SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

DATACORE SOFTWARE CORPORATION
DATACORE SANSYMPHONY-V 10.0

SPC-1 V1.14

Submitted for Review: November 30, 2015
Submission Identifier: A00164

First Edition – November 2015

Trademarks

Table of Contents

AUDIT CERTIFICATION

Ben Treiber
DataCore Software Corporation
Worldwide Headquarters
Corporate Park
6300 NW 5th Way
Fort Lauderdale, FL 33309

November 30, 2015

The SPC Benchmark 1™ Reported Data listed below for the **DataCore SANsymphony-V 10.0** was produced in compliance with the SPC Benchmark 1™ v1.14 Onsite Audit requirements.

SPC Benchmark 1™ v1.14 Reported Data	
Tested Storage Product (TSP) Name: DataCore SANsymphony-V 10.0	
Metric	**Reported Result**
SPC-1 IOPS™	459,290.87
SPC-1 Price-Performance	$0.08/SPC-1 IOPS™
Total ASU Capacity	2,924.873 GB
Data Protection Level	Protected 1 *(Mirroring)*
Total Price (including three-year maintenance)	$38,400.29
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

The following SPC Benchmark 1™ Onsite Audit requirements were reviewed and found compliant with 1.14 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 DataCore Software Corporation:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.

Storage Performance Council
643 Bair Island Road, Suite 103
Redwood City, CA 94062
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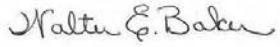
AUDIT CERTIFICATION *(CONT.)*

- The total Application Storage Unit (ASU) Capacity was filled with random data, using an auditor approved tool, prior to execution of the SPC-1 Tests.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Physical verification of the components to match the above diagram.
- 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 DataCore Software Corporation:
  - ✓ 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, 5, and 11 of the SPC-1 Benchmark Specification.
- The Test Results Files and resultant Summary Results Files received from DataCore Software Corporation 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 was no difference between the Tested Storage Configuration (TSC) 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
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650.556.9384

LETTER OF GOOD FAITH

DataCore™
SOFTWARE

Date: November 9, 2015

From: Roni Putra
DataCore Software Corporation
Worldwide Headquarters
Corporate Park
6300 NW 5th Way
Ft. Lauderdale, FL 33309
Phone: (954)-377-6000
FAX: (954) 938-7953

To: Walter E. Baker
SPC Auditor
Storage Performance Council (SPC)
643 Bair Island Road, Suite 103
Redwood City, CA 94063-2755
Phone: 650.556.9380 x111
FAX: 650.556.9385

Subject: SPC-1 Letter of Good Faith for SANsymphony-V 10.0

DataCore Software Corporation 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 V1.14 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:

September 19th, 2015

Roni Putra, Vice President and CTO
DataCore Software Corporation

Date of Signature

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EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	DataCore Software Corporation – http://www.datacore.com Ben Treiber – ben.treiber@datacore.com Worldwide Headquarters Corporate Park 6300 NW 5th Way Ft. Lauderdale, FL 33309 Phone: (954) 377-6000 FAX: (954) 938-7953
Test Sponsor Alternate Contact	DataCore Software Corporation – http://www.datacore.com Roni Putra – roni.putra@datacore.com Worldwide Headquarters Corporate Park 6300 NW 5th Way Ft. Lauderdale, FL 33309 Phone: (954) 377-6000 FAX: (954) 938-7953
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.14
SPC-1 Workload Generator revision number	V2.3.0
Date Results were first used publicly	November 30, 2015
Date the FDR was submitted to the SPC	November 30, 2015
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	November 30, 2015

Tested Storage Product (TSP) Description

SANsymphony-V provides a flexible platform that has been proven in enterprise environments. Because it is designed from the outset as parallel storage software, SANsymphony-V is uniquely able to scale to its underlying hardware environment and to do so in both conventional storage topologies and in more recent converged environments.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: DataCore SANsymphony-V 10.0	
Metric	**Reported Result**
SPC-1 IOPS™	459,290.87
SPC-1 Price-Performance™	$0.08/SPC-1 IOPS™
Total ASU Capacity	2,924.873 GB
Data Protection Level	Protected 1 *(Mirroring)*
Total Price	$38.400.29
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

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

SPC-1 Price-Performance™ is the ratio of **Total Price** to **SPC-1 IOPS™**.

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

A **Data Protection Level** of **Protected 1** using ***Mirroring*** configures two or more identical copies of user data.

> ***Protected 1:*** *The single point of failure of any* ***storage device*** *in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.*

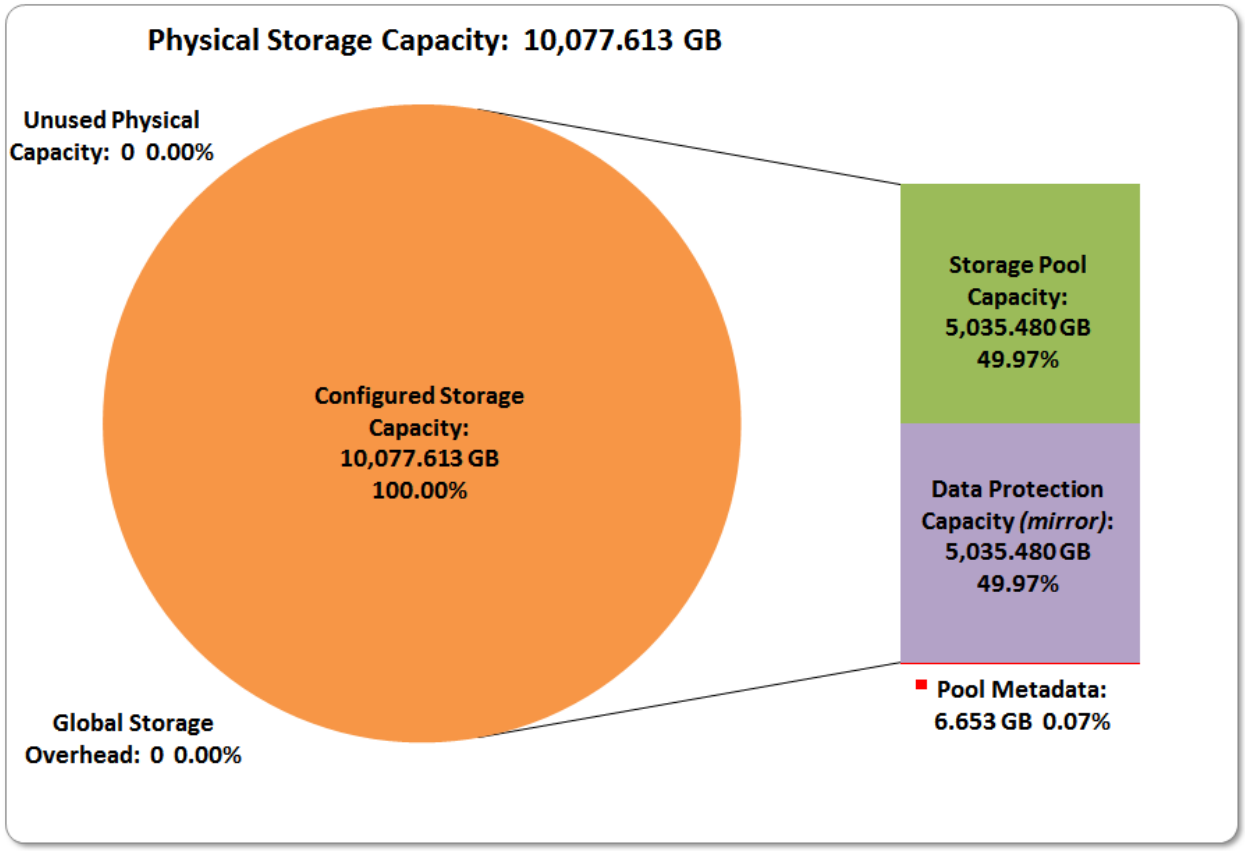
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 16.

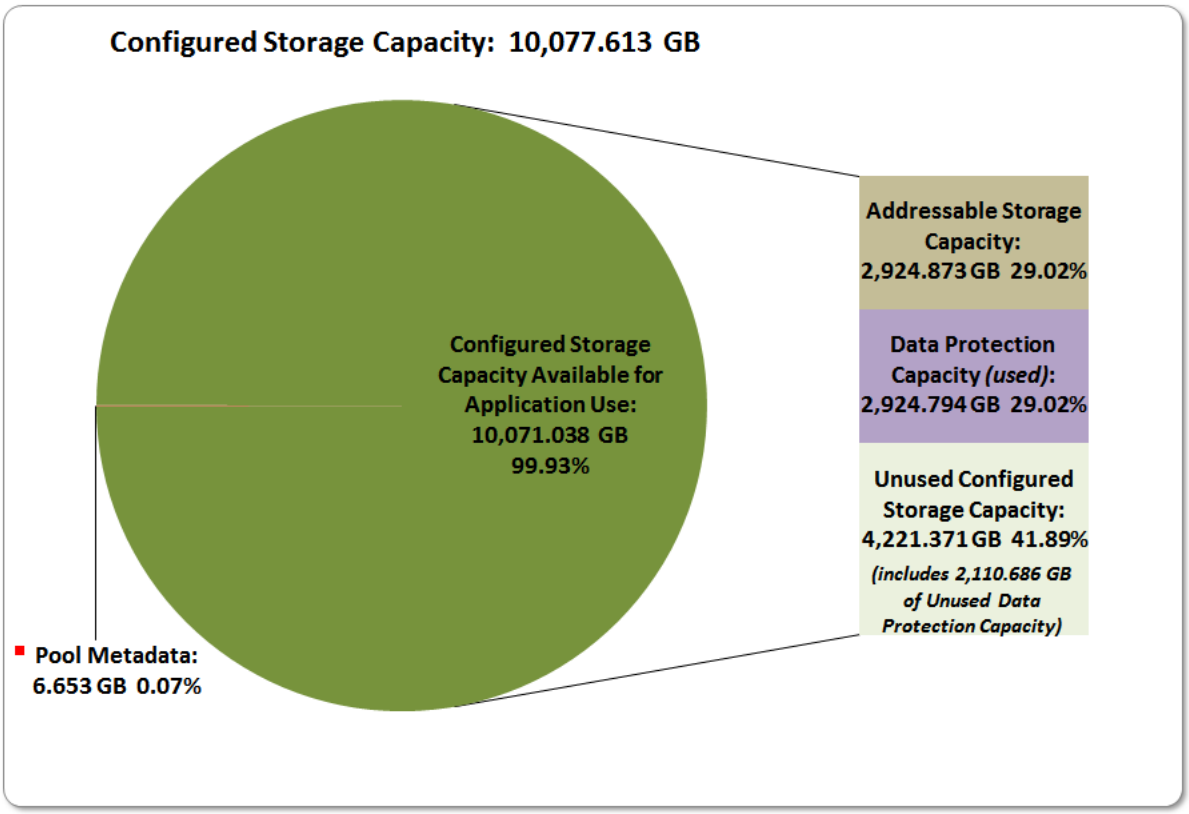
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

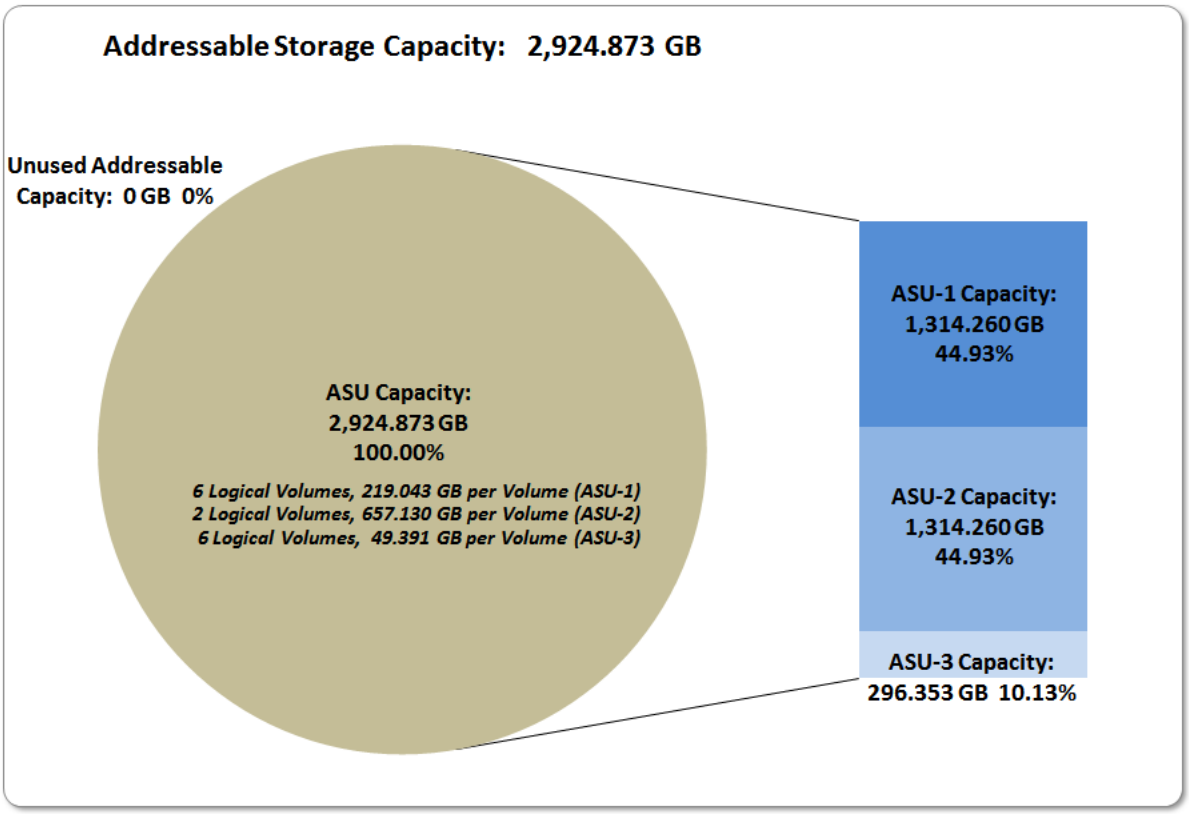
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

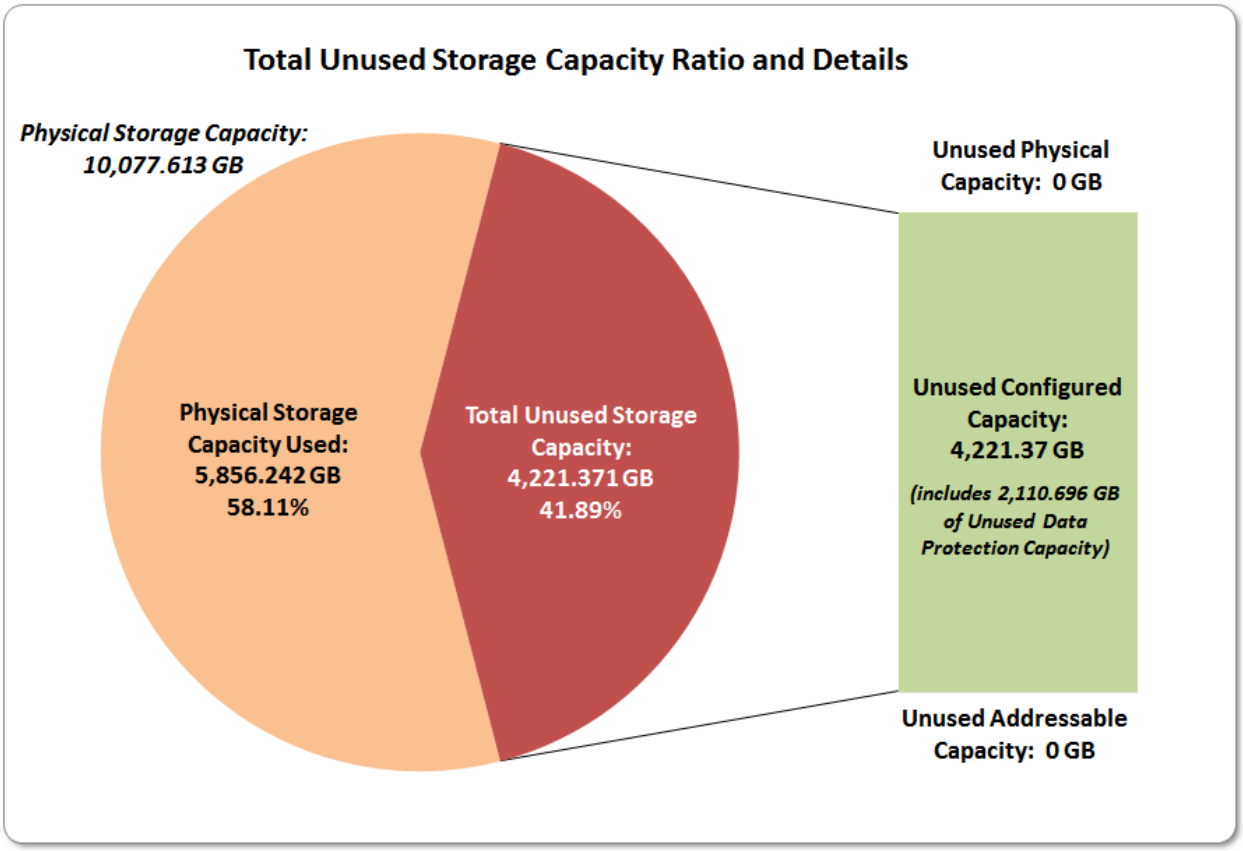
Storage Capacities, Relationships, and Utilization

The following four charts and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.




Configured Storage Capacity: 10,077.613 GB
Configured Storage Capacity Available for Application Use: 10,071.038 GB 99.93%
Pool Metadata: 6.653 GB 0.07%
Addressable Storage Capacity: 2,924.873 GB 29.02%
Data Protection Capacity (used): 2,924.794 GB 29.02%
Unused Configured Storage Capacity: 4,221.371 GB 41.89%
(includes 2,110.686 GB of Unused Data Protection Capacity)


Addressable Storage Capacity: 2,924.873 GB
Unused Addressable Capacity: 0 GB 0%
ASU Capacity: 2,924.873 GB 100.00%
6 Logical Volumes, 219.043 GB per Volume (ASU-1)
2 Logical Volumes, 657.130 GB per Volume (ASU-2)
6 Logical Volumes, 49.391 GB per Volume (ASU-3)
ASU-1 Capacity: 1,314.260 GB 44.93%
ASU-2 Capacity: 1,314.260 GB 44.93%
ASU-3 Capacity: 296.353 GB 10.13%



SPC-1 Storage Capacity Utilization	
Application Utilization	29.02%
Protected Application Utilization	58.05%
Unused Storage Ratio	41.89%

Application Utilization: Total ASU Capacity *(2,924.873 GB)* divided by Physical Storage Capacity *(10,077.613 GB)*.

Protected Application Utilization: (Total ASU Capacity *(2,924.873 GB)* plus total Data Protection Capacity *(5,035.480 GB)* minus unused Data Protection Capacity *(2,110.686 GB)*) divided by Physical Storage Capacity *(10,077.613 GB)*.

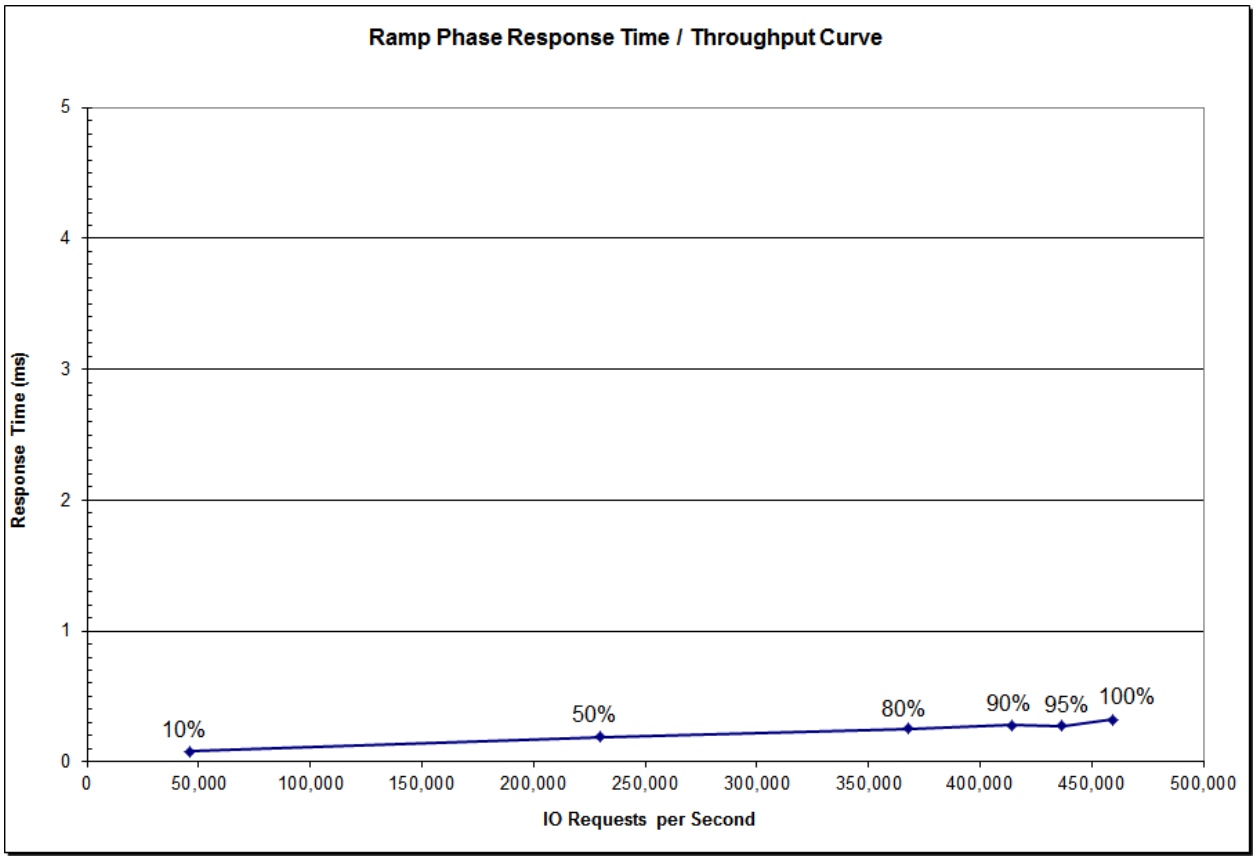
Unused Storage Ratio: Total Unused Capacity *(4,221.371 GB)* divided by Physical Storage Capacity *(10,077.613 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 25-26.

