,lun=/dev/rASU1lv38,size=875520m
sd=asu1_39,lun=/dev/rASU1lv39,size=875520m
sd=asu1_40,lun=/dev/rASU1lv40,size=875520m
*ASU2
sd=asu2_1,lun=/dev/rASU2lv1,size=875520m
sd=asu2_2,lun=/dev/rASU2lv2,size=875520m
sd=asu2_3,lun=/dev/rASU2lv3,size=875520m
sd=asu2_4,lun=/dev/rASU2lv4,size=875520m
sd=asu2_5,lun=/dev/rASU2lv5,size=875520m
sd=asu2_6,lun=/dev/rASU2lv6,size=875520m
```

```
sd=asu2_7,lun=/dev/rASU2lv7,size=875520m
sd=asu2_8,lun=/dev/rASU2lv8,size=875520m
sd=asu2_9,lun=/dev/rASU2lv9,size=875520m
sd=asu2_10,lun=/dev/rASU2lv10,size=875520m
sd=asu2_11,lun=/dev/rASU2lv11,size=875520m
sd=asu2_12,lun=/dev/rASU2lv12,size=875520m
sd=asu2_13,lun=/dev/rASU2lv13,size=875520m
sd=asu2_14,lun=/dev/rASU2lv14,size=875520m
sd=asu2_15,lun=/dev/rASU2lv15,size=875520m
sd=asu2_16,lun=/dev/rASU2lv16,size=875520m
sd=asu2_17,lun=/dev/rASU2lv17,size=875520m
sd=asu2_18,lun=/dev/rASU2lv18,size=875520m
sd=asu2_19,lun=/dev/rASU2lv19,size=875520m
sd=asu2_20,lun=/dev/rASU2lv20,size=875520m
sd=asu2_21,lun=/dev/rASU2lv21,size=875520m
sd=asu2_22,lun=/dev/rASU2lv22,size=875520m
sd=asu2_23,lun=/dev/rASU2lv23,size=875520m
sd=asu2_24,lun=/dev/rASU2lv24,size=875520m
sd=asu2_25,lun=/dev/rASU2lv25,size=875520m
sd=asu2_26,lun=/dev/rASU2lv26,size=875520m
sd=asu2_27,lun=/dev/rASU2lv27,size=875520m
sd=asu2_28,lun=/dev/rASU2lv28,size=875520m
sd=asu2_29,lun=/dev/rASU2lv29,size=875520m
sd=asu2_30,lun=/dev/rASU2lv30,size=875520m
sd=asu2_31,lun=/dev/rASU2lv31,size=875520m
sd=asu2_32,lun=/dev/rASU2lv32,size=875520m
sd=asu2_33,lun=/dev/rASU2lv33,size=875520m
sd=asu2_34,lun=/dev/rASU2lv34,size=875520m
sd=asu2_35,lun=/dev/rASU2lv35,size=875520m
sd=asu2_36,lun=/dev/rASU2lv36,size=875520m
sd=asu2_37,lun=/dev/rASU2lv37,size=875520m
sd=asu2_38,lun=/dev/rASU2lv38,size=875520m
sd=asu2_39,lun=/dev/rASU2lv39,size=875520m
sd=asu2_40,lun=/dev/rASU2lv40,size=875520m
*ASU3
sd=asu3_1,lun=/dev/rASU3lv1,size=194560m
sd=asu3_2,lun=/dev/rASU3lv2,size=194560m
sd=asu3_3,lun=/dev/rASU3lv3,size=194560m
sd=asu3_4,lun=/dev/rASU3lv4,size=194560m
sd=asu3_5,lun=/dev/rASU3lv5,size=194560m
sd=asu3_6,lun=/dev/rASU3lv6,size=194560m
sd=asu3_7,lun=/dev/rASU3lv7,size=194560m
sd=asu3_8,lun=/dev/rASU3lv8,size=194560m
sd=asu3_9,lun=/dev/rASU3lv9,size=194560m
sd=asu3_10,lun=/dev/rASU3lv10,size=194560m
sd=asu3_11,lun=/dev/rASU3lv11,size=194560m
sd=asu3_12,lun=/dev/rASU3lv12,size=194560m
sd=asu3_13,lun=/dev/rASU3lv13,size=194560m
sd=asu3_14,lun=/dev/rASU3lv14,size=194560m
sd=asu3_15,lun=/dev/rASU3lv15,size=194560m
sd=asu3_16,lun=/dev/rASU3lv16,size=194560m
sd=asu3_17,lun=/dev/rASU3lv17,size=194560m
sd=asu3_18,lun=/dev/rASU3lv18,size=194560m
sd=asu3_19,lun=/dev/rASU3lv19,size=194560m
sd=asu3_20,lun=/dev/rASU3lv20,size=194560m
sd=asu3_21,lun=/dev/rASU3lv21,size=194560m
```

