SPC BENCHMARK 2™
FULL DISCLOSURE REPORT

FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS
ETERNUS DX8900 S3 STORAGE ARRAY

SPC-2™ V1.5

Submitted for Review: May 5, 2016
Submission Identifier: B00079

First Edition – May 2016

Trademarks

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AUDIT CERTIFICATION

Kun Katsumata
Fujitsu America, Inc.
1250 East Arques Ave.
P.O. Box 3470
Sunnyvale, CA 94088 3470

May 5, 2016

The SPC Benchmark 2™ Reported Data listed below for the **Fujitsu Storage Systems ETERNUS DX8900 S3** were produced in compliance with the SPC Benchmark 2™ V1.5 Onsite Audit requirements.

SPC Benchmark 2™ 1.5 Reported Data	
Tested Storage Product (TSP) Name: Fujitsu Storage Systems ETERNUS DX8900 S3	
Metric	**Reported Result**
SPC-2 MBPS™	70,120.92
SPC-2 Price-Performance	$24.37/SPC-2 MBPS™
ASU Capacity	30,923.765 GB
Data Protection Level	Protected 2 *(Mirroring)*
Total Price *(including three-year maintenance)*	$1,708,835.40
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

The following SPC Benchmark 2™ Onsite Audit requirements were reviewed and found compliant with V1.5 of the SPC Benchmark 2™ Specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by physical inspection and documentation supplied by Fujitsu Limited:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of the Application Storage Unit (ASU) and requirements.
- The total Application Storage Unit (ASU) Capacity was filled with random data prior to the execution of the SPC-2 Tests.

Gradient Systems, Inc.
643 Bair Island Road, Suite 103
Redwood City, CA 94062
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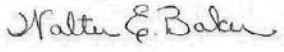
AUDIT CERTIFICATION *(CONT.)*

- An appropriate diagram of the Benchmark Configuration/Tested Storage Configuration.
- Physical verification of the components to match the above diagram
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration.
- Documentation of all customer tunable parameters and options that were changed from default values.
- The following Host System items were verified by physical inspection and documentation supplied by Fujitsu Limited:
  - ✓ Required Host System configuration information.
  - ✓ The TSC boundary within the Host System.
- The following SPC-2 Workload Generator information was verified by physical inspection and documentation supplied by Fujitsu Limited:
  - ✓ The presence and version number of the Workload Generator on each Host System.
  - ✓ Commands and parameters used to configure the SPC-2 Workload Generator.
- The execution of each Test, Test Phase, and Test Run was observed and found compliant with all of the requirements and constraints of Clauses 6, 7 and 12 of the SPC-2 Benchmark Specification.
- The Test Results Files and resultant Summary Results Files received from Fujitsu Limited for each of the following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 6, 7 and 12 of the SPC Benchmark 2™ Specification:
  - ✓ Data Persistence Test
  - ✓ Large File Processing Test
  - ✓ Large Database Query Test
  - ✓ Video on Demand Delivery Test
- There were no differences between the Tested Storage Configuration and Priced Storage Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 9 of the SPC Benchmark 2™ Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 10 of the SPC Benchmark 2™ 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

Gradient Systems, Inc.
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LETTER OF GOOD FAITH

FUJITSU

Kanagawa-ken,Kawasaki-shi,Nakahara-ku,Kamikodanaka,4-1-1,JAPAN211-8588
Phone: 044-754-3423

April 12, 2016
From: Yoshinori Terao, Fujitsu Limited

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

Subject: SPC-2 Letter of Good Faith for the FUJITSU Storage ETERNUS DX8900 S3

Fujitsu Limited is the SPC-2 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-2 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V1.5 of the SPC-2 benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark necessary to reproduce the reported results even if the items are not explicitly required to be disclosed by the SPC-2 benchmark specification.

Signed: Date:

Yoshinori Terao — April 12, 2016

Yoshinori Terao
Vice President, Storage System Division

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu America, Inc. Kun Katsumata kkatsumata@us.fujitsu.com 1250 East Arques Ave PO Box 3470 Sunnyvale, CA 94088-3470 Phone: (408) 746-6415
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage Fujitsu America, Inc. Eugene Owens eownes@us.fujitsu.com 1250 East Arques Ave PO Box 3470 Sunnyvale, CA 94088-3470 Phone: (408) 746-6415
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Yoshinori Terao terao.yoshinori@jp.fujitsu.com 1-1 Kamikodanaka 4-chome, Nakahara-ku, Kawasaki-shi, Kanagawa-ken 211-8588, Japan Phone: (044) 754-3424 FAX: (044) 754-3719
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-2 Specification revision number	V1.5
SPC-2 Workload Generator revision number	V1.2
Date Results were first used publicly	May 5, 2016
Date FDR was submitted to the SPC	May 5, 2016
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	May 4, 2016

Tested Storage Product (TSP) Description

The Fujitsu Storage ETERNUS DX8900 S3 systems are purpose-built for large enterprises and ideal for the data management of business-critical core applications and the consolidation of biggest data centers. The Quad Star Architecture with 2 to 24 controllers provides storage capacity with up to 4608 disk drives.