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	46,003.40	230,023.79	367,984.28	413,959.19	436,570.42	459,290.87
Average Response Time (ms):						
All ASUs	0.08	0.19	0.25	0.28	0.27	0.32
ASU-1	0.08	0.20	0.26	0.29	0.29	0.35
ASU-2	0.14	0.38	0.48	0.48	0.46	0.49
ASU-3	0.04	0.09	0.14	0.17	0.17	0.20
Reads	0.14	0.37	0.47	0.51	0.49	0.58
Writes	0.04	0.08	0.11	0.13	0.13	0.16

Priced Storage Configuration Pricing

Part ID	Description	Qty	List Price	Total List Price	Curvature Price	Total Price
5462AC1	IBM SYSTEM X3650 M5 2.5 SFF 8 BAY HOT SWAP	1	$ 3,150.00	$ 3,150.00	$ 2,205.00	$ 2,205.00
E5-2695V3	INTEL XEON PROCESSOR E5-2695 V3 (2.30 GHZ/14- CORE/35MB/2133MHZ)	2	$ 3,499.00	$ 6,998.00	$ 2,449.30	$ 4,898.60
HEATSINK	LENOVO HEATSINK	2	$ 150.00	$ 300.00	$ 105.00	$ 210.00
SYSTEM FAN	LENOVO SYSTEM FAN	6	$ 95.00	$ 570.00	$ 66.50	$ 399.00
46W0796	IBM 16GB TRUDDR4 MEMORY 2RX4 1.2V PC4-17000 CL15 2133MHZ LP RDIMM	2	$ 399.00	$ 798.00	$ 279.30	$ 558.60
46W0800	32GB (1X32GB), PC4-17000, DDR4, 1.2V, LRDIMM	16	$ 999.00	$ 15,984.00	$ 699.30	$ 11,188.80
MBF2300RC	300GB 10K SAS 2.5" 6G HDD	1	$ 269.00	$ 269.00	$ 188.30	$ 188.30
MZ-75E500B/AM	SAMSUNG 850 EVO 500 GB 2.5" INTERNAL SOLID STATE DRIVE - SATA	1	$ 349.00	$ 349.00	$ 244.30	$ 244.30
HUC156030CSS200	HDD, 300GB, 12G, SAS, 15K, SFF, WESTERN DIGITAL	8	$ 289.75	$ 2,318.00	$ 202.83	$ 1,622.64
46C9114	SERVER RAID M1215 SAS/SATA CONTROLLER	2	$ 225.00	$ 450.00	$ 157.50	$ 315.00
HSX-EWR-100-008	SANSYMPHONY-V VIRTUAL SAN HS8 LICENSE F/ 1 SERVER W/ UP TO 8 TBS	1	$ 4,000.00	$ 4,000.00	$ 3,600.00	$ 3,600.00
4XI0E51561	WINDOWS SVR 2012 R2 STANDARD ROK 2 CPUS/2 VMS (SEE NOTE 2)	1	$ 700.00	$ 700.00	$ 630.00	$ 630.00
HSX-EWR-TGD-008	3YR SUP SANSYMPHONY-V HS8 VIRTUAL SAN LICS FOR 1 SERVER	1	$ 2,000.00	$ 2,000.00	$ 1,800.00	$ 1,800.00
00FK936	LENOVO SYSTEM X 900W HIGH EFFICIENCY PLATINUM AC POWER SUPPLY 900 W - 120 V AC, 230 V AC	2	$ 399.00	$ 798.00	$ 279.30	$ 558.60
00NR851	LENOVO SERVICE/SUPPORT - 3 YEAR EXTENDED SERVICE SERVICE - 24 X 7 X 4 HOUR - ON-SITE - MAINTENANCE PARTS & LABOR - PHYSICAL SERVICE (SEE NOTE 3)	1	$ 810.00	$ 810.00	$ 688.50	$ 688.50
00LW731	LENOVO REMOTE TECHNICAL SUPPORT 3 YEAR - 24 X 7 X 2 HOUR TECHNICAL - ELECTRONIC SERVICE (SEE NOTE 3)	1	$ 1,375.00	$ 1,375.00	$ 1,168.75	$ 1,168.75
00FK661	LENOVO SYSTEM X3650 M5 PLUS 8X 2.5" HS HDD ASSEMBLY KIT WITH EXPANDER	1	$ 659.00	$ 659.00	$ 461.30	$ 461.30
00FK676	LENOVO SYSTEM X3650 M5 PLUS 8X2.5' HDD ASSEMBLY KIT	1	$ 249.00	$ 249.00	$ 174.30	$ 174.30
00FK658	LENOVO SYSTEM X3650 M5 REAR 2X2.5' HDD KIT	1	$ 379.00	$ 379.00	$ 265.30	$ 265.30
MZ-7KM480E	SSD, 480GB, 6GB, SATA, SFF, SAMSUNG	16	$ 459.00	$ 7,344.00	$ 321.30	$ 5,140.80
00E7600 L38552	2.5-INCH SFF DRIVE TRAY CADDY FOR IBM/LENOVO X3650 M5 (SEE NOTE 4)	25	$ 119.00	$ 2,975.00	$ 83.30	$ 2,082.50
			Net List Price:	$ 52,475.00	Net Cost:	$ 38,400.29
					Tax:	$ -
					Freight:	$ -
					Grand Total:	$ 38,400.29

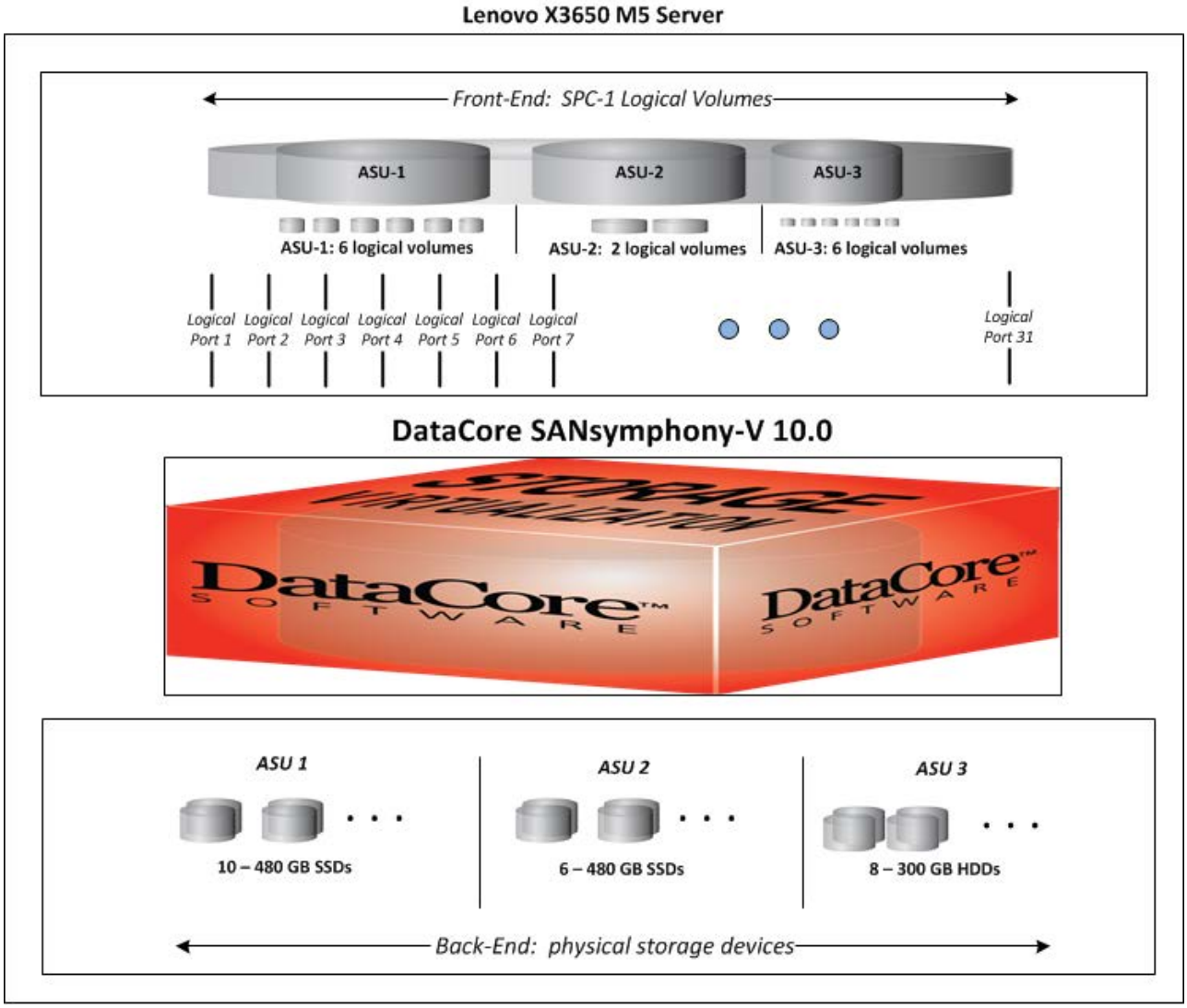
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- Acknowledgement of new and existing problems within four (4) hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Price Storage Configuration that can be remedied by the repair or replacement of a Priced Storage Configuration component.

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.

Priced Storage Configuration Diagram



Key	
Front-End: SPC-1 Logical Volumes	**ASU-1:** 6 logical volumes *(ASU_1_1 - ASU_1_6)*, 219.043 GB per logical volume **ASU-2:** 2 logical volumes *(ASU_2_1 - ASU_2_2)*, 657.130 GB per logical volume **ASU-3:** 6 logical volumes *(ASU_3_1 - ASU_3_6)*, 49.392 GB per logical volume
Back-End: physical storage devices	**Pool type ASU1:** 1 pool *(4MB_ASU1)*, 5 mirrored SSDs *(10 SSDs total)* **Pool type ASU2:** 1 pool *(4MB_ASU2)*, 3 mirrored SSDs *(6 SSDs total)* **Pool type ASU3:** 4 pools *(32MB_ASU3.1 - 32MB_ASU3.4)*, 1 mirrored HDD per pool *(8 HDDs total)*

Priced Storage Configuration Components

Priced Storage Configuration
DataCore SANsymphony-V 10.0
1 – Lenovo X3650 M5 Server, with: 2 – Intel® Xeon® 2.30 GHz E5-2695 V3 processors each with 14 cores, 35 MB Intel Smart Cache 544 GB main memory *(418,652 MiB configured for SANsymphony-V 10.0)* Windows 2008 R2 Enterprise Server w/SP1 PCIe
1 – Server RAID M1215 SAS/SATA internal controller
2 – Server RAID M1215 SAS/SATA Controllers *(external)*
1 – 300 GB 10K SAS 2.5" 6G HDD *(system HDD)* *(connected to the internal controller)*
1 – 500 GB 2.5" SSD *(page/swap) (Samsung 850 EVO MZ-75E500),* *(connected to the internal controller)*
16 – 480 GB, 6 Gb SATA SFF SSDs *(Samsung SM863 MZ-7KM480E)* *(connected to external controller 1)*
8 – 300 GB 12Gb 15K SAS SFF HDDs *(Utrastar C15K600)* *(connected to external controller 2)*

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 9.4.3.4.1

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

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 21 *(Benchmark Configuration/Tested Storage Configuration Diagram)*.

Storage Network Configuration

Clause 9.4.3.4.1

…

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 9.4.3.4.2.*

Clause 9.4.3.4.2

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration diagram described in Clause 9.4.3.4.1 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 Tested Storage Configuration (TSC) was configured with direct-attached storage.

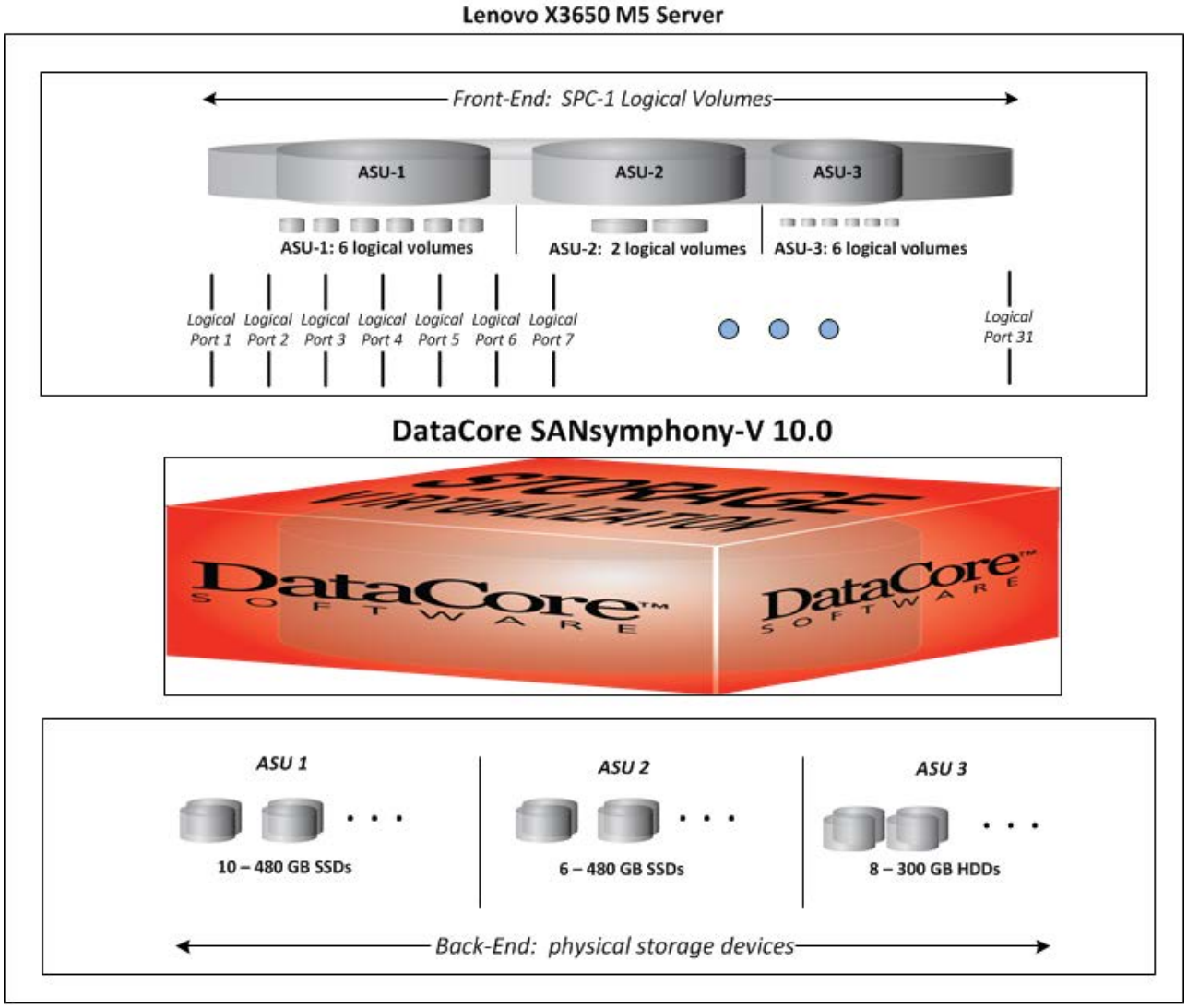
Host System(s) and Tested Storage Configuration (TSC) Table of Components

Clause 9.4.3.4.3

The FDR will contain a table that lists the major components of each Host System and the Tested Storage Configuration (TSC).

The Host System(s) and TSC table of components may be found on page 22 *(Host System and Tested Storage Configuration Components)*.

Benchmark Configuration/Tested Storage Configuration Diagram



Key	
Front-End: SPC-1 Logical Volumes	**ASU-1:** 6 logical volumes *(ASU_1_1 - ASU_1_6)*, 219.043 GB per logical volume **ASU-2:** 2 logical volumes *(ASU_2_1 - ASU_2_2)*, 657.130 GB per logical volume **ASU-3:** 6 logical volumes *(ASU_3_1 - ASU_3_6)*, 49.392 GB per logical volume
Back-End: physical storage devices	**Pool type ASU1:** 1 pool *(4MB_ASU1)*, 5 mirrored SSDs *(10 SSDs total)* **Pool type ASU2:** 1 pool *(4MB_ASU2)*, 3 mirrored SSDs *(6 SSDs total)* **Pool type ASU3:** 4 pools *(32MB_ASU3.1 - 32MB_ASU3.4)*, 1 mirrored HDD per pool *(8 HDDs total)*

Host System and Tested Storage Configuration Components

Priced Storage Configuration
DataCore SANsymphony-V 10.0
1 – Lenovo X3650 M5 Server, with: 2 – Intel® Xeon® 2.30 GHz E5-2695 V3 processors each with 14 cores, 35 MB Intel Smart Cache 544 GB main memory *(418,652 MiB configured for SANsymphony-V 10.0)* Windows 2008 R2 Enterprise Server w/SP1 PCIe
1 – Server RAID M1215 SAS/SATA internal controller
2 – Server RAID M1215 SAS/SATA Controllers *(external)*
1 – 300 GB 10K SAS 2.5" 6G HDD *(system HDD)* *(connected to the internal controller)*
1 – 500 GB 2.5" SSD *(page/swap) (Samsung 850 EVO MZ-75E500),* *(connected to the internal controller)*
16 – 480 GB, 6 Gb SATA SFF SSDs *(Samsung SM863 MZ-7KM480E)* *(connected to external controller 1)*
8 – 300 GB 12Gb 15K SAS SFF HDDs *(Utrastar C15K600)* *(connected to external controller 2)*

Customer Tunable Parameters and Options

Clause 9.4.3.5.1

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 66 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

Tested Storage Configuration (TSC) Description

Clause 9.4.3.5.2

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

SPC-1 Workload Generator Storage Configuration

Clause 9.4.3.5.3

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 83.

ASU Pre-Fill

Clause 5.3.3

Each of the three SPC-1 ASUs (ASU-1, ASU-2 and ASU-3) is required to be completely filled with specified content prior to the execution of audited SPC-1 Tests. The content is required to consist of random data pattern such as that produced by an SPC recommended tool.

The configuration file used to complete the required ASU pre-fill appears in Appendix D: SPC-1 Workload Generator Storage Commands and Parameters on page 83.

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 62 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.4.3.6.1

Two tables and four charts documenting the storage capacities and relationships of the SPC-1 Storage Hierarchy (Clause 2.1) shall be included in the FDR. … The capacity value in each chart may be listed as an integer value, for readability, rather than the decimal value listed in the table below.

SPC-1 Storage Capacities

The Physical Storage Capacity consisted of 10,077.613 GB distributed over 16 solid state devices (SSDs), each with a formatted capacity of 480.101 GB and 8 disk drives (HDDs), each with a formatted capacity 299.499 GB. There was 0 GB (0%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 0 GB (0%) of the Physical Storage Capacity. There was 4,221.371 GB (41.89%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100% of the Addressable Storage Capacity resulting in 0.00 GB (0.00%) of Unused Storage within the Addressable Storage Capacity. The Data Protection *(Mirroring)* capacity was 5,035.480 GB of which 2,924.873 GB was utilized. The total Unused Storage capacity was 4221.371 GB.

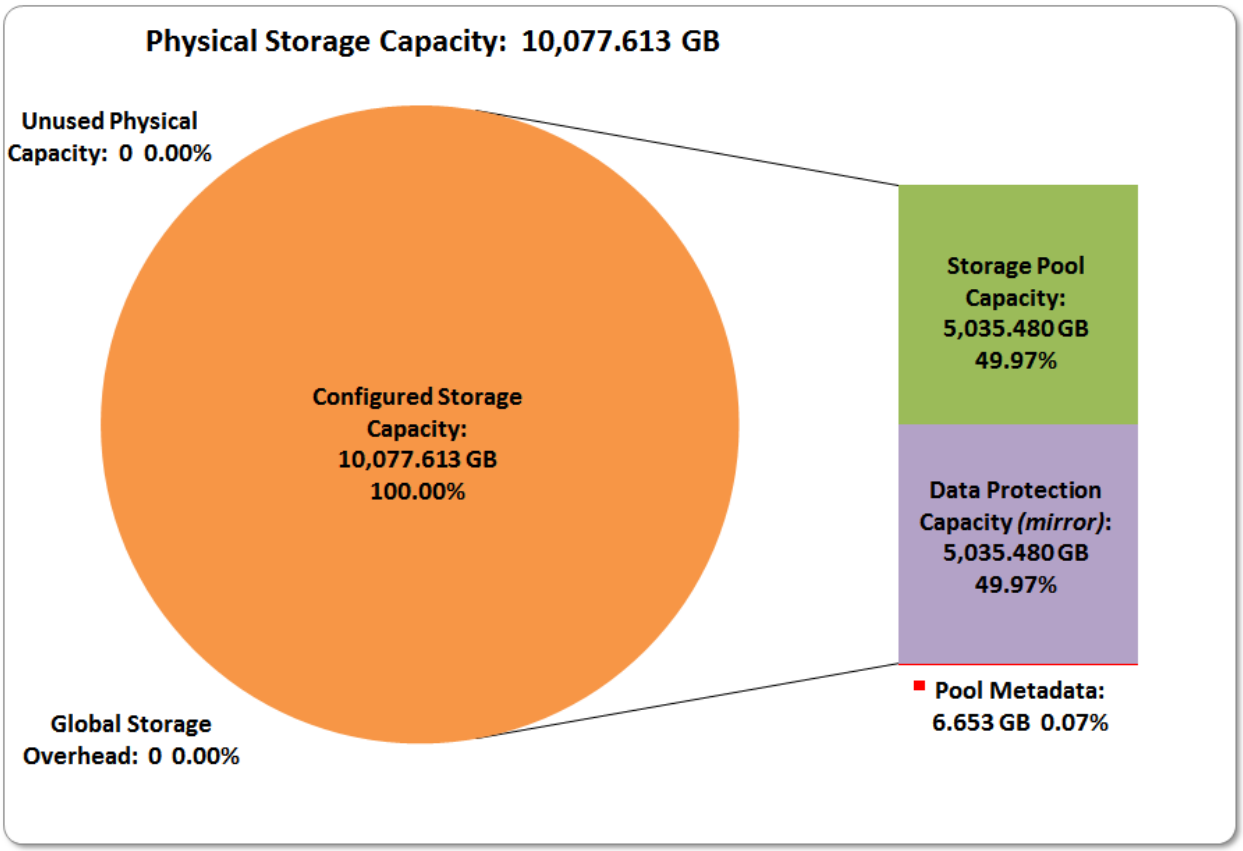
Note: The configured Storage Devices may include additional storage capacity reserved for system overhead, which is not accessible for application use. That storage capacity may not be included in the value presented for Physical Storage Capacity.