```
sd=asu3_22,lun=/dev/rASU3lv22,size=194560m
sd=asu3_23,lun=/dev/rASU3lv23,size=194560m
sd=asu3_24,lun=/dev/rASU3lv24,size=194560m
sd=asu3_25,lun=/dev/rASU3lv25,size=194560m
sd=asu3_26,lun=/dev/rASU3lv26,size=194560m
sd=asu3_27,lun=/dev/rASU3lv27,size=194560m
sd=asu3_28,lun=/dev/rASU3lv28,size=194560m
sd=asu3_29,lun=/dev/rASU3lv29,size=194560m
sd=asu3_30,lun=/dev/rASU3lv30,size=194560m
sd=asu3_31,lun=/dev/rASU3lv31,size=194560m
sd=asu3_32,lun=/dev/rASU3lv32,size=194560m
sd=asu3_33,lun=/dev/rASU3lv33,size=194560m
sd=asu3_34,lun=/dev/rASU3lv34,size=194560m
sd=asu3_35,lun=/dev/rASU3lv35,size=194560m
sd=asu3_36,lun=/dev/rASU3lv36,size=194560m
sd=asu3_37,lun=/dev/rASU3lv37,size=194560m
sd=asu3_38,lun=/dev/rASU3lv38,size=194560m
sd=asu3_39,lun=/dev/rASU3lv39,size=194560m
sd=asu3_40,lun=/dev/rASU3lv40,size=194560m
```

# APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

## Primary Metrics Test, Repeatability Test, and Persistence Test Run 1

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

```
#  input target bsu and a runidentifier
if [ $# -ne 2 ]
then
    echo "Error in $0 - Invalid Argument Count"
    echo "Syntax: $0 target(b) RunID  "
    exit
fi
bsu=$1
RunID=$2


#  do exports for java and libpath
export LIBPATH=/SPC1_run2/aix
export IBM_JAVADUMP_OUTOFMEMORY=false
export IBM_HEAPDUMP_OUTOFMEMORY=false

rundir=/usr/results/$RunID.$bsu
# Create Output Directory
mkdir -p $rundir

#
# Run metric test
#
java -Xms1536m -Xmx1536m -Xss512k -Xgcpolicy:optavgpause metrics -b $bsu
#
#
#
# Repeatability Tests
#
java -Xmx1536m -Xmx1536m -Xss512k -Xgcpolicy:optavgpause repeat1 -b $bsu

java -Xmx1536m -Xmx1536m -Xss512k -Xgcpolicy:optavgpause repeat2 -b $bsu
#
# First Persistence Test
#
java -Xmx1536m -Xmx1536m -Xss96k -Xgcpolicy:optavgpause persist1 -b $bsu