SPC-2 Reported Data

SPC-2 Reported Data consists of three groups of information:

- The following SPC-2 Primary Metrics, which characterize the overall benchmark result:
  - SPC-2 MBPS™
  - SPC-2 Price Performance™
  - Application Storage Unit (ASU) Capacity
- Supplemental data to the SPC-2 Primary Metrics.
  - Total Price
  - Data Protection Level
  - Currency Used
  - Target Country
- Reported Data for each SPC Test: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand Delivery (VOD) Test.

SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

SPC-2 Price-Performance™ is the ratio of **Total Price** to **SPC-2 MBPS™**.

ASU *(Application Storage Unit)* **Capacity** represents the total storage capacity available to be read and written in the course of executing the SPC-2 benchmark.

Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 18.

Data Protection Level of **Protected 2** using ***Mirroring***, which configures two or more identical copies of user data.

> ***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-2 Data Repository.*

Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-2 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.

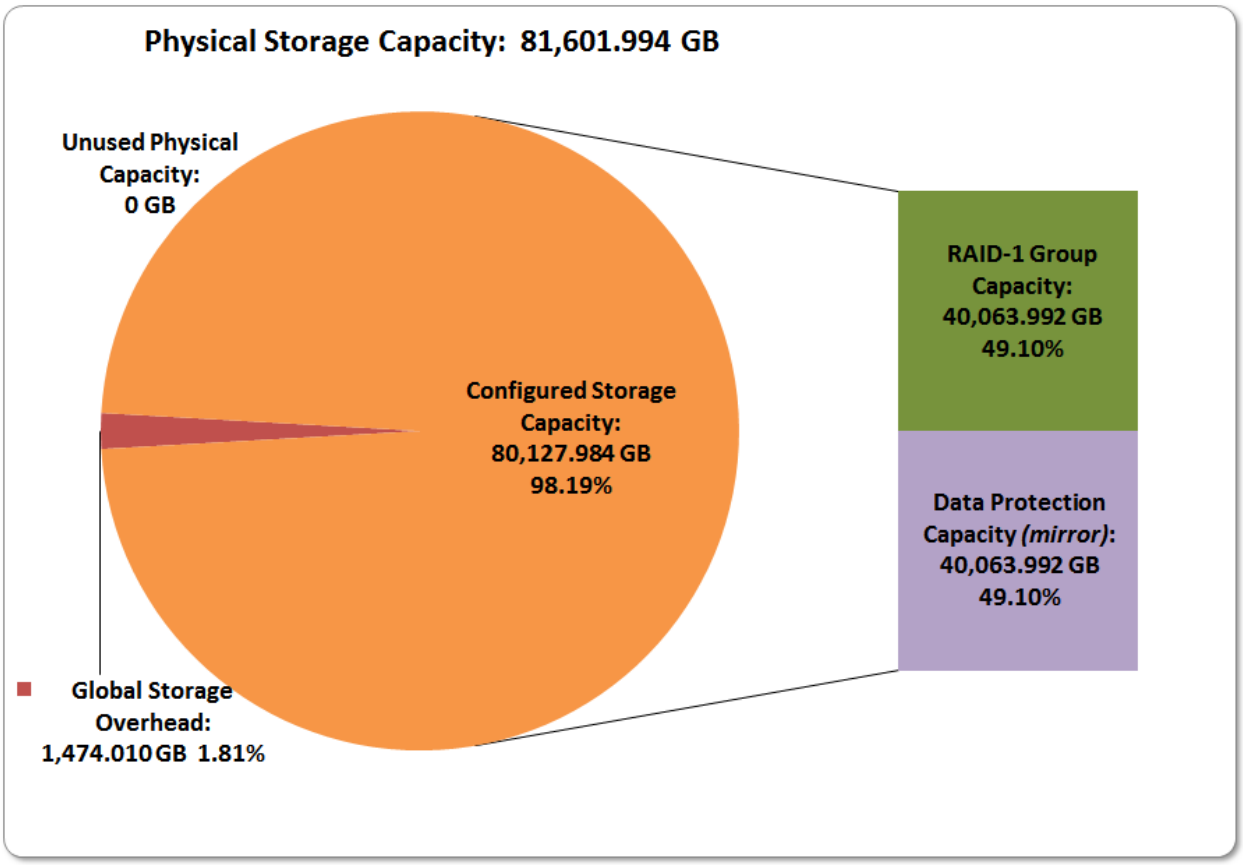
SPC-2 Reported Data *(continued)*

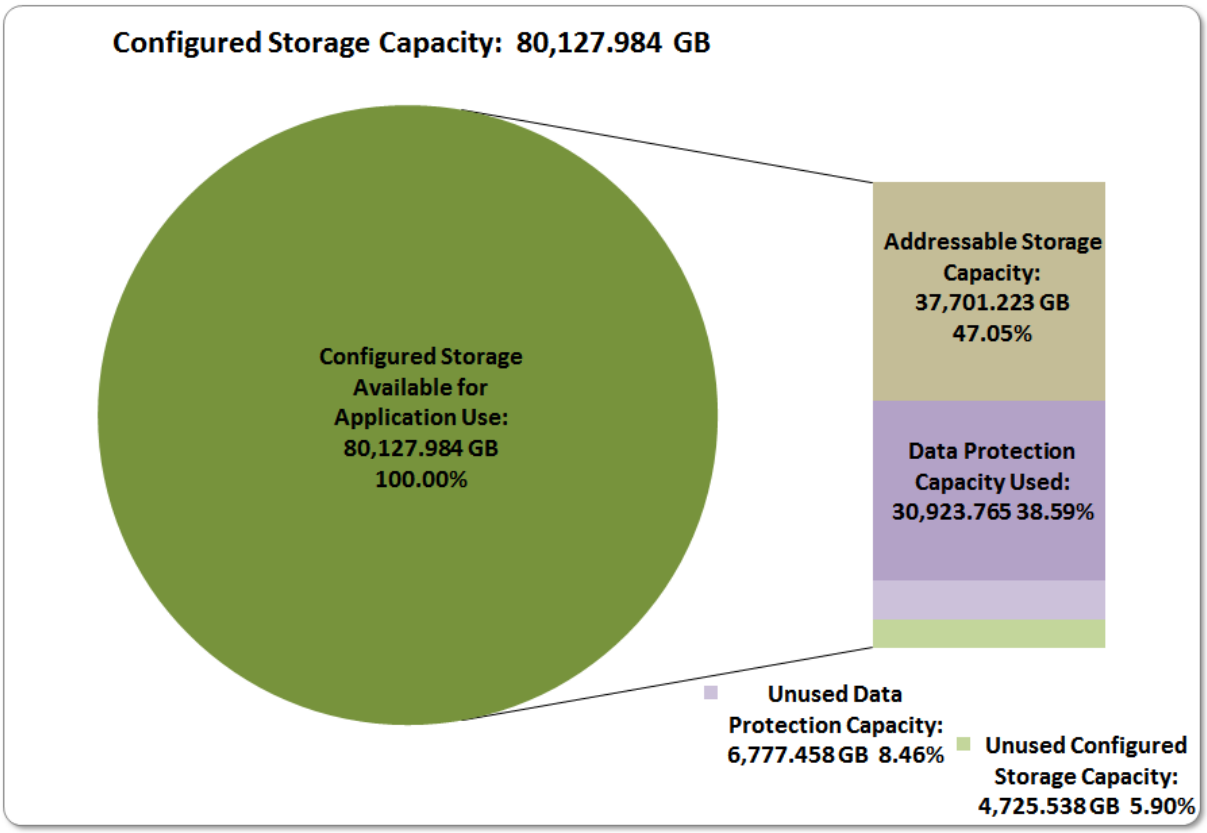
SPC-2 Reported Data				