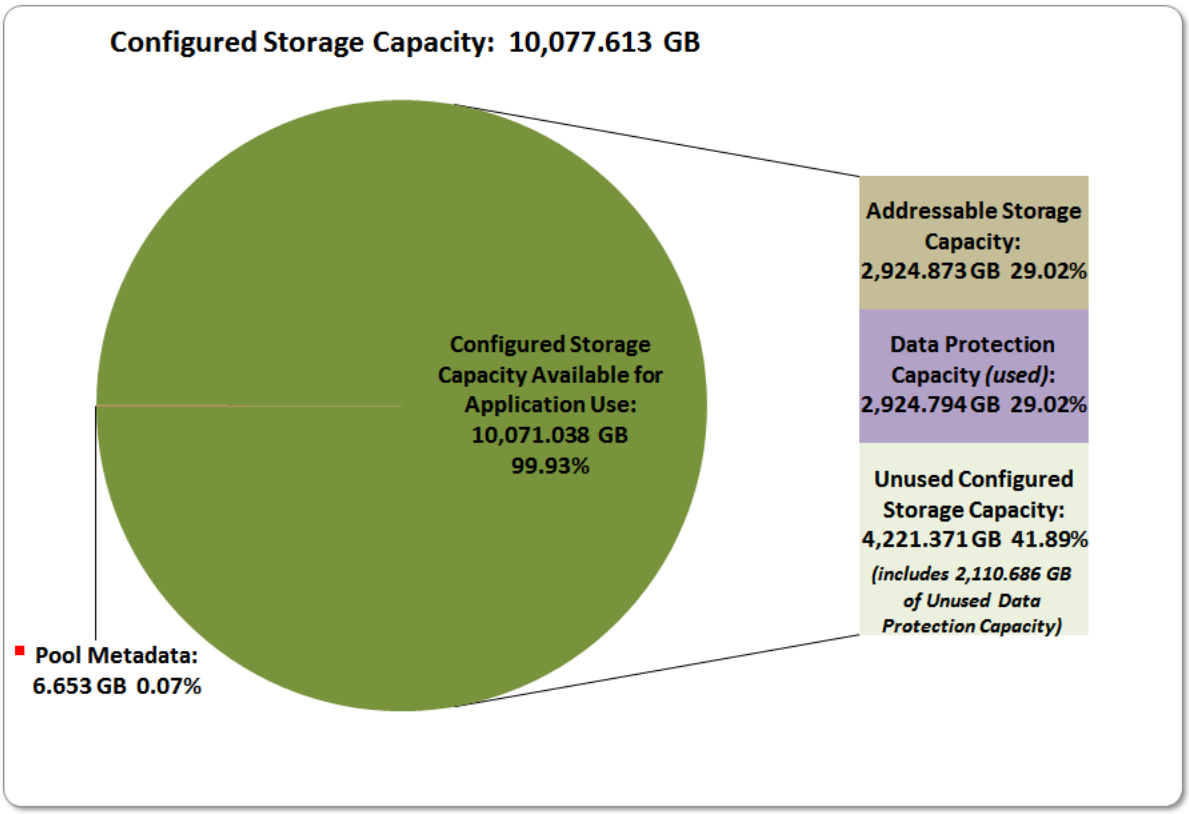
SPC-1 Storage Capacities		
Storage Hierarchy Component	**Units**	**Capacity**
Total ASU Capacity	Gigabytes (GB)	2,924.873
Addressable Storage Capacity	Gigabytes (GB)	2,924.873
Configured Storage Capacity	Gigabytes (GB)	10,077.613
Physical Storage Capacity	Gigabytes (GB)	10,077.613
Data Protection *(Mirroring)*	Gigabytes (GB)	5,035.480
Required Storage *(metadata)*	Gigabytes (GB)	6.653
Global Storage Overhead	Gigabytes (GB)	0.000
Total Unused Storage	Gigabytes (GB)	4,221.371

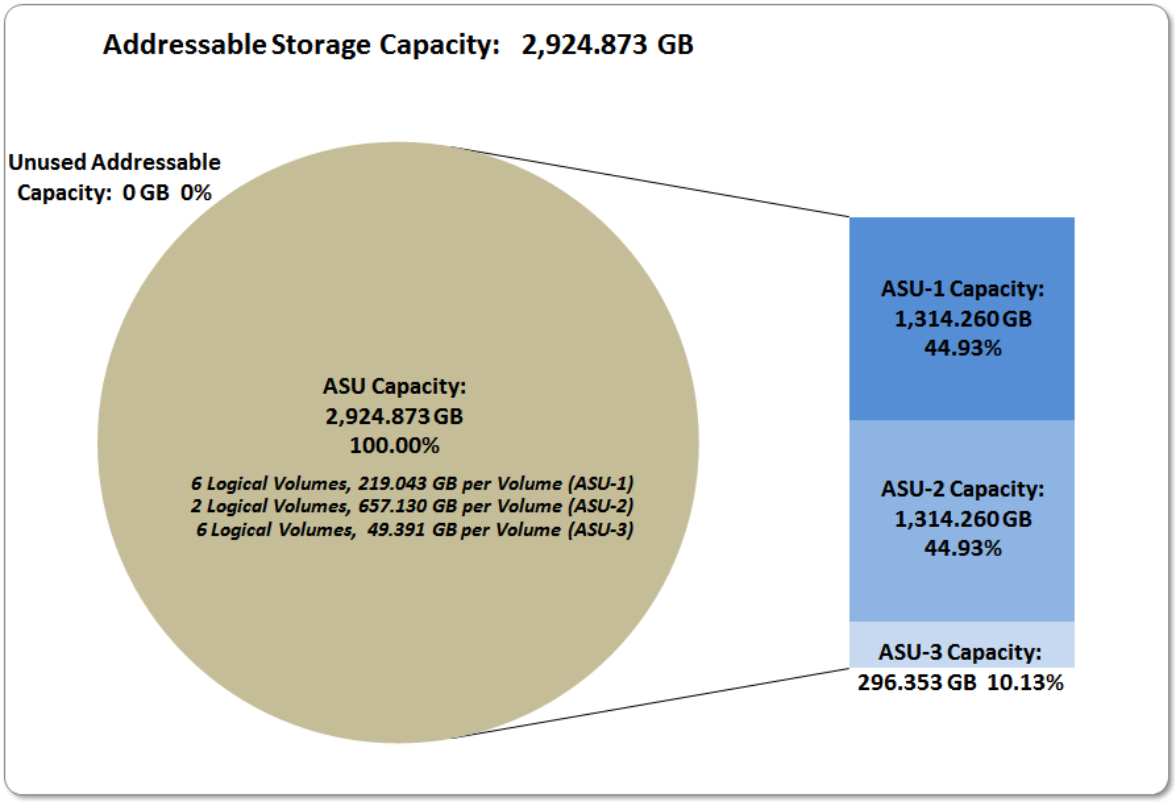
SPC-1 Storage Hierarchy Ratios

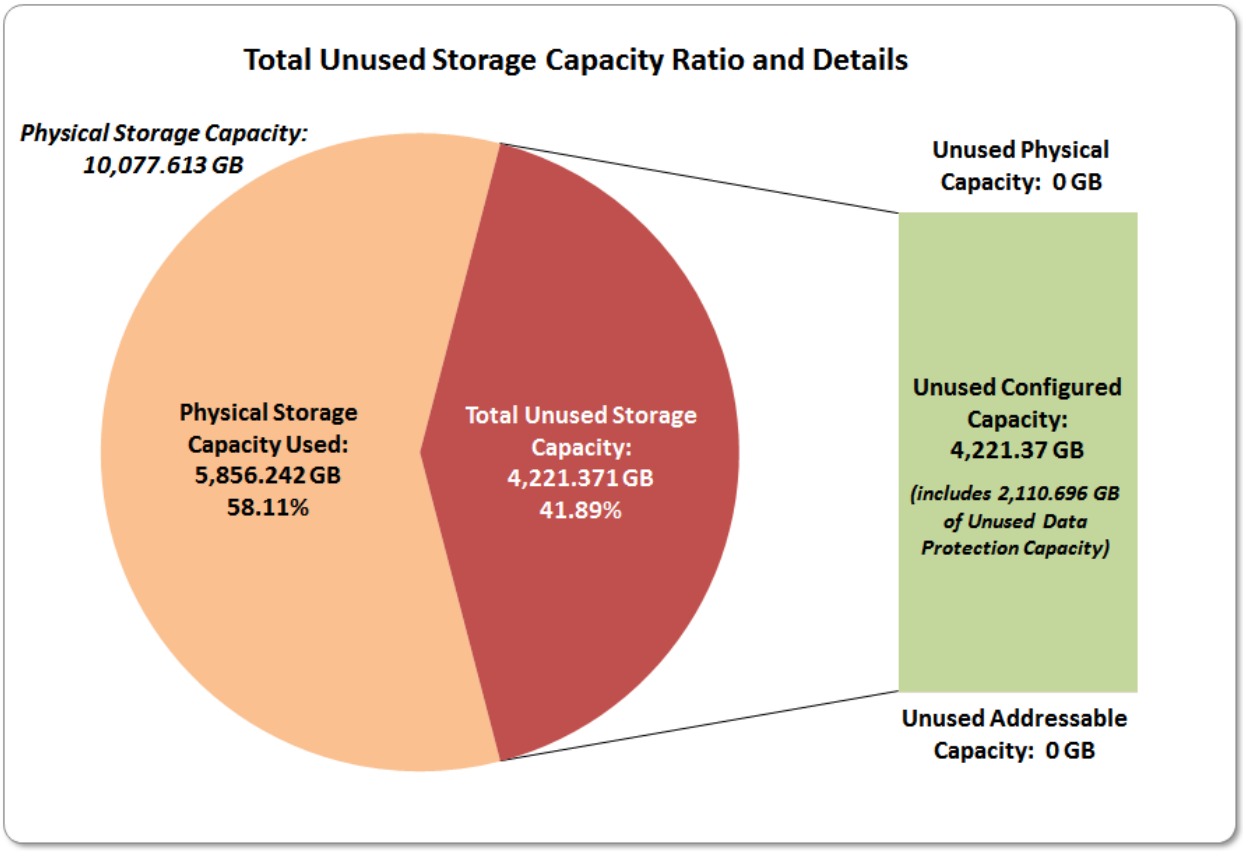
	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	29.02%	29.02%
Required for Data Protection *(Mirroring)*		49.97%	49.97%
Addressable Storage Capacity		29.02%	29.02%
Required Storage *(metadata)*		0.07%	0.07%
Configured Storage Capacity			100.00%
Global Storage Overhead			0.00%
Unused Storage:			
Addressable	0.00%		
Configured		41.89%	
Physical			0.00%

SPC-1 Storage Capacity Charts




Configured Storage Capacity: 10,077.613 GB
Configured Storage Capacity Available for Application Use: 10,071.038 GB 99.93%
Pool Metadata: 6.653 GB 0.07%
Addressable Storage Capacity: 2,924.873 GB 29.02%
Data Protection Capacity (used): 2,924.794 GB 29.02%
Unused Configured Storage Capacity: 4,221.371 GB 41.89%
(includes 2,110.686 GB of Unused Data Protection Capacity)


Addressable Storage Capacity: 2,924.873 GB
Unused Addressable Capacity: 0 GB 0%
ASU Capacity: 2,924.873 GB 100.00%
6 Logical Volumes, 219.043 GB per Volume (ASU-1)
2 Logical Volumes, 657.130 GB per Volume (ASU-2)
6 Logical Volumes, 49.391 GB per Volume (ASU-3)
ASU-1 Capacity: 1,314.260 GB 44.93%
ASU-2 Capacity: 1,314.260 GB 44.93%
ASU-3 Capacity: 296.353 GB 10.13%



Storage Capacity Utilization

Clause 9.4.3.6.2

The FDR will include a table illustrating the storage capacity utilization values defined for Application Utilization (Clause 2.8.1), Protected Application Utilization (Clause 2.8.2), and Unused Storage Ratio (Clause 2.8.3).

Clause 2.8.1

Application Utilization is defined as Total ASU Capacity divided by Physical Storage Capacity.

Clause 2.8.2

Protected Application Utilization is defined as (Total ASU Capacity plus total Data Protection Capacity minus unused Data Protection Capacity) divided by Physical Storage Capacity.

Clause 2.8.3

Unused Storage Ratio is defined as Total Unused Capacity divided by Physical Storage Capacity and may not exceed 45%.

SPC-1 Storage Capacity Utilization	
Application Utilization	29.02%
Protected Application Utilization	58.05%
Unused Storage Ratio	41.89%

Logical Volume Capacity and ASU Mapping

Clause 9.4.3.6.3

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 (1,314.260 GB)
6 Logical Volumes 219.043 GB per Logical Volume (219.043 GB used per Logical Volume)
ASU-2 (1,314.260 GB)
2 Logical Volumes 657.130 GB per Logical Volume (657.130 GB used per Logical Volume)
ASU-3 (296.353 GB)
6 Logical Volumes 49.392 GB per Logical Volume (49.392 GB used per Logical Volume)

The Data Protection Level used for all Logical Volumes was **Protected 1** using ***Mirroring*** 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. An SPC-1 glossary on page 62 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.

"Ramp-Up" Test Runs

Clause 5.3.13

In order to warm-up caches or perform the initial ASU data migration in a multi-tier configuration, a Test Sponsor may perform a series of "Ramp-Up" Test Runs as a substitute for an initial, gradual Ramp-Up.

Clause 5.3.13.3

The "Ramp-Up" Test Runs will immediately precede the Primary Metrics Test as part of the uninterrupted SPC-1 measurement sequence.

Clause 9.4.3.7.1

If a series of "Ramp-Up" Test Runs were included in the SPC-1 measurement sequence, the FDR shall report the duration (ramp-up and measurement interval), BSU level, SPC-1 IOPS and average response time for each "Ramp-Up" Test Run in an appropriate table.

There were no "Ramp-Up" Test Runs executed.

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 eight (8) 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 9.4.3.7.2

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 85.

Sustainability Test Results File

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

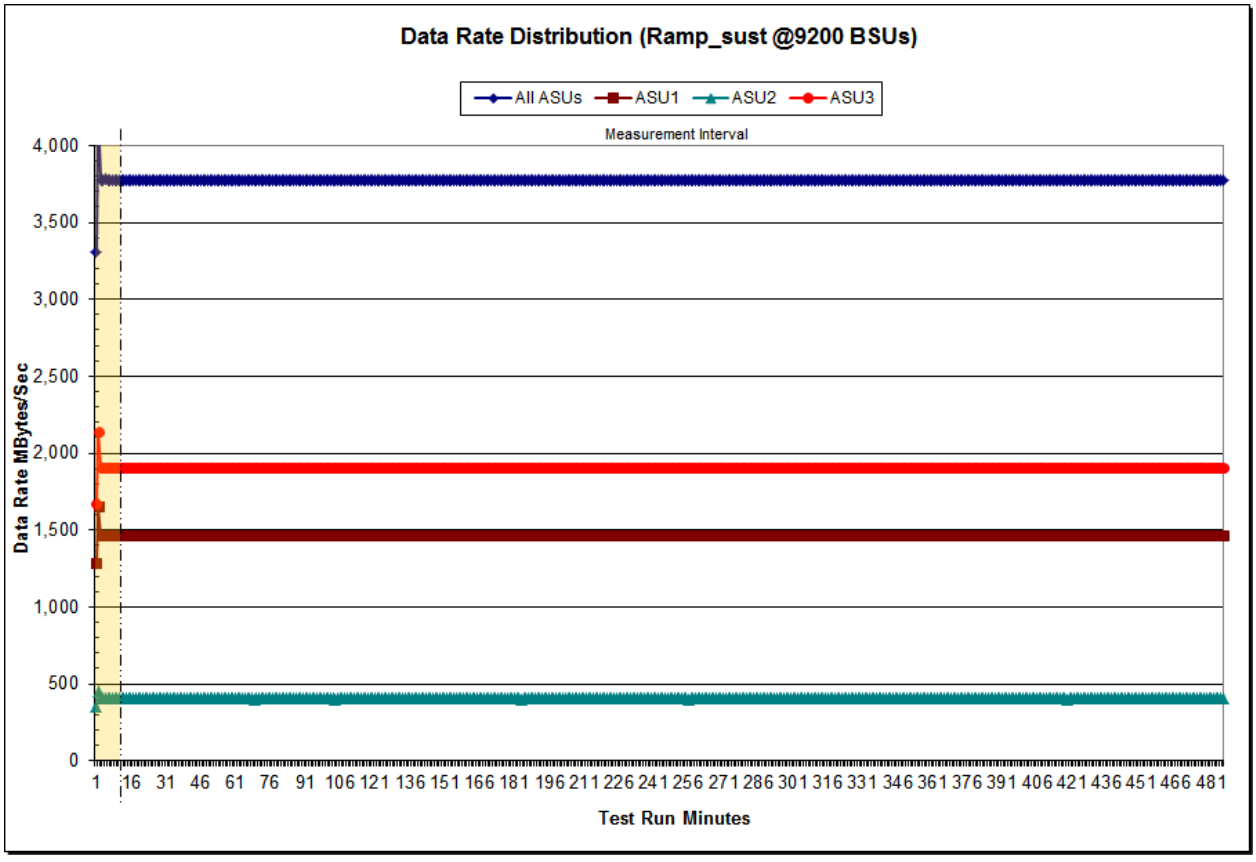
Sustainability Test Results File

Sustainability – Data Rate Distribution Data (MB/second)

The Sustainability Data Rate table of data is not embedded in this document due to its size. The table is available via the following URL:

Sustainability Data Rate Table

Sustainability – Data Rate Distribution Graph

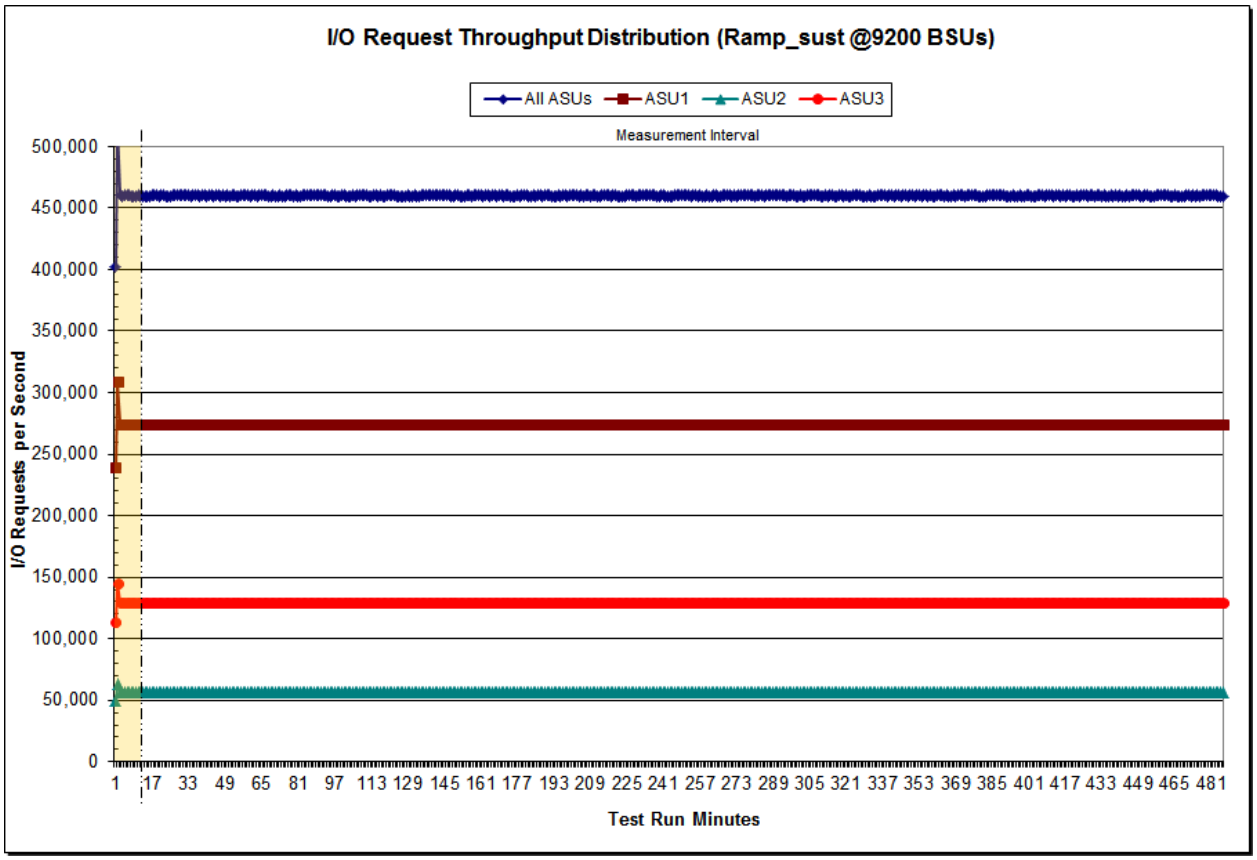


Sustainability – I/O Request Throughput Distribution Data

The Sustainability I/O Request Throughput table of data is not embedded in this document due to its size. The table is available via the following URL:

Sustainability I/O Request Throughput Table

Sustainability – I/O Request Throughput Distribution Graph

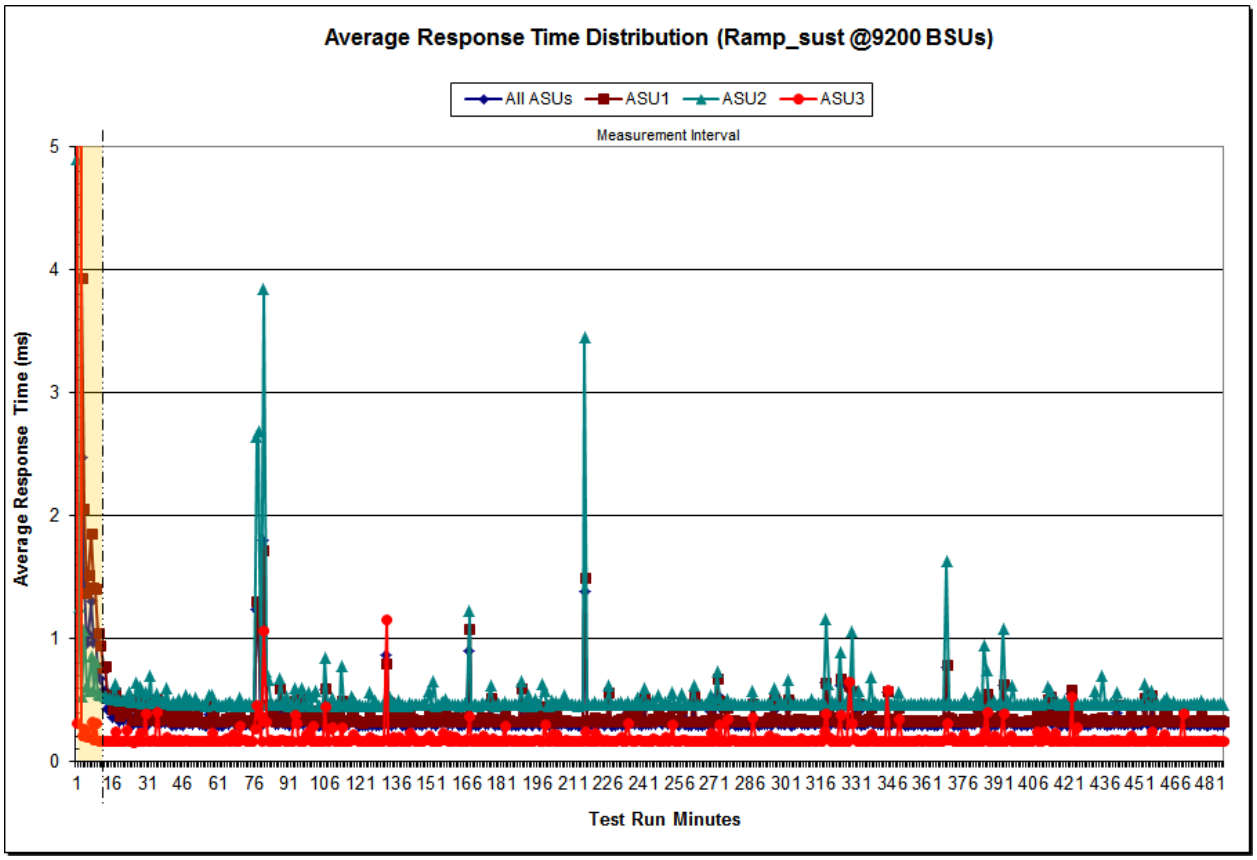


Sustainability – Average Response Time (ms) Distribution Data

The Sustainability Average Response Time table of data is not embedded in this document due to its size. The table is available via the following URL:

Sustainability Average Response Time Table

Sustainability – Average Response Time (ms) Distribution Graph



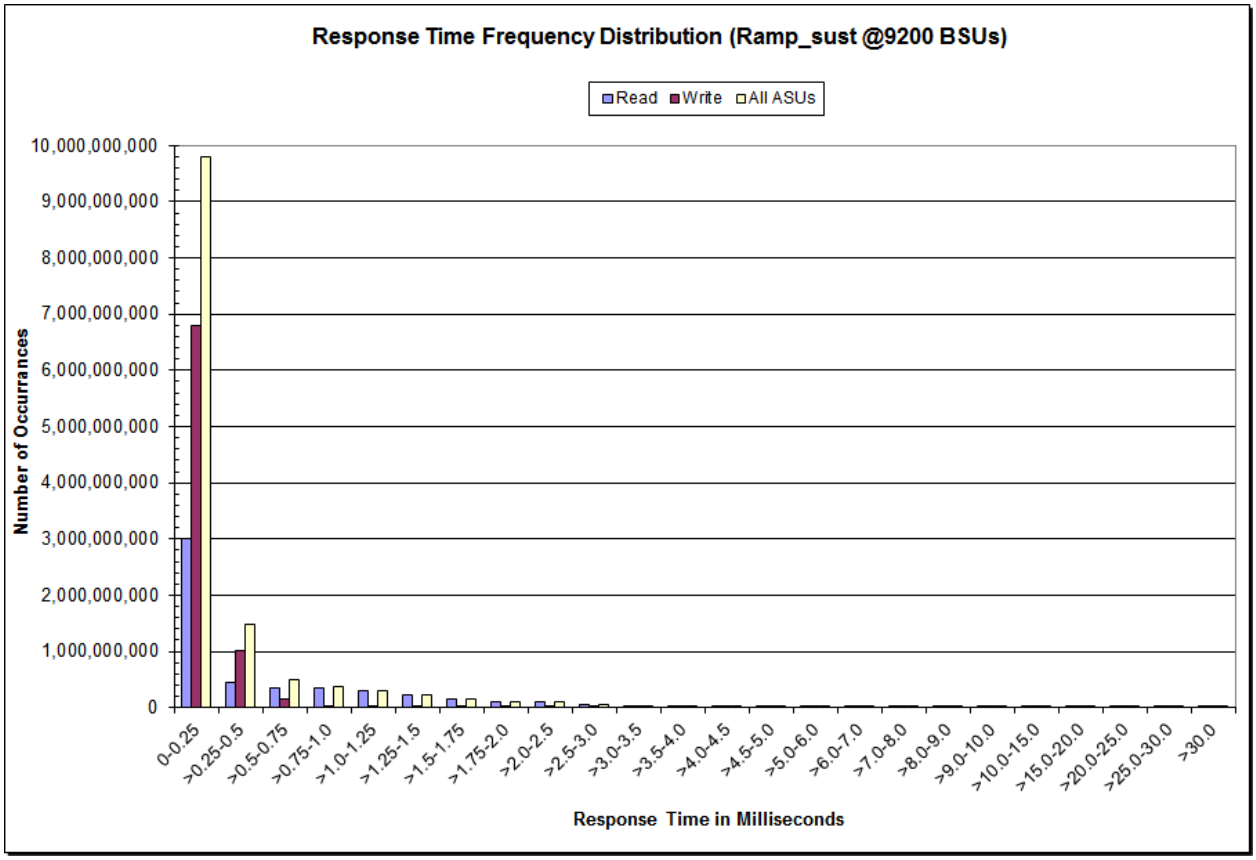
Sustainability – Response Time Frequency Distribution Data

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	3,014,493,193	453,554,029	347,651,117	353,147,915	300,520,957	230,795,944	156,752,215	98,878,304
Write	6,792,819,301	1,025,314,191	155,317,456	25,633,215	6,003,442	3,021,425	2,076,574	1,290,316
All ASUs	9,807,312,494	1,478,868,220	502,968,573	378,781,130	306,524,399	233,817,369	158,828,789	100,168,620
ASU1	5,838,233,671	698,636,332	283,134,569	258,633,777	224,402,244	177,628,375	123,998,040	80,048,328
ASU2	1,058,113,676	106,398,093	108,879,564	104,064,526	79,355,819	55,437,358	34,414,676	19,809,887
ASU3	2,910,965,147	673,833,795	110,954,440	16,082,827	2,766,336	751,636	416,073	310,405

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	110,778,353	52,769,275	28,185,921	17,549,952	11,817,186	8,665,777	11,473,722	6,998,614
Write	1,499,719	989,611	644,469	515,237	409,305	353,377	581,280	470,613
All ASUs	112,278,072	53,758,886	28,830,390	18,065,189	12,226,491	9,019,154	12,055,002	7,469,227
ASU1	91,246,224	43,239,776	22,017,479	12,826,137	8,005,130	5,545,661	6,840,356	3,934,403
ASU2	20,571,877	10,173,692	6,524,499	4,987,286	3,996,139	3,270,841	4,862,565	3,236,318
ASU3	459,971	345,418	288,412	251,766	225,222	202,652	352,081	298,506

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	4,353,310	2,653,848	1,548,905	3,234,243	2,095,970	1,634,781	1,289,380	4,332,208
Write	401,377	352,930	314,963	1,223,220	999,568	820,115	647,160	1,025,760
All ASUs	4,754,687	3,006,778	1,863,868	4,457,463	3,095,538	2,454,896	1,936,540	5,357,968
ASU1	2,436,417	1,587,206	1,080,849	3,199,454	2,251,159	1,761,840	1,361,135	3,772,802
ASU2	2,061,225	1,189,145	573,961	466,183	163,108	117,078	83,723	672,302
ASU3	257,045	230,427	209,058	791,826	681,271	575,978	491,682	912,864

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 5.1.10 and 5.3.15.2

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 5.3.15.3

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	0.000	0.001	0.001	0.001	0.000

Primary Metrics Test – IOPS Test Phase

Clause 5.4.4.2

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 9.4.3.7.3

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 to 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 85.

IOPS Test Results File

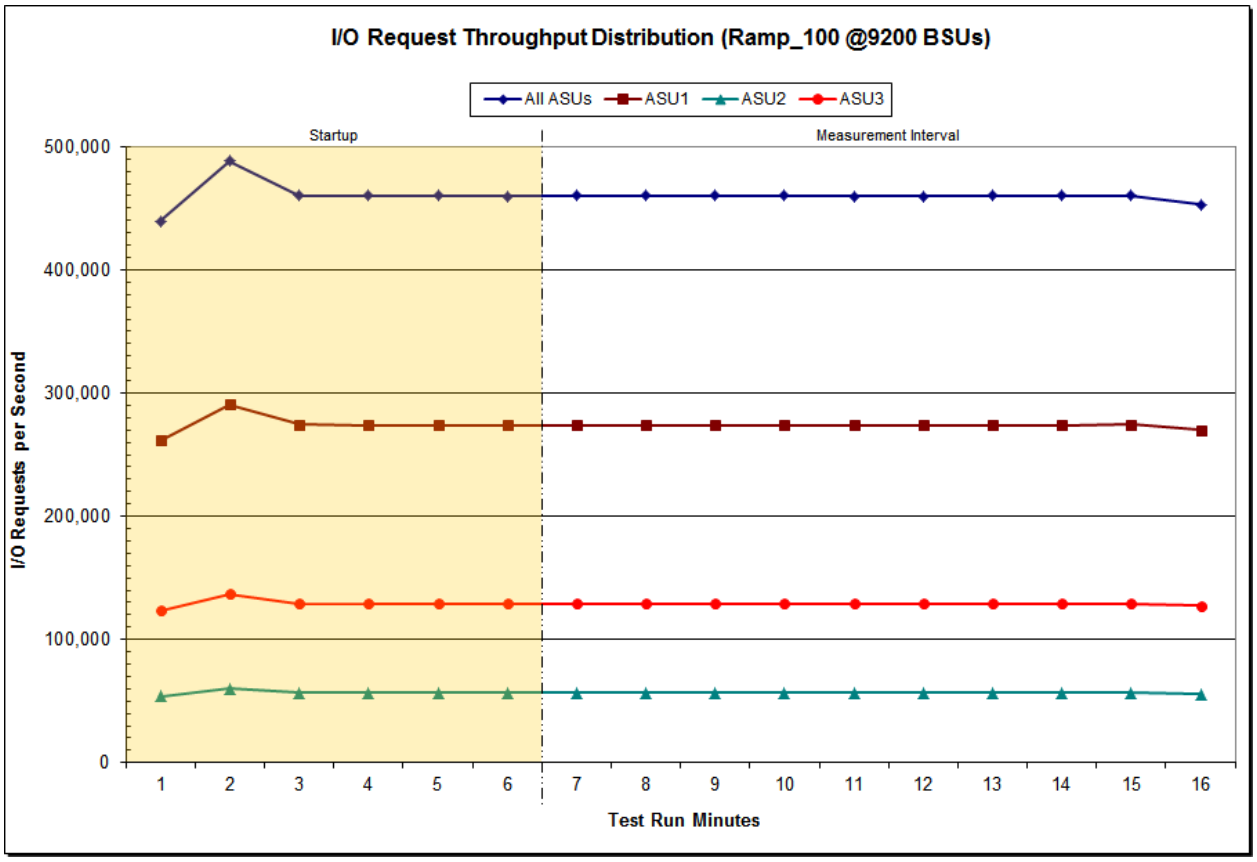
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

9,200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:07:45	2:13:46	0-5	0:06:01
Measurement Interval	2:13:46	2:23:46	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	439,325.85	261,801.05	54,006.40	123,518.40
1	488,141.87	290,842.22	60,110.00	137,189.65
2	460,053.92	274,237.83	56,634.75	129,181.33
3	459,984.95	274,165.42	56,616.30	129,203.23
4	459,984.73	274,102.20	56,650.02	129,232.52
5	459,950.57	274,149.62	56,569.35	129,231.60
6	460,038.37	274,138.57	56,588.22	129,311.58
7	459,987.12	274,044.60	56,647.30	129,295.22
8	459,992.35	274,144.63	56,592.68	129,255.03
9	459,999.40	274,073.77	56,612.12	129,313.52
10	459,876.57	274,105.73	56,573.87	129,196.97
11	459,868.63	274,127.13	56,549.73	129,191.77
12	459,990.82	274,166.40	56,522.28	129,302.13
13	459,983.77	274,182.33	56,521.50	129,279.93
14	460,065.18	274,277.20	56,553.77	129,234.22
15	453,106.48	270,080.30	55,727.03	127,299.15
Average	***459,290.87***	***273,734.07***	***56,488.85***	***129,067.95***

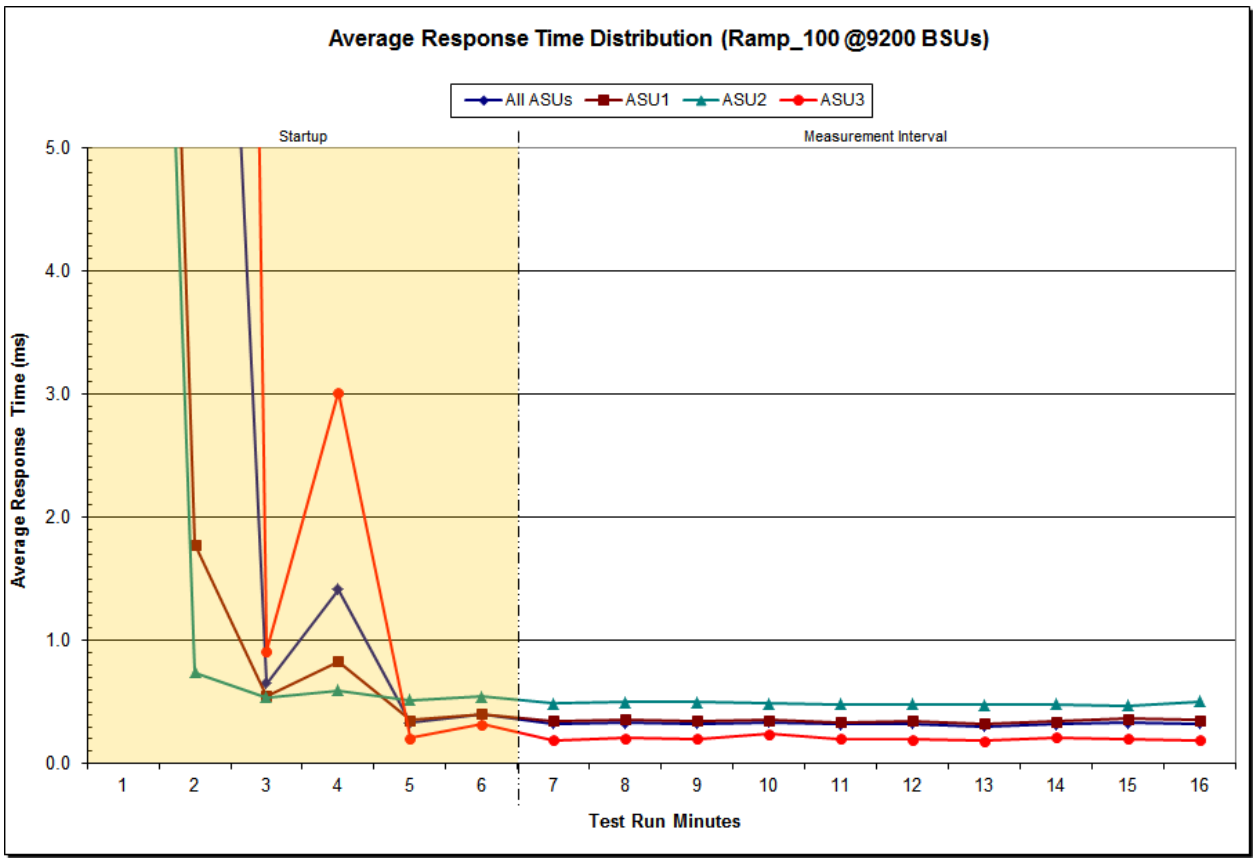
IOPS Test Run – I/O Request Throughput Distribution Graph



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

9,200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:07:45	2:13:46	0-5	0:06:01
Measurement Interval	2:13:46	2:23:46	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	38.94	19.34	16.87	90.14
1	12.93	1.78	0.74	41.89
2	0.65	0.55	0.54	0.91
3	1.41	0.83	0.60	3.01
4	0.33	0.35	0.52	0.21
5	0.40	0.40	0.55	0.32
6	0.32	0.35	0.49	0.19
7	0.33	0.36	0.50	0.21
8	0.32	0.35	0.50	0.20
9	0.34	0.35	0.49	0.24
10	0.32	0.34	0.48	0.20
11	0.32	0.35	0.48	0.20
12	0.30	0.32	0.48	0.19
13	0.32	0.34	0.48	0.21
14	0.33	0.37	0.47	0.20
15	0.33	0.35	0.51	0.19
Average	***0.32***	***0.35***	***0.49***	***0.20***

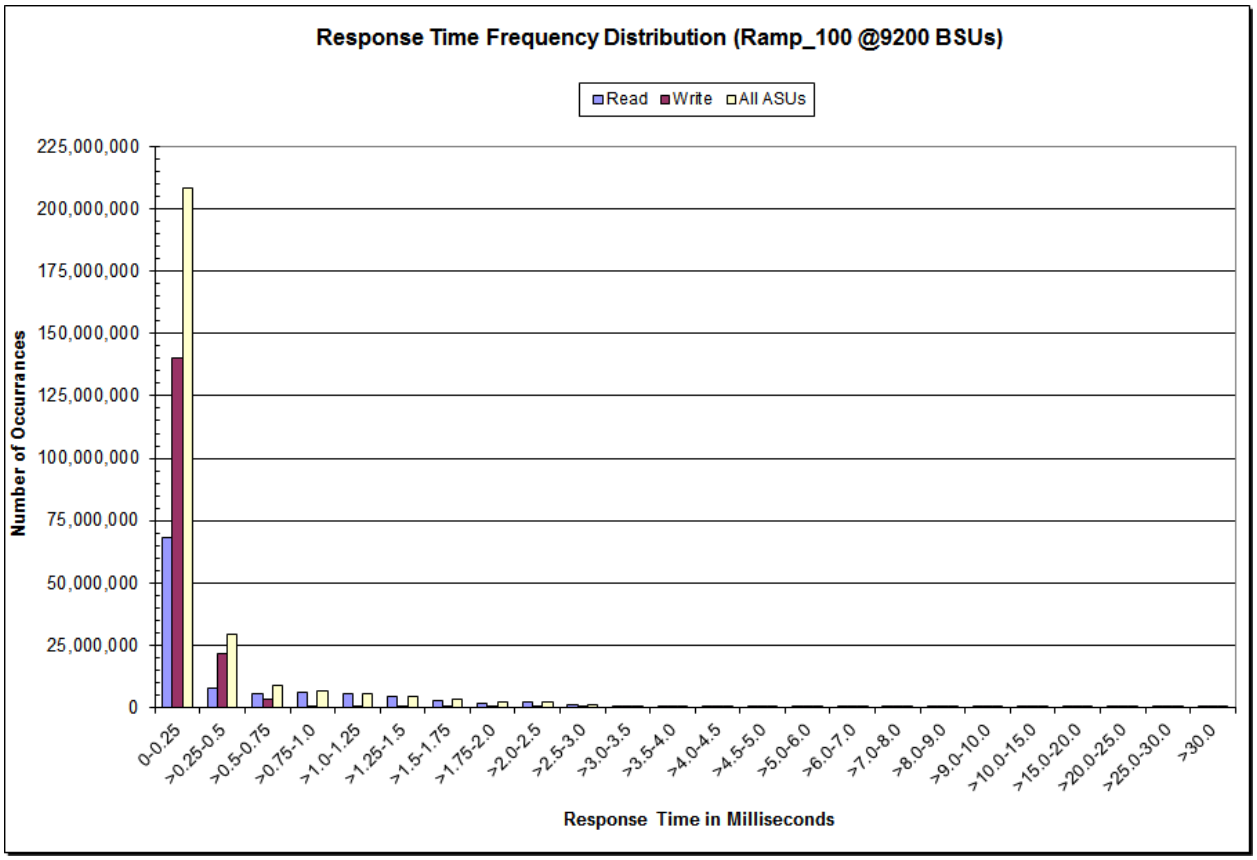
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	68,126,269	7,661,557	5,546,093	5,983,860	5,384,334	4,365,864	3,097,177	2,007,804
Write	140,107,943	21,515,501	3,644,598	738,382	224,024	115,869	78,309	55,366
All ASUs	208,234,212	29,177,058	9,190,691	6,722,242	5,608,358	4,481,733	3,175,486	2,063,170
ASU1	127,420,082	12,072,595	4,300,666	4,154,902	3,838,611	3,240,933	2,387,221	1,601,789
ASU2	22,562,716	1,898,624	2,009,982	2,030,796	1,623,469	1,176,082	745,863	429,779
ASU3	58,251,414	15,205,839	2,880,043	536,544	146,278	64,718	42,402	31,602
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	2,335,908	1,190,576	681,819	460,956	342,942	274,488	405,289	274,178
Write	76,221	53,051	38,857	30,735	26,331	22,579	34,443	22,896
All ASUs	2,412,129	1,243,627	720,676	491,691	369,273	297,067	439,732	297,074
ASU1	1,927,067	989,397	553,458	360,559	259,164	203,364	293,879	193,661
ASU2	438,438	219,761	140,057	108,452	89,970	76,214	118,363	84,655
ASU3	46,624	34,469	27,161	22,680	20,139	17,489	27,490	18,758
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	180,900	110,965	60,207	92,301	35,842	19,913	9,398	22,167
Write	21,263	15,182	9,035	20,749	8,072	5,763	476	2,672
All ASUs	202,163	126,147	69,242	113,050	43,914	25,676	9,874	24,839
ASU1	125,923	77,078	44,555	82,123	31,545	17,499	8,296	21,513
ASU2	58,181	36,743	18,413	16,139	4,738	2,723	1,276	1,238
ASU3	18,059	12,326	6,274	14,788	7,631	5,454	302	2,088

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
275,539,124	275,514,285	24,839

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 5.1.10 and 5.3.15.2

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 5.3.15.3

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	0.000	0.001	0.001	0.001	0.000

Primary Metrics Test – Response Time Ramp Test Phase

Clause 5.4.4.3

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 15.

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 9.4.3.7.4

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 85.

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 table and graph for completeness.

100% Load Level: 9,200- BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:07:45	2:13:46	0-5	0:06:01
Measurement Interval	2:13:46	2:23:46	6-15	0:10:00
(60 second intervals)	**All ASUs**	**ASU-1**	**ASU-2**	**ASU-3**
0	439,325.85	261,801.05	54,006.40	123,518.40
1	488,141.87	290,842.22	60,110.00	137,189.65
2	460,053.92	274,237.83	56,634.75	129,181.33
3	459,984.95	274,165.42	56,616.30	129,203.23
4	459,984.73	274,102.20	56,650.02	129,232.52
5	459,950.57	274,149.62	56,569.35	129,231.60
6	460,038.37	274,138.57	56,588.22	129,311.58
7	459,987.12	274,044.60	56,647.30	129,295.22
8	459,992.35	274,144.63	56,592.68	129,255.03
9	459,999.40	274,073.77	56,612.12	129,313.52
10	459,876.57	274,105.73	56,573.87	129,196.97
11	459,868.63	274,127.13	56,549.73	129,191.77
12	459,990.82	274,166.40	56,522.28	129,302.13
13	459,983.77	274,182.33	56,521.50	129,279.93
14	460,065.18	274,277.20	56,553.77	129,234.22
15	453,106.48	270,080.30	55,727.03	127,299.15
Average	***459,290.87***	***273,734.07***	***56,488.85***	***129,067.95***

95% Load Level: 8,740 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:25:26	2:31:27	0-5	0:06:01
Measurement Interval	2:31:27	2:41:27	6-15	0:10:00
(60 second intervals)	**All ASUs**	**ASU-1**	**ASU-2**	**ASU-3**
0	441,565.98	263,217.77	54,261.62	124,086.60
1	437,102.27	260,497.48	53,763.80	122,840.98
2	436,951.48	260,504.42	53,736.93	122,710.13
3	437,155.73	260,569.43	53,808.48	122,777.82
4	437,013.02	260,483.13	53,735.03	122,794.85
5	437,023.98	260,359.07	53,748.25	122,916.67
6	436,920.37	260,425.58	53,768.57	122,726.22
7	437,104.02	260,491.72	53,783.00	122,829.30
8	436,972.52	260,449.78	53,760.22	122,762.52
9	436,908.95	260,363.30	53,781.13	122,764.52
10	437,064.32	260,486.98	53,768.58	122,808.75
11	437,196.40	260,558.55	53,784.08	122,853.77
12	436,893.15	260,343.00	53,788.83	122,761.32
13	436,924.27	260,474.80	53,700.58	122,748.88
14	437,007.40	260,524.62	53,756.62	122,726.17
15	432,712.85	257,949.93	53,225.42	121,537.50
Average	***436,570.42***	***260,206.83***	***53,711.70***	***122,651.89***

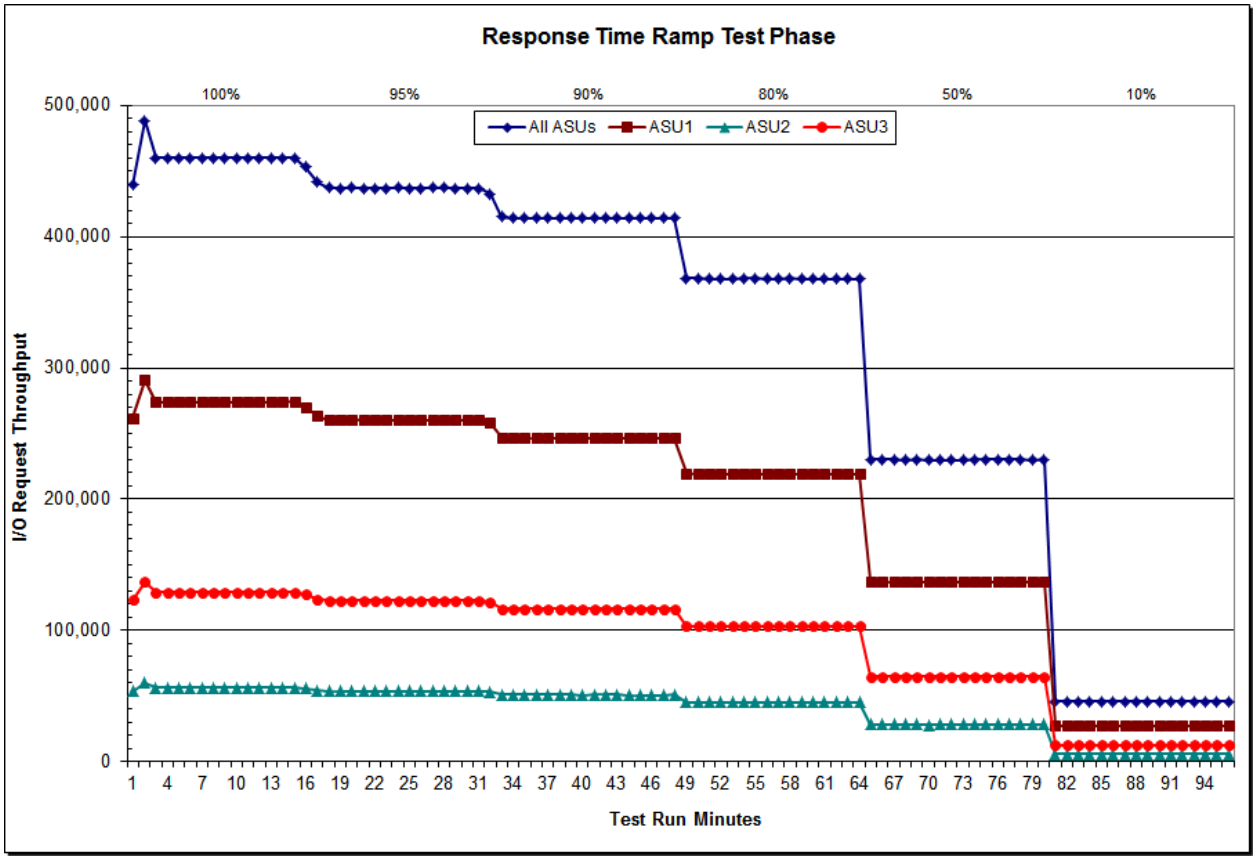
90% Load Level: 8,280 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	2:43:03	2:49:04	0-5	0:06:01
Measurement Interval	2:49:04	2:59:04	6-15	0:10:00
(60 second intervals)	**All ASUs**	**ASU-1**	**ASU-2**	**ASU-3**
0	415,071.27	247,337.52	51,037.83	116,695.92
1	414,183.28	246,862.48	50,943.18	116,377.62
2	414,025.30	246,769.90	50,933.08	116,322.32
3	414,165.73	246,861.07	50,957.50	116,347.17
4	413,934.25	246,649.08	50,940.23	116,344.93
5	414,006.98	246,732.35	50,946.40	116,328.23
6	413,991.23	246,770.05	50,939.40	116,281.78
7	414,043.02	246,765.78	50,890.37	116,386.87
8	413,891.42	246,659.07	50,908.57	116,323.78
9	414,018.45	246,746.83	50,921.00	116,350.62
10	413,972.63	246,698.15	50,926.53	116,347.95
11	413,932.02	246,727.45	50,889.67	116,314.90
12	413,945.15	246,730.43	50,876.50	116,338.22
13	413,926.45	246,729.13	50,891.92	116,305.40
14	413,909.30	246,803.32	50,888.20	116,217.78
15	413,962.22	246,663.45	50,917.20	116,381.57
Average	***413,959.19***	***246,729.37***	***50,904.94***	***116,324.89***