#  Need to power off system before the next step is executed by itself
```

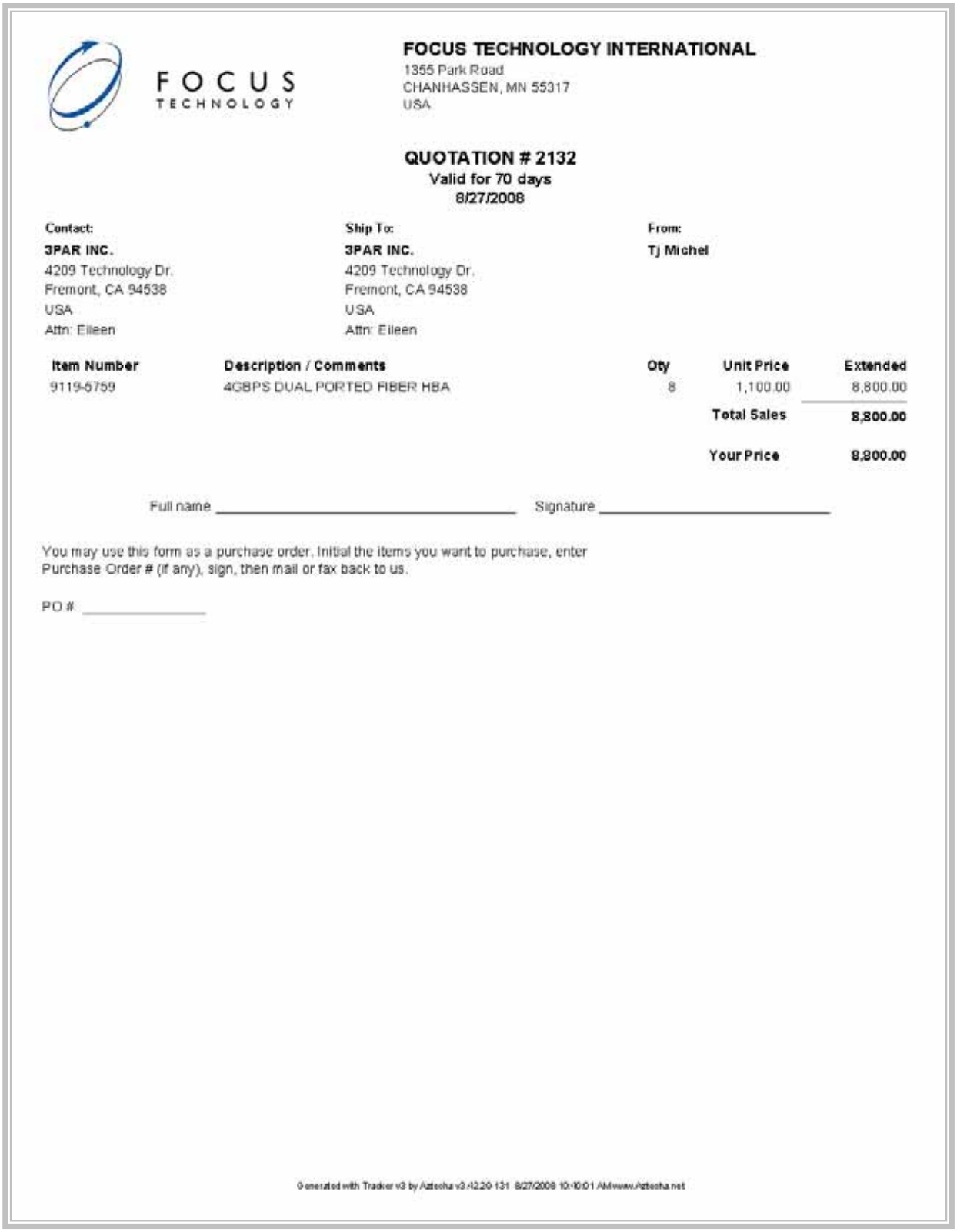
## Persistence Test Run 2

The following script was used to execute Persistence Test Run 2.

```
#  input target bsu and a runidentifier
if [ $# -ne 2 ]
```

```
then
    echo "Error in $0 - Invalid Argument Count"
    echo "Syntax: $0 target(b) RunID  "
    exit
fi
bsu=$1
RunID=$2


#  do exports for java and libpath
export LIBPATH=/SPC1_run2/aix
export IBM_JAVADUMP_OUTOFMEMORY=false
export IBM_HEAPDUMP_OUTOFMEMORY=false

rundir=/usr/results/$RunID.$bsu
# Output Directory created during part1

# this is after shutdown and restart of InServ

#
# Second Persistence Test
#

#  do exports for java and libpath
export LIBPATH=/SPC1_run2/aix
export IBM_JAVADUMP_OUTOFMEMORY=false
export IBM_HEAPDUMP_OUTOFMEMORY=false

java -Xmx1536m -Xmx1536m -Xss96k -Xgcpolicy:optavgpause persist2

# Save off results and key files


mv metrics $rundir
mv repeatability1 $rundir
mv repeatability2 $rundir
mv persistence1 $rundir
mv persistence2 $rundir

mv SPCOut $rundir
cp SPC1.cfg $rundir
cp SPC1.parm $rundir
```

# APPENDIX F: THIRD-PARTY QUOTATION



FOCUS TECHNOLOGY

**FOCUS TECHNOLOGY INTERNATIONAL**
1355 Park Road
CHANHASSEN, MN 55317
USA

**QUOTATION # 2132**
Valid for 70 days
8/27/2008

| Contact: | Ship To: | From: |
|---|---|---|
| **3PAR INC.** | **3PAR INC.** | **Tj Michel** |
| 4209 Technology Dr. | 4209 Technology Dr. | |
| Fremont, CA 94538 | Fremont, CA 94538 | |
| USA | USA | |
| Attn: Eileen | Attn: Eileen | |

| Item Number | Description / Comments | Qty | Unit Price | Extended |
|---|---|---|---|---|
| 9119-5759 | 4GBPS DUAL PORTED FIBER HBA | 8 | 1,100.00 | 8,800.00 |
| | | | **Total Sales** | **8,800.00** |
| | | | **Your Price** | **8,800.00** |

Full name _____ Signature _____

You may use this form as a purchase order. Initial the items you want to purchase, enter Purchase Order # (if any), sign, then mail or fax back to us.

PO # _____

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