80% Load Level: 7,360 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:00:31	3:06:32	0-5	0:06:01
Measurement Interval	3:06:32	3:16:32	6-15	0:10:00
(60 second intervals)	**All ASUs**	**ASU-1**	**ASU-2**	**ASU-3**
0	368,310.28	219,499.67	45,303.65	103,506.97
1	368,106.00	219,328.40	45,324.62	103,452.98
2	368,014.78	219,272.70	45,305.87	103,436.22
3	368,022.67	219,338.25	45,252.43	103,431.98
4	367,937.57	219,329.93	45,214.53	103,393.10
5	368,054.30	219,348.18	45,239.53	103,466.58
6	368,040.98	219,350.18	45,279.80	103,411.00
7	368,001.05	219,306.48	45,291.45	103,403.12
8	367,901.95	219,219.05	45,262.53	103,420.37
9	368,033.43	219,372.03	45,287.28	103,374.12
10	367,957.43	219,339.55	45,271.28	103,346.60
11	367,969.73	219,279.67	45,254.72	103,435.35
12	367,997.65	219,419.83	45,243.45	103,334.37
13	367,995.27	219,369.60	45,274.30	103,351.37
14	367,946.32	219,303.25	45,272.53	103,370.53
15	367,998.93	219,326.03	45,260.15	103,412.75
Average	***367,984.28***	***219,328.57***	***45,269.75***	***103,385.96***

Response Time Ramp Distribution (IOPS) Data *(continued)*

50% Load Level: 4,600 BSUs	Start	Stop	Interval	Duration	10% Load Level: 920 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:17:33	3:23:34	0-5	0:06:01	Start-Up/Ramp-Up	3:33:59	3:40:00	0-5	0:06:01
Measurement Interval	3:23:34	3:33:34	6-15	0:10:00	Measurement Interval	3:40:00	3:50:00	6-15	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	*(60 second intervals)*	All ASUs	ASU-1	ASU-2	ASU-3
0	230,470.42	137,358.35	28,338.32	64,773.75	0	46,116.70	27,490.52	5,675.70	12,950.48
1	230,023.83	137,095.07	28,315.53	64,613.23	1	46,020.38	27,409.30	5,667.80	12,943.28
2	230,045.57	137,069.70	28,317.83	64,658.03	2	46,044.50	27,453.42	5,666.93	12,924.15
3	229,998.87	137,059.10	28,306.67	64,633.10	3	46,025.02	27,418.00	5,655.90	12,951.12
4	230,030.83	137,108.27	28,331.12	64,591.45	4	46,008.98	27,412.77	5,659.63	12,936.58
5	229,933.53	137,065.43	28,235.47	64,632.63	5	45,999.57	27,425.23	5,663.03	12,911.30
6	229,990.82	137,036.67	28,326.40	64,627.75	6	45,994.27	27,414.98	5,653.53	12,925.75
7	229,970.17	137,056.78	28,276.53	64,636.85	7	45,982.85	27,422.47	5,657.60	12,902.78
8	229,926.90	137,038.27	28,291.27	64,597.37	8	46,006.07	27,419.67	5,655.92	12,930.48
9	230,076.73	137,142.43	28,290.15	64,644.15	9	46,018.40	27,426.03	5,669.60	12,922.77
10	230,064.77	137,099.80	28,254.20	64,710.77	10	46,020.00	27,431.57	5,665.63	12,922.80
11	230,064.82	137,146.57	28,292.65	64,625.60	11	45,987.93	27,405.92	5,656.37	12,925.65
12	230,037.37	137,072.15	28,302.95	64,662.27	12	46,040.58	27,419.13	5,675.92	12,945.53
13	230,032.67	137,069.50	28,322.30	64,640.87	13	45,944.30	27,398.77	5,646.88	12,898.65
14	229,985.73	137,057.37	28,329.65	64,598.72	14	46,019.93	27,452.48	5,652.33	12,915.12
15	230,087.90	137,151.88	28,307.48	64,628.53	15	46,019.62	27,417.12	5,658.33	12,944.17
Average	***230,023.79***	***137,087.14***	***28,299.36***	***64,637.29***	***Average***	***46,003.40***	***27,420.81***	***5,659.21***	***12,923.37***

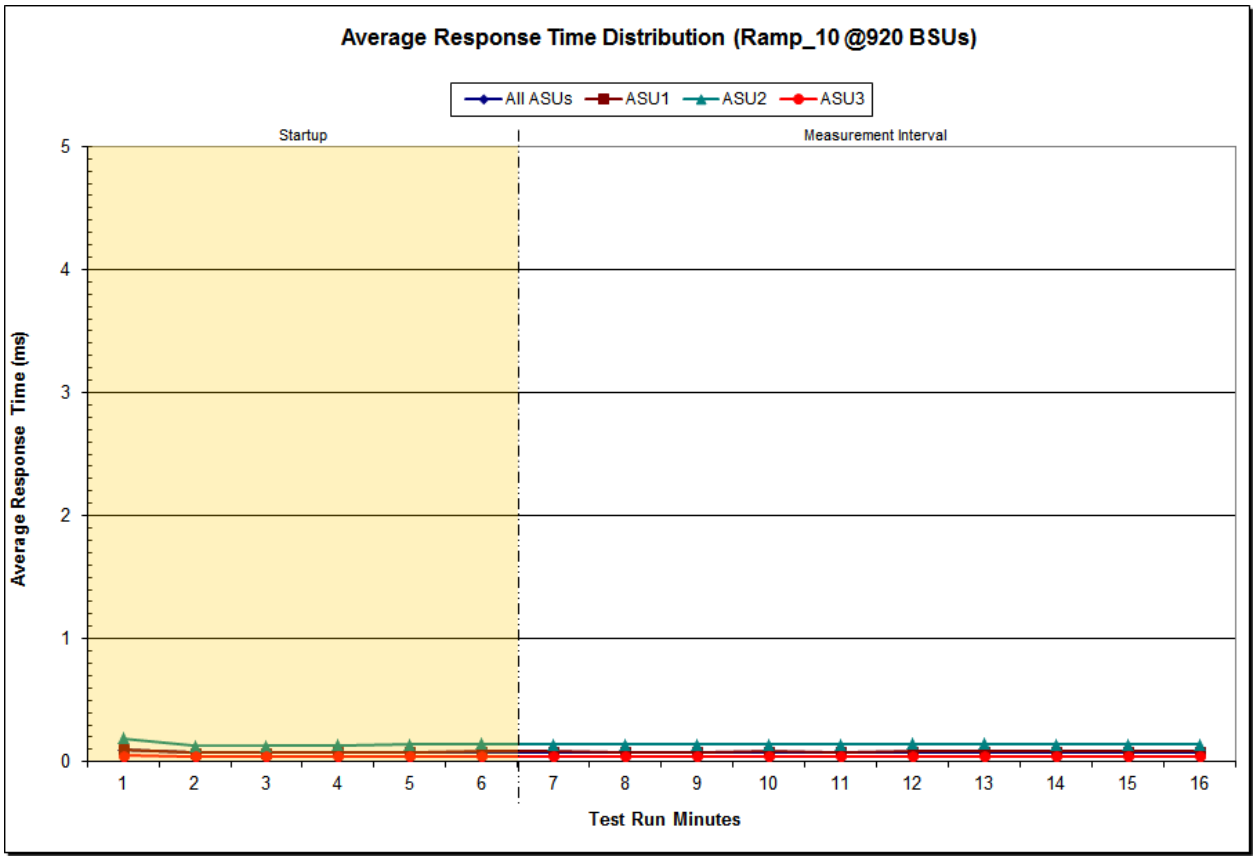
Response Time Ramp Distribution (IOPS) Graph



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

920 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:33:59	3:40:00	0-5	0:06:01
Measurement Interval	0:00:00	3:50:00	6-15	3:50:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.10	0.10	0.19	0.05
1	0.07	0.07	0.13	0.04
2	0.07	0.07	0.13	0.04
3	0.08	0.08	0.13	0.04
4	0.08	0.08	0.14	0.04
5	0.08	0.08	0.15	0.04
6	0.08	0.08	0.14	0.04
7	0.08	0.08	0.14	0.04
8	0.08	0.08	0.14	0.04
9	0.08	0.08	0.14	0.04
10	0.08	0.08	0.14	0.04
11	0.08	0.08	0.15	0.04
12	0.08	0.08	0.15	0.04
13	0.08	0.08	0.14	0.04
14	0.08	0.08	0.14	0.04
15	0.08	0.08	0.14	0.04
Average	***0.08***	***0.08***	***0.14***	***0.04***

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 5.1.10 and 5.3.15.2

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 5.3.15.3

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	0.2101	0.0180	0.0701	0.0349	0.2809
COV	0.004	0.001	0.002	0.001	0.006	0.003	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 the 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% or less than the SPC-1 LRT™ metric plus one (1) millisecond (ms).

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 9.4.3.7.5

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 85.

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	***459,290.87***
Repeatability Test Phase 1	460,020.99
Repeatability Test Phase 2	459,985.19

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	***0.08***
Repeatability Test Phase 1	0.08
Repeatability Test Phase 2	0.08

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 or less than the reported SPC-1 LRT™ Primary Metric plus one (1) millisecond (ms).

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)

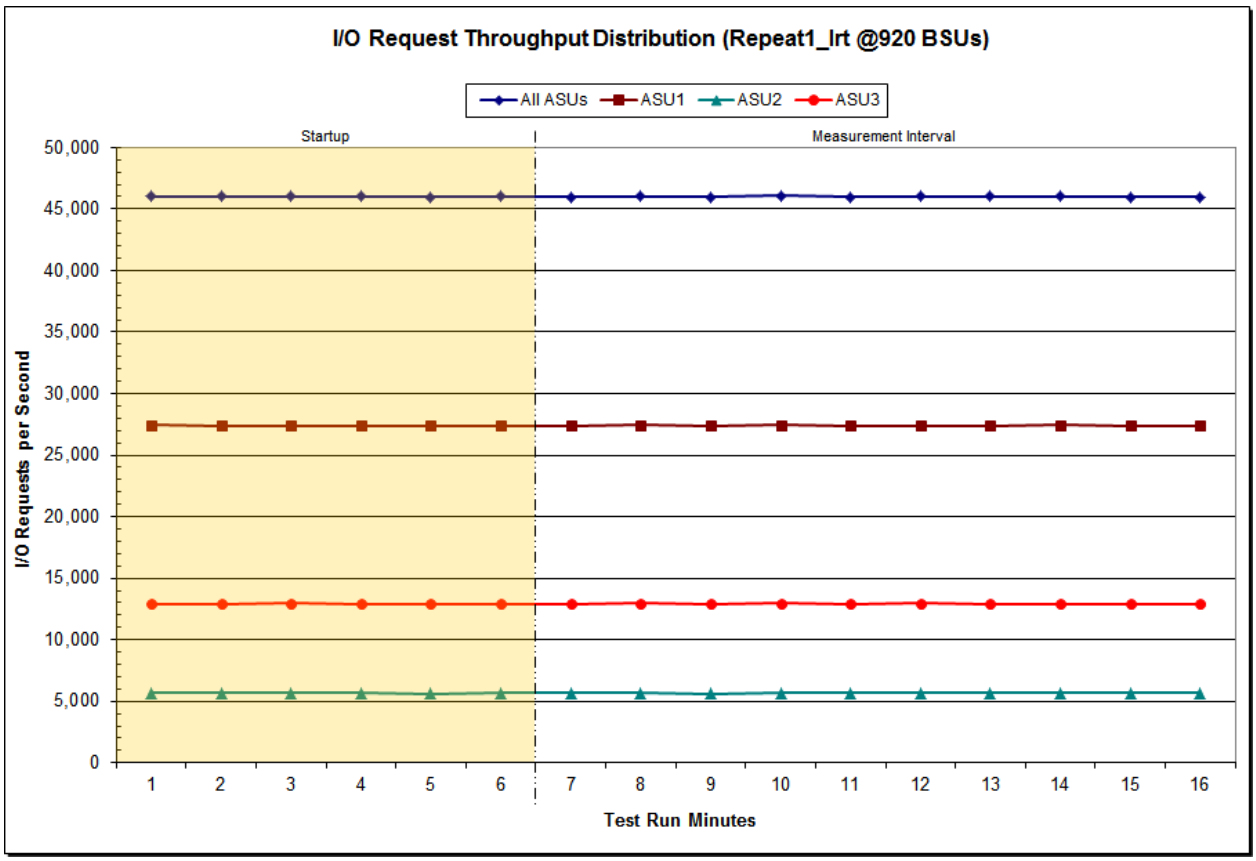
Repeatability Test Phase 2, Test Run 1 (LRT)

Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

920 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:50:34	3:56:34	0-5	0:06:00
Measurement Interval	3:56:34	4:06:34	6-15	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	46,025.75	27,459.82	5,654.77	12,911.17
1	46,001.22	27,412.80	5,661.87	12,926.55
2	46,016.13	27,412.55	5,647.60	12,955.98
3	45,997.90	27,406.07	5,664.32	12,927.52
4	45,962.00	27,403.12	5,630.47	12,928.42
5	45,998.25	27,396.57	5,675.73	12,925.95
6	45,980.48	27,394.92	5,659.27	12,926.30
7	46,028.20	27,435.08	5,647.53	12,945.58
8	45,977.12	27,419.00	5,643.83	12,914.28
9	46,070.42	27,461.40	5,665.83	12,943.18
10	45,978.88	27,398.75	5,661.68	12,918.45
11	46,009.20	27,393.83	5,661.45	12,953.92
12	46,002.80	27,415.17	5,660.50	12,927.13
13	45,997.37	27,448.05	5,648.75	12,900.57
14	45,945.57	27,369.75	5,661.27	12,914.55
15	45,949.35	27,403.58	5,654.38	12,891.38
Average	***45,993.94***	***27,413.95***	***5,656.45***	***12,923.54***

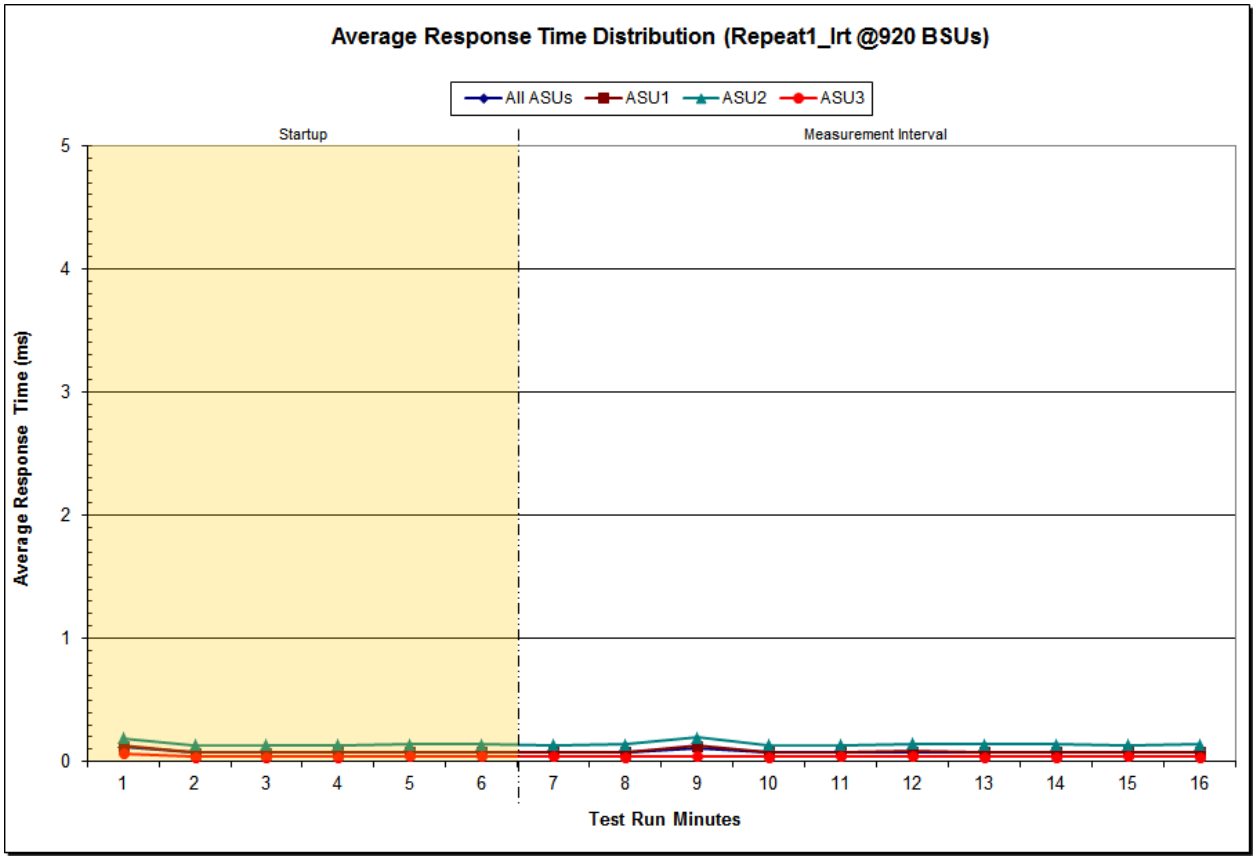
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

920 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	3:50:34	3:56:34	0-5	0:06:00
Measurement Interval	3:56:34	4:06:34	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.12	0.13	0.19	0.07
1	0.07	0.07	0.13	0.04
2	0.07	0.08	0.14	0.04
3	0.07	0.08	0.14	0.04
4	0.08	0.08	0.14	0.04
5	0.07	0.08	0.14	0.04
6	0.08	0.08	0.14	0.04
7	0.07	0.08	0.14	0.04
8	0.12	0.13	0.20	0.04
9	0.08	0.08	0.14	0.04
10	0.08	0.08	0.14	0.04
11	0.08	0.08	0.15	0.04
12	0.08	0.08	0.14	0.04
13	0.08	0.08	0.14	0.04
14	0.08	0.08	0.14	0.04
15	0.08	0.08	0.14	0.04
Average	***0.08***	***0.08***	***0.14***	***0.04***

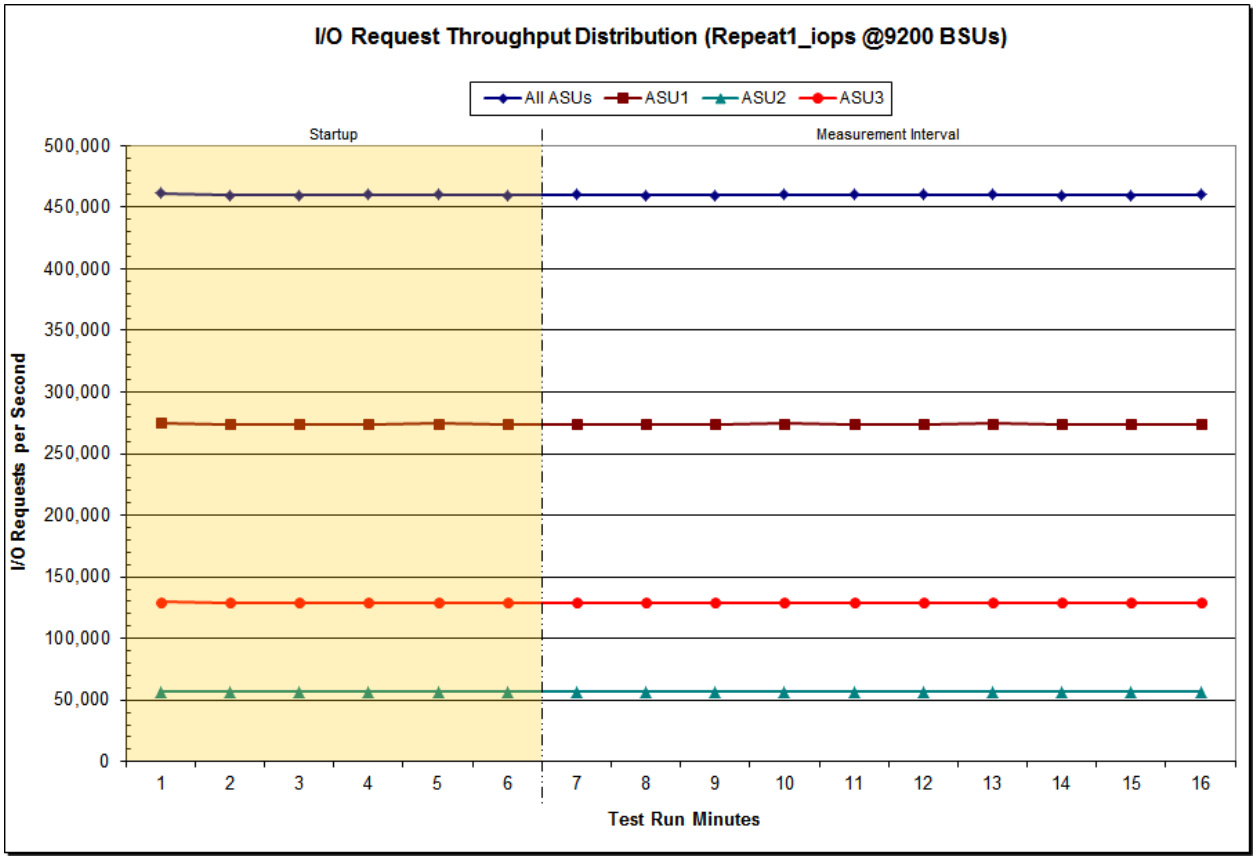
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

9,200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:08:16	4:14:17	0-5	0:06:01
Measurement Interval	4:14:17	4:24:17	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	461,247.83	274,859.88	56,736.97	129,650.98
1	459,845.37	274,054.47	56,576.73	129,214.17
2	459,949.37	274,095.62	56,592.43	129,261.32
3	460,003.78	274,181.88	56,577.02	129,244.88
4	460,020.58	274,229.82	56,591.72	129,199.05
5	459,942.00	274,131.75	56,564.57	129,245.68
6	460,004.42	274,177.15	56,579.73	129,247.53
7	459,931.05	274,139.03	56,542.50	129,249.52
8	459,901.73	274,029.62	56,655.92	129,216.20
9	460,194.07	274,287.02	56,585.33	129,321.72
10	460,031.50	274,209.92	56,613.22	129,208.37
11	460,108.72	274,207.47	56,615.60	129,285.65
12	460,034.30	274,240.43	56,564.83	129,229.03
13	459,960.12	274,131.77	56,589.50	129,238.85
14	459,966.72	274,176.40	56,583.62	129,206.70
15	459,977.30	274,111.03	56,620.55	129,245.72
Average	***460,010.99***	***274,170.98***	***56,595.08***	***129,244.93***

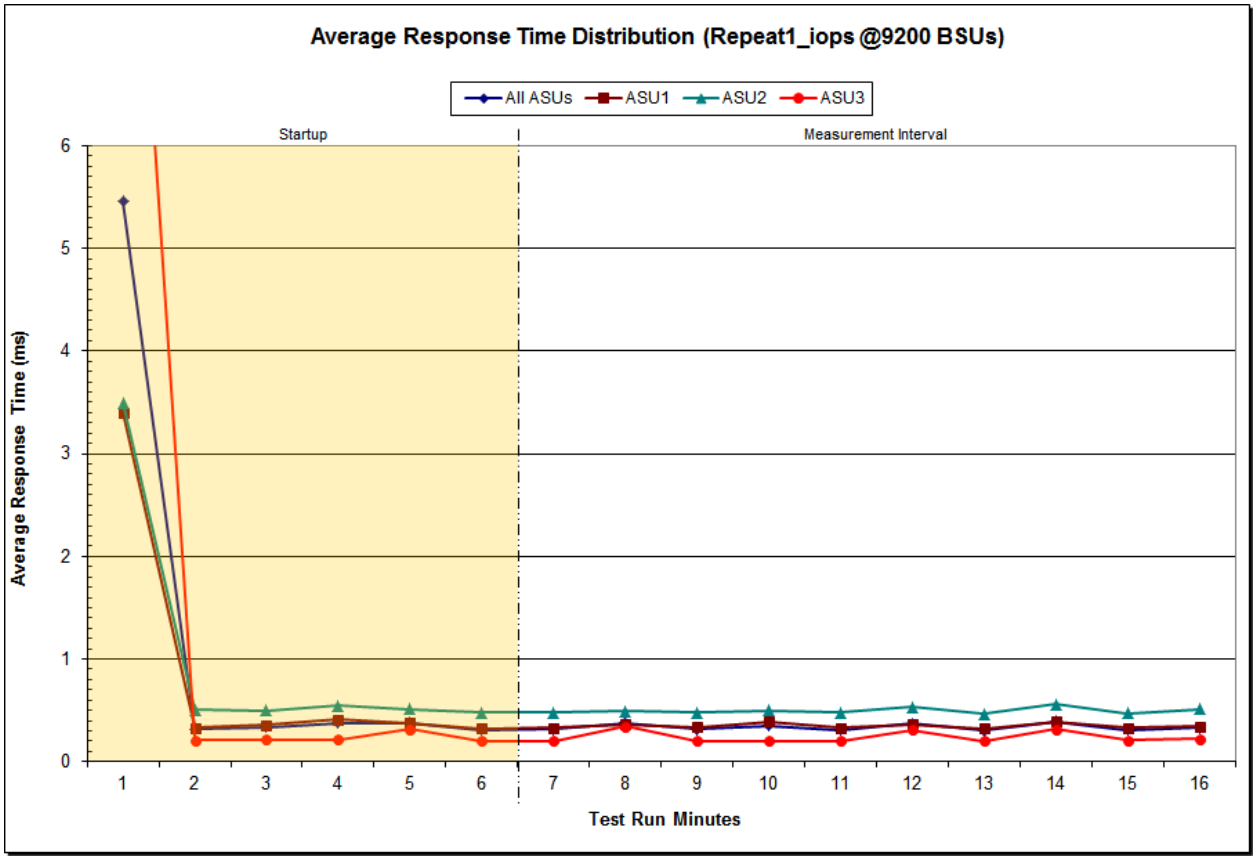
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

9,200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:08:16	4:14:17	0-5	0:06:01
Measurement Interval	4:14:17	4:24:17	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	5.46	3.40	3.50	10.68
1	0.32	0.33	0.51	0.21
2	0.34	0.36	0.50	0.22
3	0.38	0.41	0.55	0.22
4	0.38	0.38	0.51	0.32
5	0.31	0.33	0.48	0.20
6	0.32	0.33	0.48	0.21
7	0.38	0.37	0.49	0.34
8	0.32	0.34	0.48	0.20
9	0.35	0.39	0.50	0.20
10	0.31	0.33	0.48	0.20
11	0.37	0.36	0.53	0.31
12	0.31	0.32	0.47	0.20
13	0.39	0.39	0.56	0.31
14	0.31	0.33	0.47	0.21
15	0.33	0.34	0.51	0.22
Average	***0.34***	***0.35***	***0.50***	***0.24***

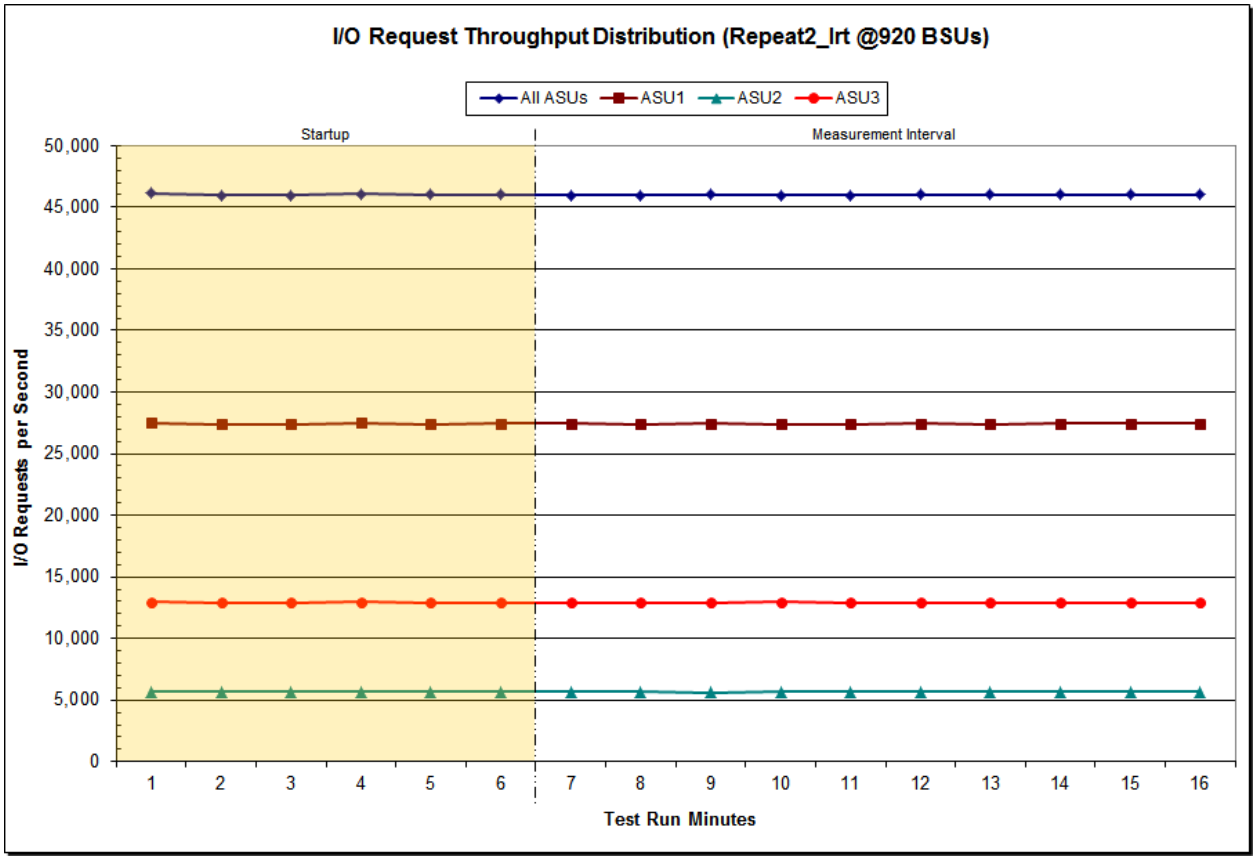
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

920 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:24:55	4:30:55	0-5	0:06:00
Measurement Interval	4:30:55	4:40:55	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	46,154.53	27,498.72	5,679.75	12,976.07
1	45,972.43	27,402.67	5,652.73	12,917.03
2	45,984.28	27,397.42	5,658.50	12,928.37
3	46,075.85	27,478.78	5,654.60	12,942.47
4	46,013.28	27,420.17	5,661.75	12,931.37
5	46,009.02	27,444.78	5,650.37	12,913.87
6	45,983.63	27,428.18	5,650.75	12,904.70
7	45,994.45	27,415.52	5,649.75	12,929.18
8	46,017.85	27,452.22	5,639.47	12,926.17
9	45,982.78	27,382.03	5,646.23	12,954.52
10	45,982.88	27,402.37	5,653.75	12,926.77
11	46,014.53	27,449.63	5,671.35	12,893.55
12	46,011.73	27,400.40	5,678.10	12,933.23
13	46,039.65	27,450.63	5,656.42	12,932.60
14	46,024.85	27,431.20	5,660.05	12,933.60
15	46,013.72	27,432.33	5,662.98	12,918.40
Average	***46,006.61***	***27,424.45***	***5,656.89***	***12,925.27***

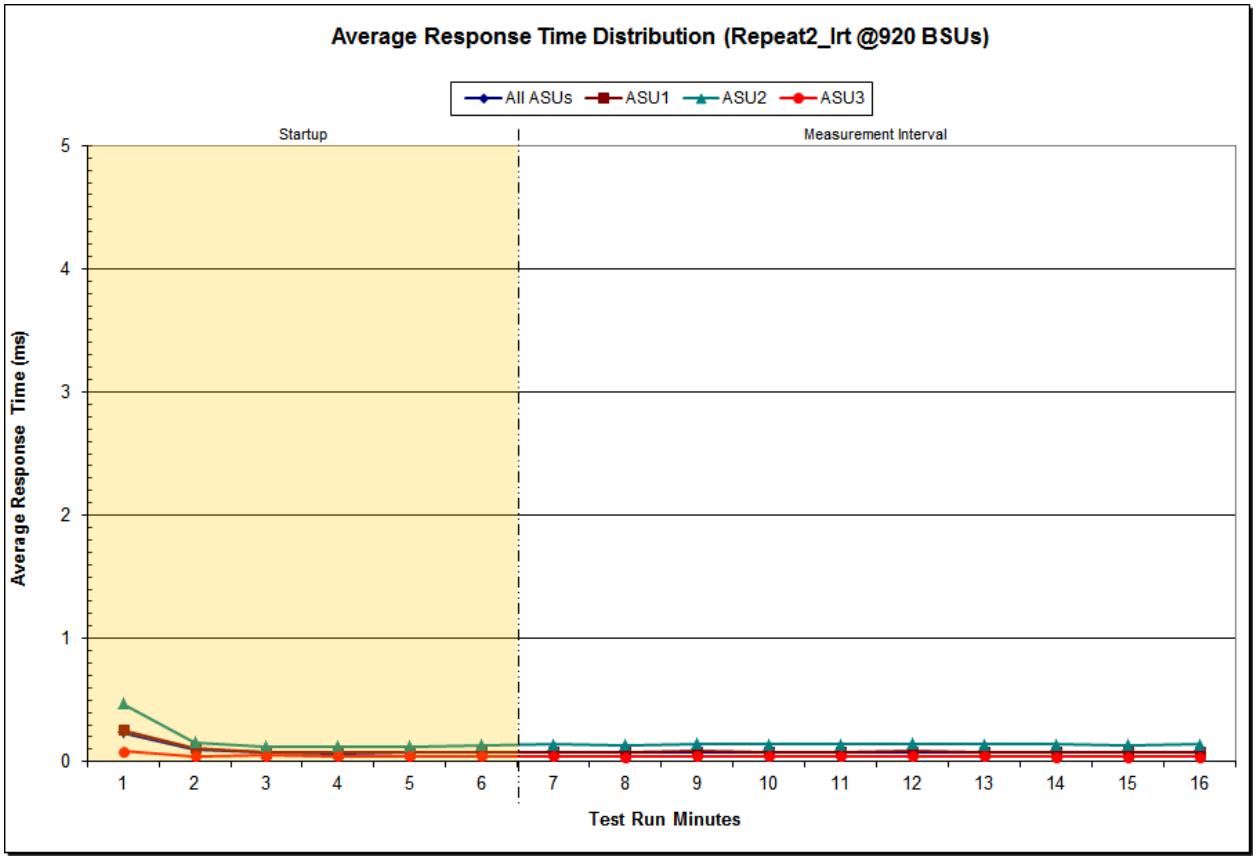
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

920 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:24:55	4:30:55	0-5	0:06:00
Measurement Interval	4:30:55	4:40:55	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.24	0.26	0.47	0.08
1	0.10	0.11	0.16	0.05
2	0.07	0.07	0.13	0.05
3	0.07	0.07	0.12	0.04
4	0.07	0.07	0.12	0.04
5	0.08	0.08	0.14	0.04
6	0.08	0.08	0.14	0.05
7	0.08	0.08	0.14	0.04
8	0.08	0.08	0.14	0.05
9	0.08	0.08	0.14	0.04
10	0.08	0.08	0.14	0.04
11	0.08	0.08	0.15	0.04
12	0.08	0.08	0.14	0.04
13	0.08	0.08	0.14	0.04
14	0.08	0.08	0.14	0.04
15	0.08	0.08	0.14	0.04
Average	***0.08***	***0.08***	***0.14***	***0.04***

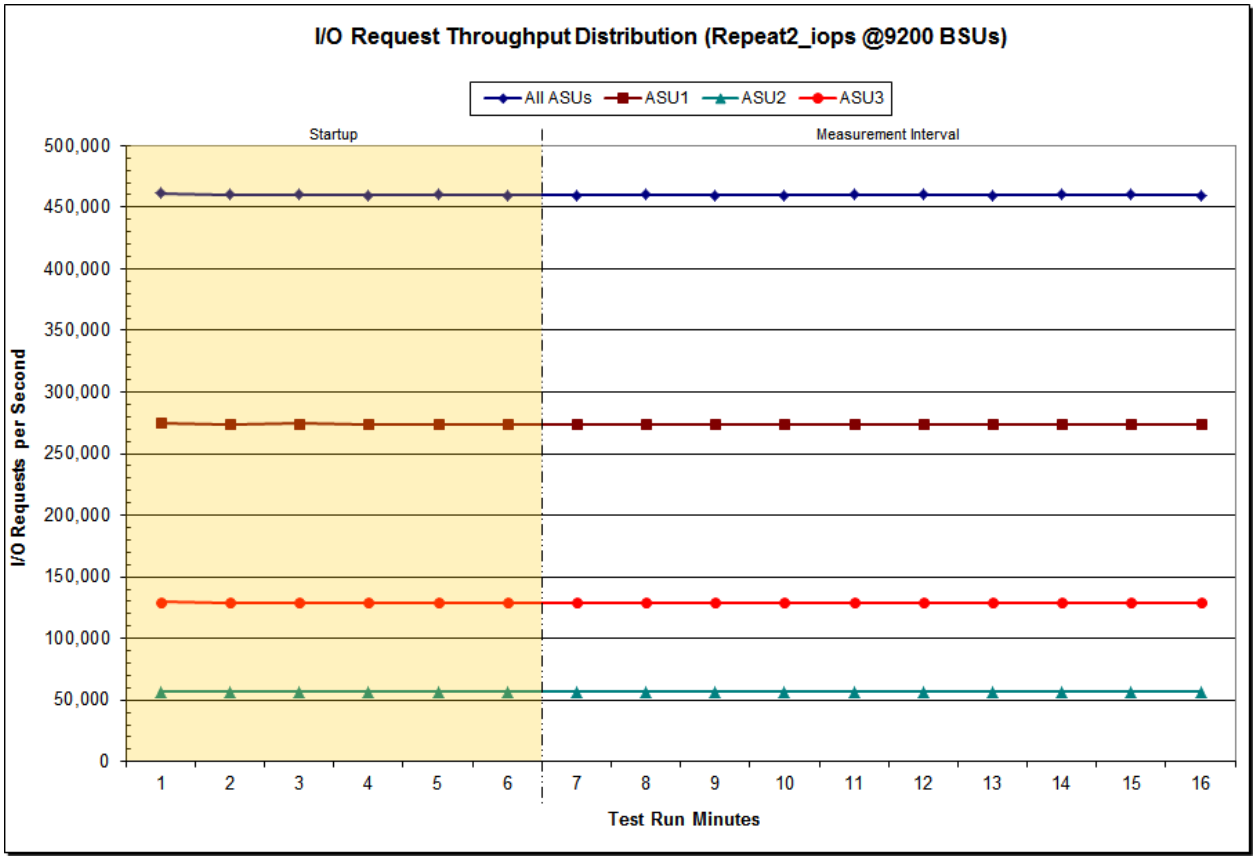
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

9,200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:42:35	4:48:36	0-5	0:06:01
Measurement Interval	4:48:36	4:58:36	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	461,274.87	274,858.10	56,712.22	129,704.55
1	460,024.92	274,163.05	56,602.53	129,259.33
2	460,037.95	274,231.45	56,574.65	129,231.85
3	459,866.12	274,043.17	56,617.33	129,205.62
4	459,982.85	274,119.97	56,600.67	129,262.22
5	459,965.00	274,139.33	56,583.12	129,242.55
6	459,948.13	274,127.78	56,580.30	129,240.05
7	460,044.30	274,191.80	56,605.53	129,246.97
8	459,945.00	274,122.30	56,627.05	129,195.65
9	459,893.85	274,103.32	56,552.47	129,238.07
10	459,993.03	274,106.30	56,593.68	129,293.05
11	460,069.22	274,191.22	56,624.88	129,253.12
12	459,941.65	274,132.60	56,550.57	129,258.48
13	459,978.15	274,137.58	56,543.28	129,297.28
14	460,097.13	274,143.47	56,586.05	129,367.62
15	459,941.43	274,096.12	56,621.05	129,224.27
Average	***459,985.19***	***274,135.25***	***56,588.49***	***129,261.46***

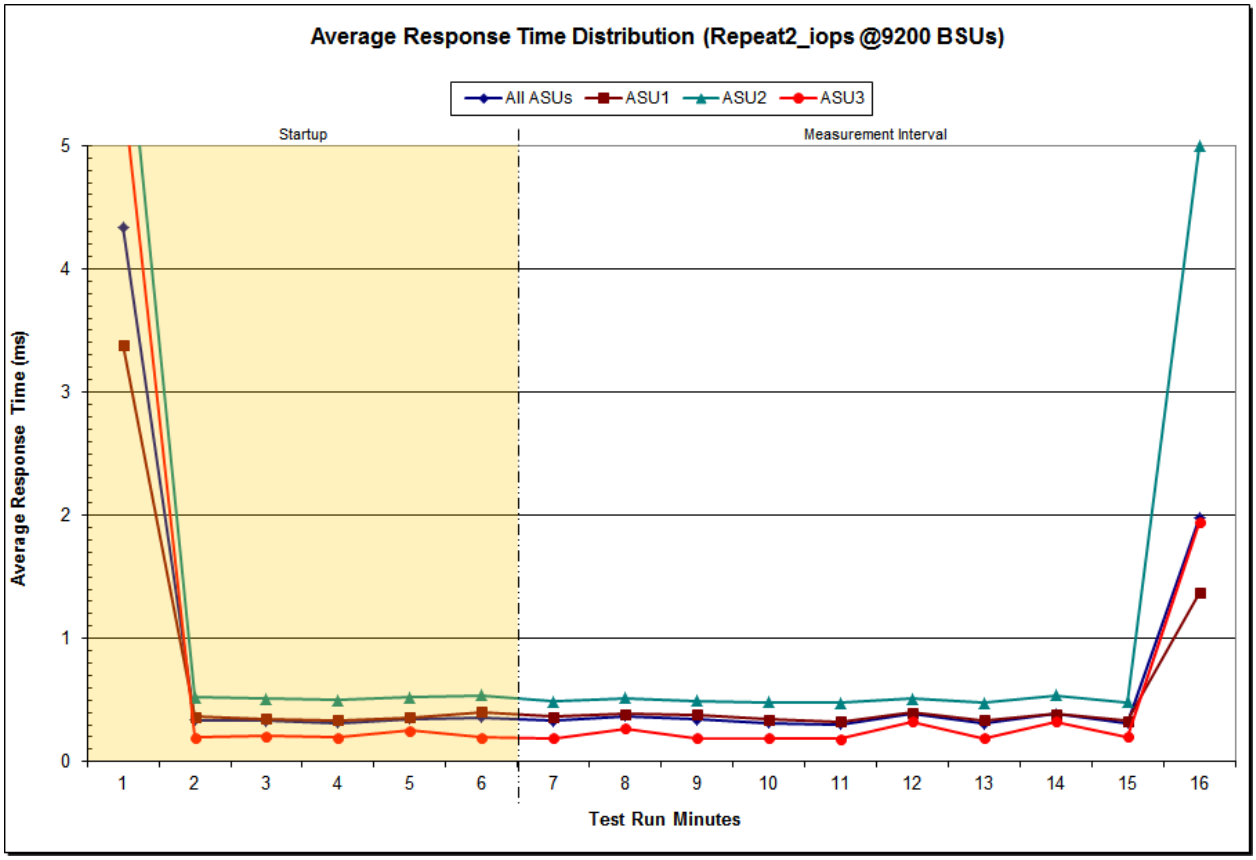
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

9,200 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	4:42:35	4:48:36	0-5	0:06:01
Measurement Interval	4:48:36	4:58:36	6-15	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	4.34	3.39	6.36	5.47
1	0.34	0.37	0.52	0.20
2	0.33	0.35	0.51	0.21
3	0.32	0.34	0.50	0.20
4	0.35	0.36	0.52	0.25
5	0.36	0.40	0.54	0.20
6	0.33	0.36	0.49	0.19
7	0.37	0.39	0.52	0.27
8	0.34	0.38	0.50	0.19
9	0.32	0.34	0.48	0.19
10	0.31	0.33	0.48	0.19
11	0.39	0.40	0.51	0.32
12	0.31	0.34	0.48	0.19
13	0.39	0.39	0.54	0.33
14	0.31	0.33	0.48	0.20
15	1.98	1.37	4.99	1.94
Average	***0.50***	***0.46***	***0.95***	***0.40***

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.*

Clauses5.1.10 and 5.3.15.2

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 5.3.15.3

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	0.0351	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.001	0.003	0.001	0.004	0.003	0.004	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	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.000	0.000	0.002	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	0.0350	0.2811	0.0700	0.2101	0.0179	0.0700	0.0350	0.2809
COV	0.003	0.001	0.003	0.001	0.006	0.002	0.004	0.001

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

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

Data Persistence Test

Clause 6

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

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

The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 IOPS™ 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 Tested Storage Configuration (TSC) 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 9.4.3.8

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 (may be contained in an appendix).*

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 85.

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	838,561.456
Total Number of Logical Blocks Verified	236,235,632
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 9.4.3.9

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 for the Priced Storage Configuration must be the date at which all components are committed to be available.

The DataCore SANsymphony-V 10.0 as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.4.3.3.6

The Executive Summary shall contain a pricing spreadsheet as documented in Clause 8.3.1.

Pricing information may be found in the Priced Storage Configuration Pricing section on page 16.

TESTED STORAGE CONFIGURATION (TSC) AND PRICED STORAGE CONFIGURATION DIFFERENCES

Clause 9.4.3.3.8

The Executive Summary shall contain a list of all differences between the Tested Storage Configuration (TSC) and the Priced Storage Configuration.

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 16.

ANOMALIES OR IRREGULARITIES

Clause 9.4.3.10

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 DataCore SANsymphony-V 10.0.

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

Protected 1: The single point of failure of any ***storage device*** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.

Protected 2: The single point of failure of any ***component*** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.

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.

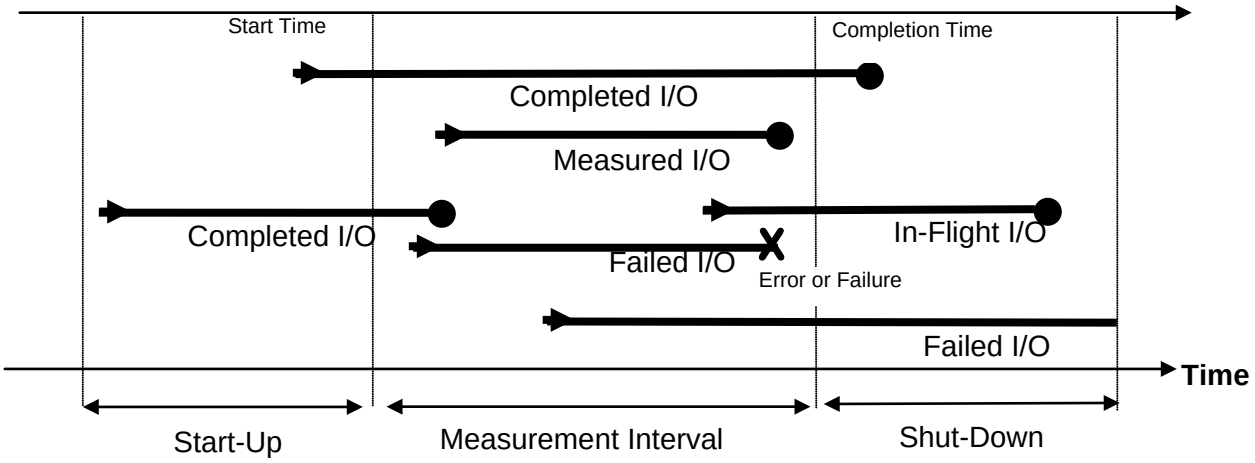
Steady State: The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant.

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

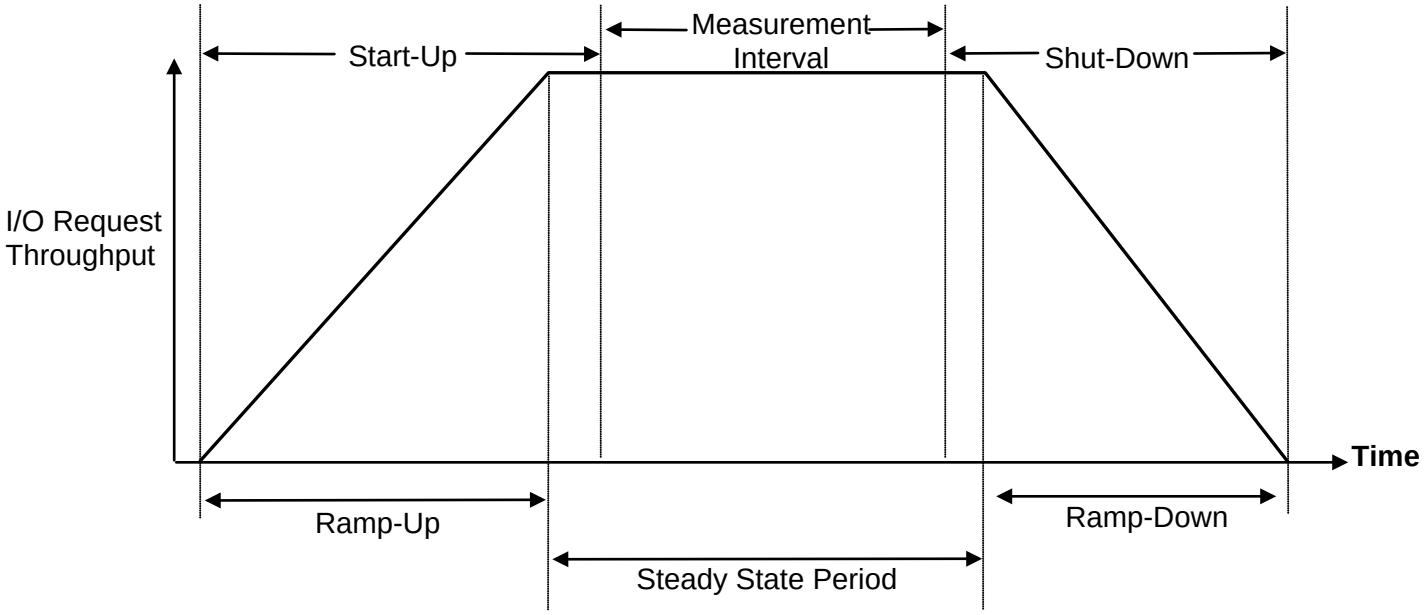
Test Run: The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have 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

Windows 2008 Server Registry Settings

The following Windows 2008 Server registry settings were either changed from their default values or added if they did not exist. Settings changed from their default values will have the default value listed in parenthesis and new settings will be annotated with "(new)".

SANsymphony-V Cache Settings for defined Virtual Disks

[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters]
(will be applied to each virtual disk)

- **WriteSizeStop=dword:46000000** ***(00040000)***
  Maximum amount of dirty data (cache memory locations that have changed but not committed to the backend) in the cache.
- **ReadAhead=dword:00000000** ***(00000001)***
  Enable prefetching. Setting means no prefetching
- **IoQueueCount=dword:00000078** ***(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00024220** ***(00002000)***
  Max number of blocks that can be outstanding to the backend
- **AllowRewrite=dword:00000001** ***(00000000)***
  Enable rewrite. When set, an initiator can overwrite dirty data.
- **CmdPoolSize=dword:0000fa00** ***(new)***
  Number of storage commands that may be simultaneously in progress (global to the entire storage node)
- **MaxLowWaterMark=dword:00000400** ***(new)***
  Point at which the cache is critically short of available blocks and will begin to return busy status to requests.
- **CheckRegSecs=dword:0000003c** ***(new)***
  interval (seconds) at which the driver will check for changes to the registry parameters
- **WriteThruLowWaterMark=dword:00010000** ***(new)***
  Point at which the cache will begin to process all write requests by synchronizing them with the backend. (begins writethrough)

SANsymphony-V Cache settings for defined specific Virtual Disks

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters\V.{434ce28d-45d9-11e5-a922-9abe94f83b67}-00000002

ASU3_1=""

- **IoQueueCount=dword:0000000c *(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00075300 *(00002000)***
  Max number of blocks that can be outstanding to the backend
- **WriteQueueCount=dword:0000000c *(IoQueueCount)***
  Max number of outstanding writes to the backend
- **WriteQueueSize=dword:00075300 *(IoQueueSize)***
  Max number of write blocks that can be outstanding to the backend

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters\V.{434ce28f-45d9-11e5-a922-9abe94f83b67}-00000002

ASU3_2=""

- **IoQueueCount=dword:0000000c *(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00075300 *(00002000)***
  Max number of blocks that can be outstanding to the backend
- **WriteQueueCount=dword:0000000c *(IoQueueCount)***
  Max number of outstanding writes to the backend
- **WriteQueueSize=dword:00075300 *(IoQueueSize)***
  Max number of write blocks that can be outstanding to the backend

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters\V.{434ce291-45d9-11e5-a922-9abe94f83b67}-00000002

ASU3_3=""

- **IoQueueCount=dword:0000000c *(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00075300 *(00002000)***
  Max number of blocks that can be outstanding to the backend
- **WriteQueueCount=dword:0000000c *(IoQueueCount)***
  Max number of outstanding writes to the backend
- **WriteQueueSize=dword:00075300 *(IoQueueSize)***
  Max number of write blocks that can be outstanding to the backend

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters\V.{434ce293-45d9-11e5-a922-9abe94f83b67}-00000002

ASU3_4=""

- **IoQueueCount=dword:00000008** ***(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00075300** ***(00002000)***
  Max number of blocks that can be outstanding to the backend
- **WriteQueueCount=dword:00000008** ***(IoQueueCount)***
  Max number of outstanding writes to the backend
- **WriteQueueSize=dword:00075300** ***(IoQueueSize)***
  Max number of write blocks that can be outstanding to the backend

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters\V.{434ce293-45d9-11e5-a922-9abe94f83b67}-00000003

ASU3_5=""

- **IoQueueCount=dword:00000008** ***(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00075300** ***(00002000)***
  Max number of blocks that can be outstanding to the backend
- **WriteQueueCount=dword:00000008** ***(IoQueueCount)***
  Max number of outstanding writes to the backend
- **WriteQueueSize=dword:00075300** ***(IoQueueSize)***
  Max number of write blocks that can be outstanding to the backend

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsCache\Parameters\V.{434ce293-45d9-11e5-a922-9abe94f83b67}-00000004

ASU3_6=""

- **IoQueueCount=dword:00000008** ***(00000020)***
  Max number of outstanding IOs to the backend
- **IoQueueSize=dword:00075300** ***(00002000)***
  Max number of blocks that can be outstanding to the backend
- **WriteQueueCount=dword:00000008** ***(IoQueueCount)***
  Max number of outstanding writes to the backend
- **WriteQueueSize=dword:00075300** ***(IoQueueSize)***
  Max number of write blocks that can be outstanding to the backend

SANsymphony-V Poller settings

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsPoll\Parameters

- **LoadHighWaterMark=dword:00000004** ***(00000028)***
  Determines when a new scheduler instance is spawned.
- **LoadLowWaterMark=dword:00000000** ***(0000000a)***
  Determines when a scheduler instance is retired.
- **MinPollers=dword:0000001f** ***(00000002) (new)***
  Minimum number of schedulers
- **CpuAffinity=dword:00000001** ***(00000000) (new)***
  Hint that determines scheduler to CPU affinity. (1st on CPU1, 2nd on CPU2, etc.)
- **MaxPollers=dword:0000001f** ***(0000000a) (new)***
  Allows max pollers to increase to 31 and addition of logical Ports to increase to 31

The **MinPollers**, **CpuAffinity** and **MaxPollers** registry entries do not appear by default in the registry editor. If not created explicitly, the "default" values listed in parenthesis will be used. Those registry entries were explicitly created with the documented values for this benchmark configuration.

SANsymphony-V settings for Pools

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsPool\Parameters

- **DisableAutoTrim=dword:00000001** ***(00000000) (new)***
  Disable Auto Trim Storage Allocation Units are not reclaimed automatically when filled with zeros.
- **DisableZeroWrites=dword:00000001** ***(00000000) (new)***
  Disable filling Storage Allocation Units (SAUs) with Zeros when doing garbage collection or initialization. Means newly added disks to pool have been zeroed (e.g. low level format)

The **DisableAutoTrim** and **DisableZeroWrites** registry entries do not appear by default in the registry editor. If not created explicitly, the "default" values listed in parenthesis will be used. Those registry entries were explicitly created with the documented values for this benchmark configuration.

SANsymphony-V settings for specific Pools

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\DcsPool\Parameters\MaxActiveIOsPerDisk

(Set per pool by specifying the Pool's GUID)

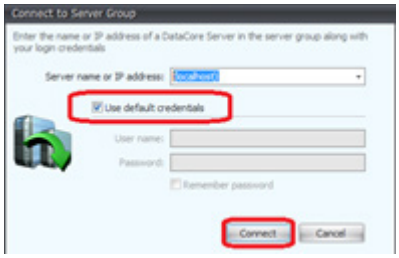
- **{0272bb99-5afc-11e5-ae3f-9abe94f83b67}=dword:00000080** ***(00000020)***
  4MB_Pool1*, 128 IOs per disk in this pool*
- **{0272bbaf-5afc-11e5-ae3f-9abe94f83b67}=dword:00000040** ***(00000020)***
  4MB_Pool2*, 64 IOs per disk in this pool*

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

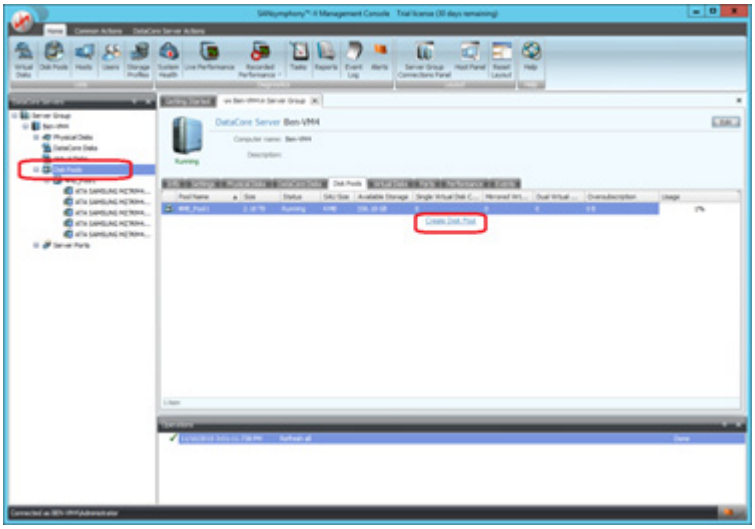
1. **Install SANsymphony-V 10.0 Storage Software:**
   The software installation is performed by running a self-extracting executable file

   After installation, the SANsymphony-V Management Console can be accessed from the Windows "start" menu or by using the desktop shortcut with the DataCore logo. Online help for using the Management Console is located at http://www.datacore.com/SSV-Webhelp/ *(refer the help topic, SANSymphony-V Management Console for more information).*

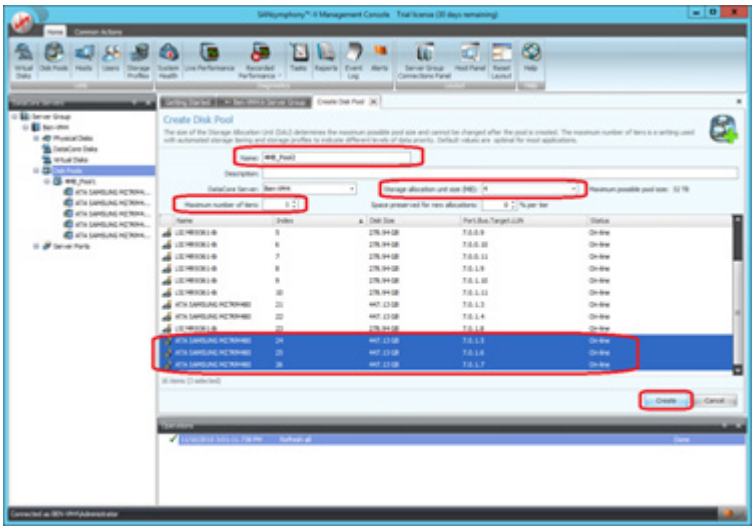
2. Open and log in to the SANsymphony-V Management Console using the following steps. At the end of this step, you will be logged into the management and configuration console:
   a. On the system desktop, double-click on the "SANsymphony-V" icon to start the management console.
   b. Select the "Use default credentials checkbox and click Connect to proceed to the management console:



3. Create pools from managed physical disk resources with the following steps:
   a. In the management console, click **Disk Pools** in the left panel labeled **DataCore Servers**, then click **Create Disk Pool** in the main panel to initiate the next step.



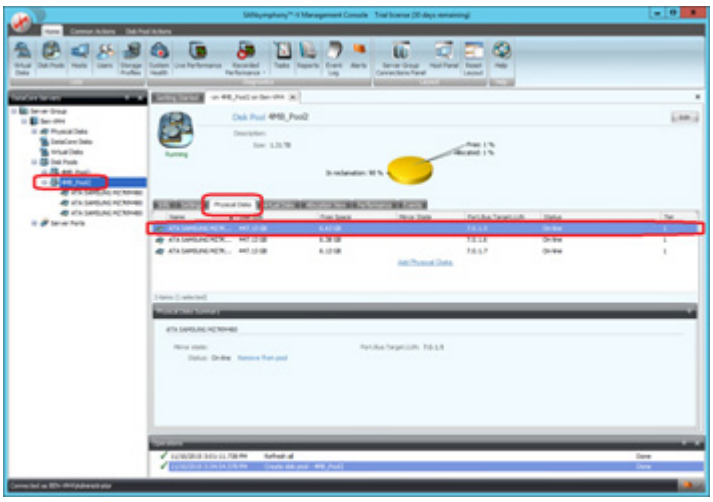
b. On the subsequent screen, in the main panel, complete the **Name:**, **Storage allocation unit size (MB):**, set the **Maximum number of tiers:** to 1, and select the proper type and amount of physical disks in accordance with the table listed below the following screenshot. Click the **Create** button to create the pool after selecting the disks. *(Note: **4MB_Pool1** has been created as an example).* Repeat this step for each of the 6 pools that are to be created:



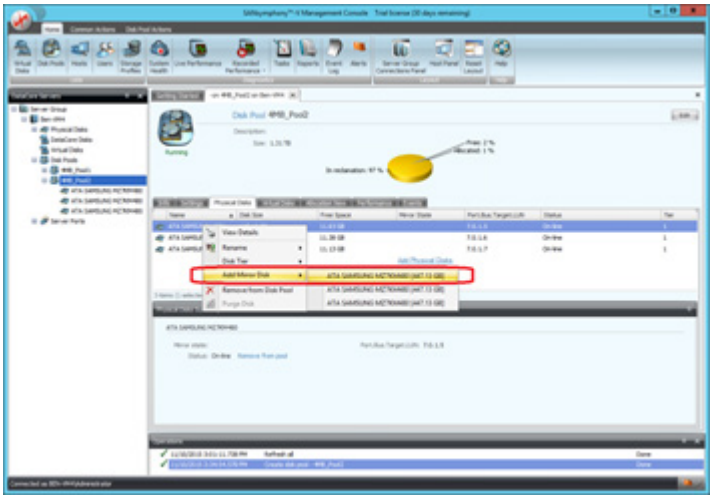
Pool Number	PoolName	Storage Allocation Unit Size(MB)	Number of physical Disks to select (in lower panel)	Type of Physical Disk (from "Name" column in lower panel)
1	4MB_Pool1	4	5	ATA SAMSUNG MZ7KM480
2	4MB_Pool2	4	3	ATA SAMSUNG MZ7KM480
3	32MB_ASU3.1	32	1	LSI MR9361-8i
4	32MB_ASU3.2	32	1	LSI MR9361-8i
5	32MB_ASU3.3	32	1	LSI MR9361-8i
6	32MB_ASU3.4	32	1	LSI MR9361-8i

4. Mirror each pooled physical disk in each pool created in step **3b** by performing step **4a** for each pool, then step **4b** for each disk in the pool.

   a. Select the pool. In the management console, click on a disk pool in the left panel, then click the tab labeled **Physical Disks** in the main panel and then select a disk in the panel below that tab.



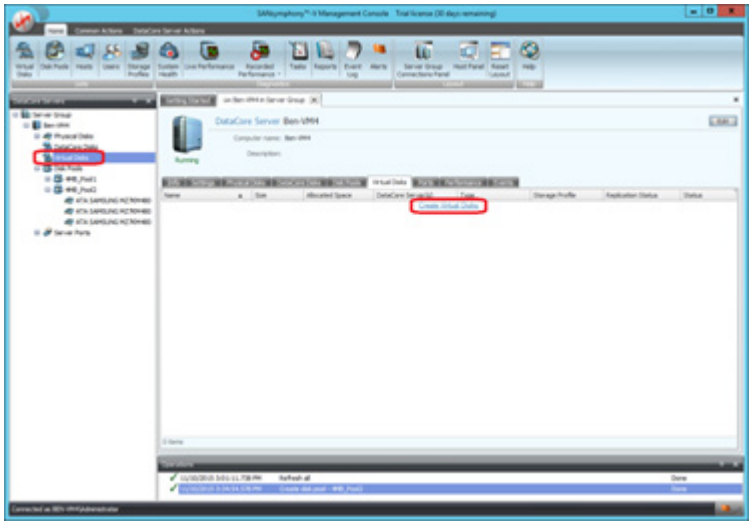
   b. Right-click on the disk (**Name** column) and select **Add Mirror Disk** and select a disk of the same type to mirror to.



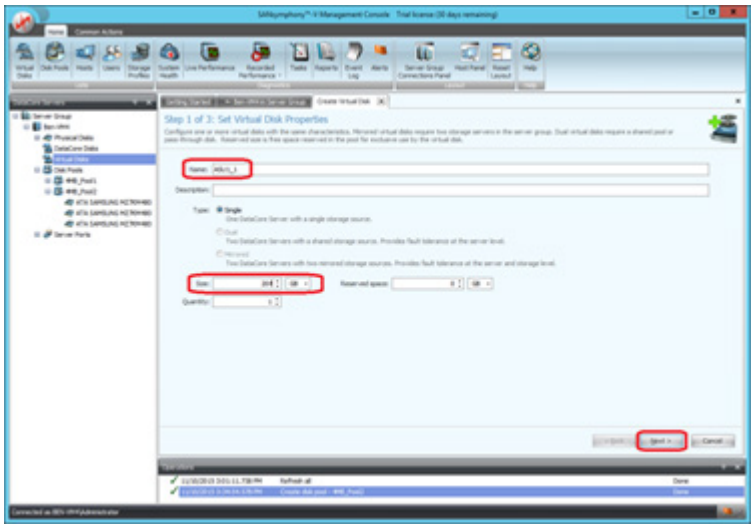
5. Create 14 Virtual Disks repeating steps **5a** through **5d** 14 times, once for each of the virtual disks to be created, using the details in the following table. The virtual disks created in this step will be mapped and are the SPC-1 Logical Volumes use to define the SPC-1 ASUs.'

Virtual Disk Number	Name:	Size: (GB)	Source Pool:
1	ASU1_1	204	4MB_Pool1
2	ASU1_2	204	4MB_Pool1
3	ASU1_3	204	4MB_Pool1
4	ASU1_4	204	4MB_Pool2
5	ASU1_5	204	4MB_Pool1
6	ASU1_6	204	4MB_Pool2
7	ASU2_1	612	4MB_Pool2
8	ASU2_2	612	4MB_Pool1
9	ASU3_1	46	32MB_ASU3.1
10	ASU3_2	46	32MB_ASU3.2
11	ASU3_3	46	32MB_ASU3.3
12	ASU3_4	46	32MB_ASU3.4
13	ASU3_5	46	32MB_ASU3.4
14	ASU3_6	46	32MB_ASU3.4

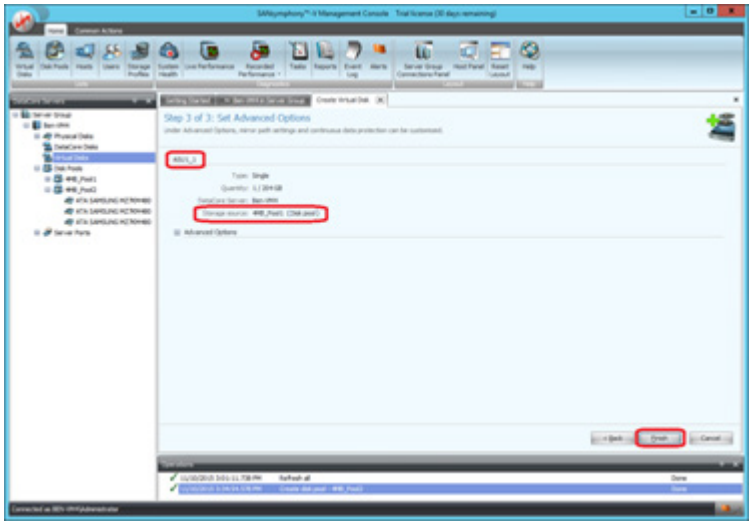
a. In the management console, click **Virtual Disks** in the left panel labeled **DataCore Servers**, then click **Create Virtual Disks** in the main panel.



b. On the subsequent screen, complete the **Name:** and the **Size (GB):** as described in the table above. Click the **Next** button to proceed to the next step. *(Note: **ASU1_1** is being created as an example)*:



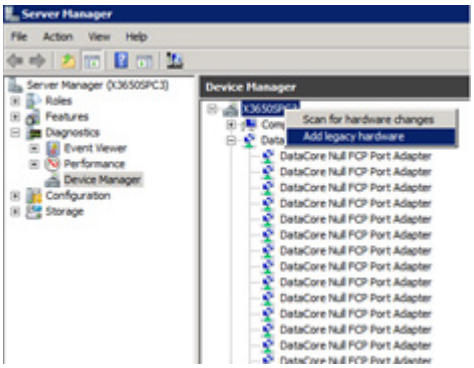
c. On the subsequent screen, set the storage source by clicking on the appropriate entry *(Refer to the above table in step 5.)* under the **Pool Name** column and proceed to the next step by clicking the **Next** button,



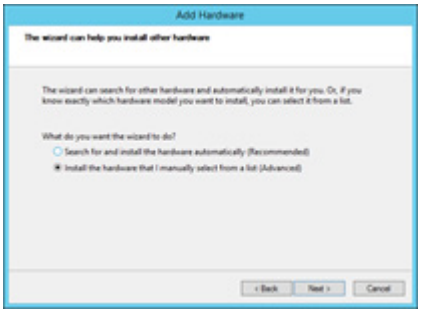
6. Use the Windows 2008 Server registry editor to make the changes documented in *Appendix B: Customer Tunable Parameters and Options* on page 66.

7. Install logical (Null) ports from 5 to 31 *(27 ports total)*. Open the Windows Device Manager and add legacy hardware (see step **7a**) to increase logical ports with the following sequence of steps repeated 27 times. Each iteration will increment the logical device number by 1.

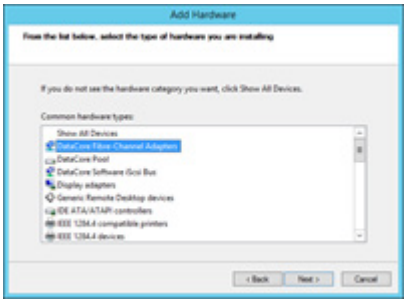
   a. Right click on top of tree and **add legacy hardware** *(see example screenshot)*



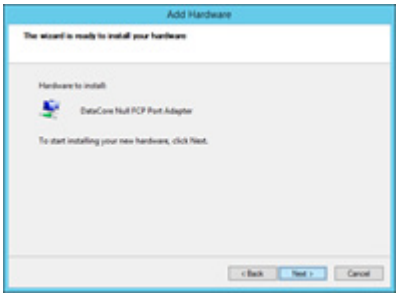
   b. **Install the hardware that I manually select** *(Advanced)'*



   c. Choose **DataCore Fibre-Channel Adapters** *(see example screenshot)*



d. Click the **Next** button to install the Null Port Adapter (see example screenshot)



8. Double-click the desktop icon labeled "SANsymphony-V cmdlet shell to open it and execute the script **ServeVD_jb_bal.ps1**. This script maps the virtual disks created in step 5 to the host via the specified logical ports created in step 7.
   a. Maps virtual disks via logical ports 1-9,11-14 and 29-31 for ASU1_1,2,3,5 and logical ports 18,19 for ASU2_2.
   b. Maps virtual disks via logical ports 10 for ASU1_4 and ASU1_6 and 15-17 for ASU2_1.
   c. Maps virtual disks for ASU3_1-ASU3_6 via logical ports 20-28.

ServeVD_jb_bal.ps1

```
Connect-DcsServer

Write-Host "ASU1_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_1 -InitiatorPort "Loopback
Port 1" -TargetPort "Loopback Port 1"
Start-Sleep -Seconds 4
Write-Host "ASU1_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_1 -InitiatorPort "Loopback
Port 2" -TargetPort "Loopback Port 2"
Start-Sleep -Seconds 4
Write-Host "ASU1_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_1 -InitiatorPort "Loopback
Port 29" -TargetPort "Loopback Port 29"
Start-Sleep -Seconds 4

Write-Host "ASU1_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_2 -InitiatorPort "Loopback
Port 3" -TargetPort "Loopback Port 3"
Start-Sleep -Seconds 4
Write-Host "ASU1_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_2 -InitiatorPort "Loopback
Port 4" -TargetPort "Loopback Port 4"
Start-Sleep -Seconds 4
Write-Host "ASU1_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_2 -InitiatorPort "Loopback
Port 5" -TargetPort "Loopback Port 5"
Start-Sleep -Seconds 4
Write-Host "ASU1_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_2 -InitiatorPort "Loopback
Port 6" -TargetPort "Loopback Port 6"
```

```
Start-Sleep -Seconds 4
Write-Host "ASU1_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_2 -InitiatorPort "Loopback
Port 7" -TargetPort "Loopback Port 7"
Start-Sleep -Seconds 4
Write-Host "ASU1_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_2 -InitiatorPort "Loopback
Port 30" -TargetPort "Loopback Port 30"
Start-Sleep -Seconds 4

Write-Host "ASU1_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_3 -InitiatorPort "Loopback
Port 8" -TargetPort "Loopback Port 8"
Start-Sleep -Seconds 4
Write-Host "ASU1_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_3 -InitiatorPort "Loopback
Port 9" -TargetPort "Loopback Port 9"
Start-Sleep -Seconds 4

Write-Host "ASU1_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_4 -InitiatorPort "Loopback
Port 10" -TargetPort "Loopback Port 10"
Start-Sleep -Seconds 4

Write-Host "ASU1_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_5 -InitiatorPort "Loopback
Port 11" -TargetPort "Loopback Port 11"
Start-Sleep -Seconds 4
Write-Host "ASU1_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_5 -InitiatorPort "Loopback
Port 12" -TargetPort "Loopback Port 12"
Start-Sleep -Seconds 4
Write-Host "ASU1_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_5 -InitiatorPort "Loopback
Port 13" -TargetPort "Loopback Port 13"
Start-Sleep -Seconds 4
Write-Host "ASU1_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_5 -InitiatorPort "Loopback
Port 14" -TargetPort "Loopback Port 14"
Start-Sleep -Seconds 4
Write-Host "ASU1_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_5 -InitiatorPort "Loopback
Port 31" -TargetPort "Loopback Port 31"
Start-Sleep -Seconds 4

Write-Host "ASU1_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU1_6 -InitiatorPort "Loopback
Port 10" -TargetPort "Loopback Port 10"
Start-Sleep -Seconds 4

Write-Host "ASU2_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU2_1 -InitiatorPort "Loopback
Port 15" -TargetPort "Loopback Port 15"
Start-Sleep -Seconds 4
Write-Host "ASU2_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU2_1 -InitiatorPort "Loopback
Port 16" -TargetPort "Loopback Port 16"
Start-Sleep -Seconds 4
Write-Host "ASU2_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU2_1 -InitiatorPort "Loopback
Port 17" -TargetPort "Loopback Port 17"
Start-Sleep -Seconds 4
```

```
Write-Host "ASU2_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU2_2 -InitiatorPort "Loopback
Port 18" -TargetPort "Loopback Port 18"
Start-Sleep -Seconds 4
Write-Host "ASU2_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU2_2 -InitiatorPort "Loopback
Port 19" -TargetPort "Loopback Port 19"
Start-Sleep -Seconds 4

Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 20" -TargetPort "Loopback Port 20"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 21" -TargetPort "Loopback Port 21"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 22" -TargetPort "Loopback Port 22"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 23" -TargetPort "Loopback Port 23"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 24" -TargetPort "Loopback Port 24"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 25" -TargetPort "Loopback Port 25"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 26" -TargetPort "Loopback Port 26"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 27" -TargetPort "Loopback Port 27"
Start-Sleep -Seconds 4
Write-Host "ASU3_1"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_1 -InitiatorPort "Loopback
Port 28" -TargetPort "Loopback Port 28"
Start-Sleep -Seconds 4

Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 20" -TargetPort "Loopback Port 20"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 21" -TargetPort "Loopback Port 21"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 22" -TargetPort "Loopback Port 22"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 23" -TargetPort "Loopback Port 23"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
```

```
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 24" -TargetPort "Loopback Port 24"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 25" -TargetPort "Loopback Port 25"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 26" -TargetPort "Loopback Port 26"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 27" -TargetPort "Loopback Port 27"
Start-Sleep -Seconds 4
Write-Host "ASU3_2"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_2 -InitiatorPort "Loopback
Port 28" -TargetPort "Loopback Port 28"
Start-Sleep -Seconds 4

Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 20" -TargetPort "Loopback Port 20"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 21" -TargetPort "Loopback Port 21"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 22" -TargetPort "Loopback Port 22"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 23" -TargetPort "Loopback Port 23"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 24" -TargetPort "Loopback Port 24"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 25" -TargetPort "Loopback Port 25"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 26" -TargetPort "Loopback Port 26"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 27" -TargetPort "Loopback Port 27"
Start-Sleep -Seconds 4
Write-Host "ASU3_3"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_3 -InitiatorPort "Loopback
Port 28" -TargetPort "Loopback Port 28"
Start-Sleep -Seconds 4

Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 20" -TargetPort "Loopback Port 20"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
```

```
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 21" -TargetPort "Loopback Port 21"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 22" -TargetPort "Loopback Port 22"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 23" -TargetPort "Loopback Port 23"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 24" -TargetPort "Loopback Port 24"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 25" -TargetPort "Loopback Port 25"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 26" -TargetPort "Loopback Port 26"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 27" -TargetPort "Loopback Port 27"
Start-Sleep -Seconds 4
Write-Host "ASU3_4"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_4 -InitiatorPort "Loopback
Port 28" -TargetPort "Loopback Port 28"
Start-Sleep -Seconds 4

Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 20" -TargetPort "Loopback Port 20"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 21" -TargetPort "Loopback Port 21"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 22" -TargetPort "Loopback Port 22"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 23" -TargetPort "Loopback Port 23"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 24" -TargetPort "Loopback Port 24"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 25" -TargetPort "Loopback Port 25"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 26" -TargetPort "Loopback Port 26"
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 27" -TargetPort "Loopback Port 27"
```

```
Start-Sleep -Seconds 4
Write-Host "ASU3_5"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_5 -InitiatorPort "Loopback
Port 28" -TargetPort "Loopback Port 28"
Start-Sleep -Seconds 4

Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 20" -TargetPort "Loopback Port 20"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 21" -TargetPort "Loopback Port 21"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 22" -TargetPort "Loopback Port 22"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 23" -TargetPort "Loopback Port 23"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 24" -TargetPort "Loopback Port 24"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 25" -TargetPort "Loopback Port 25"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 26" -TargetPort "Loopback Port 26"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 27" -TargetPort "Loopback Port 27"
Start-Sleep -Seconds 4
Write-Host "ASU3_6"
Serve-DcsVirtualDisk -Machine x3650SPC3 -VirtualDisk ASU3_6 -InitiatorPort "Loopback
Port 28" -TargetPort "Loopback Port 28"
Start-Sleep -Seconds 4

Disconnect-DcsServer
```

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

ASU Pre-Fill

The content of command and parameter file, used in this benchmark to execute the required ASU pre-fill, is listed below.

```
compratio=1
sd=default,threads=8
sd=asu3_2,lun=\\.\PhysicalDrive35,threads=4
sd=asu3_5,lun=\\.\PhysicalDrive38,threads=4
sd=asu3_6,lun=\\.\PhysicalDrive39,threads=4
sd=asu1_4,lun=\\.\PhysicalDrive29,threads=4
sd=asu3_3,lun=\\.\PhysicalDrive36,threads=4
sd=asu3_4,lun=\\.\PhysicalDrive37,threads=4
sd=asu1_5,lun=\\.\PhysicalDrive30,threads=4
sd=asu1_1,lun=\\.\PhysicalDrive26,threads=4
sd=asu1_6,lun=\\.\PhysicalDrive31,threads=4
sd=asu1_2,lun=\\.\PhysicalDrive27,threads=4
sd=asu3_1,lun=\\.\PhysicalDrive34,threads=4
sd=asu2_1,lun=\\.\PhysicalDrive32,threads=4
sd=asu2_2,lun=\\.\PhysicalDrive33,threads=4
sd=asu1_3,lun=\\.\PhysicalDrive28,threads=4
wd=default,rdpct=0,seek=-1,xfersize=512k
wd=wd1,sd=asu3_2
wd=wd2,sd=asu3_5
wd=wd3,sd=asu3_6
wd=wd4,sd=asu1_4
wd=wd5,sd=asu3_3
wd=wd6,sd=asu3_4
wd=wd7,sd=asu1_5
wd=wd8,sd=asu1_1
wd=wd9,sd=asu1_6
wd=wd10,sd=asu1_2
wd=wd11,sd=asu3_1
wd=wd12,sd=asu2_1
wd=wd13,sd=asu2_2
wd=wd14,sd=asu1_3
rd=asuprefill,wd=wd*,iorate=max,elapsed=24h,interval=60
```

Primary Metrics, Repeatability and Persistence Tests

The content of SPC-1 Workload Generator command and parameter files used in this benchmark to execute the Primary Metrics *(Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase)* and Repeatability *(Repeatability Test Phase 1 and Repeatability Test Phase 2)* Tests are listed below.

```
javaparms="-Xmx768m"
sd=asu1_1,lun=\\.\PhysicalDrive26
sd=asu1_2,lun=\\.\PhysicalDrive27
sd=asu1_3,lun=\\.\PhysicalDrive28
sd=asu1_4,lun=\\.\PhysicalDrive29
sd=asu1_5,lun=\\.\PhysicalDrive30
sd=asu1_6,lun=\\.\PhysicalDrive31
sd=asu2_1,lun=\\.\PhysicalDrive32
sd=asu2_2,lun=\\.\PhysicalDrive33
sd=asu3_1,lun=\\.\PhysicalDrive34
sd=asu3_2,lun=\\.\PhysicalDrive35
sd=asu3_3,lun=\\.\PhysicalDrive36
sd=asu3_4,lun=\\.\PhysicalDrive37
sd=asu3_5,lun=\\.\PhysicalDrive38
sd=asu3_6,lun=\\.\PhysicalDrive39
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

The following script, **RunBench.bat**, was invoked to execute the required ASU pre-fill, 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 the SPC-1 Persistence Test Run 1 *(write phase)* in an uninterrupted sequence.

The second script, **Persist2.bat**, was invoked to execute the SPC-1 Persistence Test Run 2 *(read phase)* after completionof the required TSC power off/power on cycle.

Each of the two scripts included the appropriate command to capture a storage capacity listing as part of the audit.

RunBench.bat

```
rem mode con: cols=160 lines=60
cd c:\BenchmarkRun
powershell.exe c:\BenchMarkRun\GetInfo.ps1 -NoLogo > psOutputStart.txt
rem
rem PreFill ASU space with vdbench
rem
call C:\spc\vdbench\vdbench.bat -f ASU-PreFill-script.cfg -o prefill.out
rem
java -version
rem
rem Change to benchmark results folder
rem
cd C:\BenchmarkRun
rem
rem Metrics sustainability -
rem
java metrics -b 9200 -s 360 -t 28800
rem
rem Repeatability Runs
rem
java repeat1 -b 9200 -s 360
Rem
java repeat2 -b 9200 -s 360
rem
rem Persist runs
rem
java persist1 -b 9200
rem
rem Run persist2 after power cycle
rem
```

Persist2.bat

```
mode con: cols=160 lines=70
cd c:\BenchmarkRun
rem Run second Persist command to validate contents of storage
rem Run persist2 after power cycle
java -Xmx2048m persist2
powershell.exe c:\BenchMarkRun\GetInfo.ps1 -NoLogo > psOutputEnd.txt
```

APPENDIX F: THIRD-PARTY QUOTATION

Priced Storage Configuration

CURVATURE
Formerly Network Hardware Resale

Account Executive: Mike Ferrone
Phone: (805) 690-3731
Fax: +1 (805) 690-1856
Email: mferrone@curvature.com
Address: 6500 Hollister Ave Ste. 210
Santa Barbara, CA 93117
United States

Quote: 00461605
Date : 2015-11-16
Expires : 2016-01-31
Payment Terms: TBD

Customer:
Datacore Software Corporation
Devi Madhavan
(954) 377-6000
devi.madhavan@datacore.com
www.datacore.com

Bill To:
Datacore Software Corporation
Devi Madhavan
,

Ship To:
Datacore Software Corporation
Devi Madhavan
,

Hardware and Software

Line	Product Name	QTY	Product Description	List Price	Sales Price	Total Price
1.0	5462AC1	1	IBM SYSTEM x3650 M5 2.5 SFF 8 BAY HOT SWAP	3,150.00	2,205.00	2,205.00
2.0	E5-2695V3	2	INTEL XEON PROCESSOR E5-2695 V3 (2.30 GHZ/14-CORE/35MB/2133MHZ)	3,499.00	2,449.30	4,898.60
3.0	MISCELLANEOUS	2	HEATSINK	150.00	105.00	210.00
4.0	MISCELLANEOUS	6	SYSTEM FAN	95.00	66.50	399.00
5.0	46W0796	2	IBM 16GB TRUDDR4 MEMORY 2RX4 1.2V PC4-17000 CL15 2133MHZ LP RDIM	399.00	279.30	558.60
6.0	46W0800	16	32GB (1X32GB), PC4-17000, DDR4, 1.2V, LRDIMM	999.00	699.30	11,188.80
7.0	MBF2300RC	1	300GB 10K SAS 2.5" 6G HDD	269.00	188.30	188.30
8.0	MZ-75E500B/AM	1	Samsung 850 EVO 500 GB 2.5" Internal Solid State Drive - SATA	349.00	244.30	244.30
9.0	HUC156030CSS200	8	HDD, 300GB, 12G, SAS, 15K, SFF, WESTERN DIGITAL,	289.75	202.83	1,622.64
10.0	46C9114	2	SERVER RAID M1215 SAS/SATA CONTROLLER	225.00	157.50	315.00
11.0	LENOVO-WARRANTY	1	00NR851 - Lenovo Service/Support - 3 Year Extended Service - Service - 24 x 7 x 4 Hour - On-site - Maintenance - Parts & Labor - Physical Service (SEE NOTE 3)	810.00	688.50	688.50
12.0	LENOVO-WARRANTY	1	00LW731 - Lenovo Remote Technical Support - 3 Year - 24 x 7 x 2 Hour - Technical - Electronic Service (SEE NOTE 3)	1,375.00	1,168.75	1,168.75
13.0	00FK936	2	Lenovo System x 900W High Efficiency Platinum AC Power Supply - 900 W - 120 V AC, 230 V AC	399.00	279.30	558.60
14.0	00FK661	1	LENOVO SYSTEM X3650 M5 PLUS 8X 2.5" HS HDD ASSEMBLY KIT WITH EXPANDER	659.00	461.30	461.30
15.0	00FK676	1	LENOVO SYSTEM X3650 M5 PLUS 8X2.5' HDD ASSEMBLY KIT	249.00	174.30	174.30
16.0	00FK658	1	LENOVO SYSTEM X3650 M5 REAR 2X2.5' HDD KIT	379.00	265.30	265.30
17.0	MZ-7KM480E	16	SSD, 480GB, 6GB, SATA, SFF, SAMSUNG	459.00	321.30	5,140.80
18.0	MISCELLANEOUS	25	00E7600 L38552 - AFTERMARKET 00E7600 L38552 2.5-INCH SFF DRIVE TRAY CADDY FOR IBM/LENOVO X3650 M5, X3550 M5, X3250 M5, X3850 X6, X3950 X6 (SEE NOTE 4)	119.00	83.30	2,082.50

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Priced Storage Configuration *(continued)*

CURVATURE
Formerly Network Hardware Resale

Account Executive: Mike Ferrone
Phone: (805) 690-3731
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Email: mferrone@curvature.com

Quote: 00461605
Date : 2015-11-16
Expires : 2016-01-31
Payment Terms: TBD

19.0	4XI0E51561	1	WINDOWS SVR 2012 R2 STANDARD ROK 2 CPUS/2 VMS	700.00	630.00	630.00
20.0	HSX-EWR-100-008	1	SANSYMPHONY-V VIRTUAL SAN HS8 LICENSE F/ 1 SERVER W/ UP TO 8 TBS	4,000.00	3,600.00	3,600.00
21.0	HSX-EWR-TGD-008	1	3YR SUP SANSYMPHONY-V HS8 VIRTUAL SAN LICS FOR 1 SERVER	2,000.00	1,800.00	1,800.00

TOTAL LIST PRICE: 52,475.00
DISCOUNT: 14,074.71
[redacted]

HARDWARE AND SOFTWARE SUBTOTAL USD: 38,400.29

Maintenance and Services

Line	Product Name	Covered Hardware	QTY	Product Description	Duration	Period	Sales Price	Total Price
11.0	LENOVO-WARRANTY		1	00NR851 - Lenovo Service/Support - 3 Year Extended Service - Service - 24 x 7 x 4 Hour - On-site - Maintenance - Parts & Labor - Physical Service (SEE NOTE 3)	1	Year	688.50	688.50
12.0	LENOVO-WARRANTY		1	00LW731 - Lenovo Remote Technical Support - 3 Year - 24 x 7 x 2 Hour - Technical - Electronic Service (SEE NOTE 3)	1	Year	1,168.75	1,168.75

MAINTENANCE AND SERVICES SUBTOTAL USD: 1,857.25

SUBTOTAL: 38,400.29
FREIGHT: TBD
TAX (%):
D&T:
TOTAL USD: 38,400.29

NOTES:
1. DISCOUNT CLARIFICATION - This quote reflects a 10% discount on software, a 30% discount on hardware, and a 15% discount on services and support. These discounts are unconditional.

2. OPERATING SYSTEM DOWNGRADE - With the purchase of a Lenovo Windows 2012 license, you are able to downgrade but the downgrade media is required after point of sale from Lenovo. The Windows 2012 downgrade must be requested through Lenovo. Here is a link that details the process: https://support.lenovo.com/us/en/documents/ht101582

3. LENOVO SUPPORT - Lenovo support covers all hardware components, including hard drives or solid state drives, as long as a Service pack is attached. Service level is determined by selected Service pack. In this case, 4HR on-site repair. The technical warranty

Page 2 of 3

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Priced Storage Configuration *(continued)*

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Quote: 00461605
Date : 2015-11-16
Expires : 2016-01-31
Payment Terms: TBD

refers to the service level of remote technical support. This service is over the phone/internet as it is remote. In this case, the service level is 2HR response.

4. LENOVO DRIVE TRAY - Lenovo drive trays are typically bundled with hard drives and don't have an individual part number. These are Lenovo OEM trays and will come installed on all hard drives.

Freight and taxes TBD upon shipping location and terms.
Returns subject to 20% restocking fee within 30 days; software, warranties, and other special order items may not be returned. Lifetime warranty on all pre-owned OEM hardware and all new Curvature hardware. See warranty agreement for details. The commodities, technology, and/or software set forth above (collectively, the "Products") are sold and exported in accordance with all applicable laws including, but not limited to, the US Export Administration Regulations administered by the US Department of Commerce, the European Union 428/2009 export regulations, Singapore's Strategic Goods Control Act, and all other applicable import and export laws. Diversion contrary to any such laws is prohibited. Customer and, if applicable, its appointed agent, agree to comply with all such laws. Curvature provides this Quote subject to its right to require Customer to sign an Export Control Certification and provide further details regarding Customer's intentions for the Products (including final destination, intended end use and intended end user) prior to shipment being made. Customer's failure to provide such certification and information upon request may result in Curvature's cancellation of this Quote.

APPROVAL

Datacore Software Corporation	**Curvature**
Signature:_____	Signature:_____
Name:_____	Name:_____
Title: _____	Title: _____

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