Fujitsu ETERNUS DX8900 S3				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
70,120.92	$24.37	30,923.765	$1,708,835.40	Protected 2 *(mirroring)*
The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD)				
Currency Used:		**"Target Country":**		
U.S. dollars		USA		
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LFP Composite	52,589.36			$32.49
Write Only:				
1024 KiB Transfer	26,749.00	192	139.32	
256 KiB Transfer	28,959.04	192	150.83	
Read-Write:				
1024 KiB Transfer	50,403.05	192	262.52	
256 KiB Transfer	50,207.67	192	261.50	
Read Only:				
1024 KiB Transfer	77,074.27	2,308	33.39	
256 KiB Transfer	82,143.15	3,840	21.39	
The above SPC-2 Data Rate value for LFP Composite represents the aggregate performance of all three LFP Test Phases: (Write Only, Read-Write, and Read Only).				
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LDQ Composite	84,083.42			$20.32
1024 KiB Transfer Size				
4 I/Os Outstanding	79,428.97	1,264	62.84	
1 I/O Outstanding	79,277.92	3,264	24.29	
64 KiB Transfer Size				
4 I/Os Outstanding	84,513.51	614	137.64	
1 I/O Outstanding	93,113.27	615	151.40	
The above SPC-2 Data Rate value for LDQ Composite represents the aggregate performance of the two LDQ Test Phases: (1024 KiB and 64 KiB Transfer Sizes).				
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
	73,689.99	93,700	0.79	$23.19

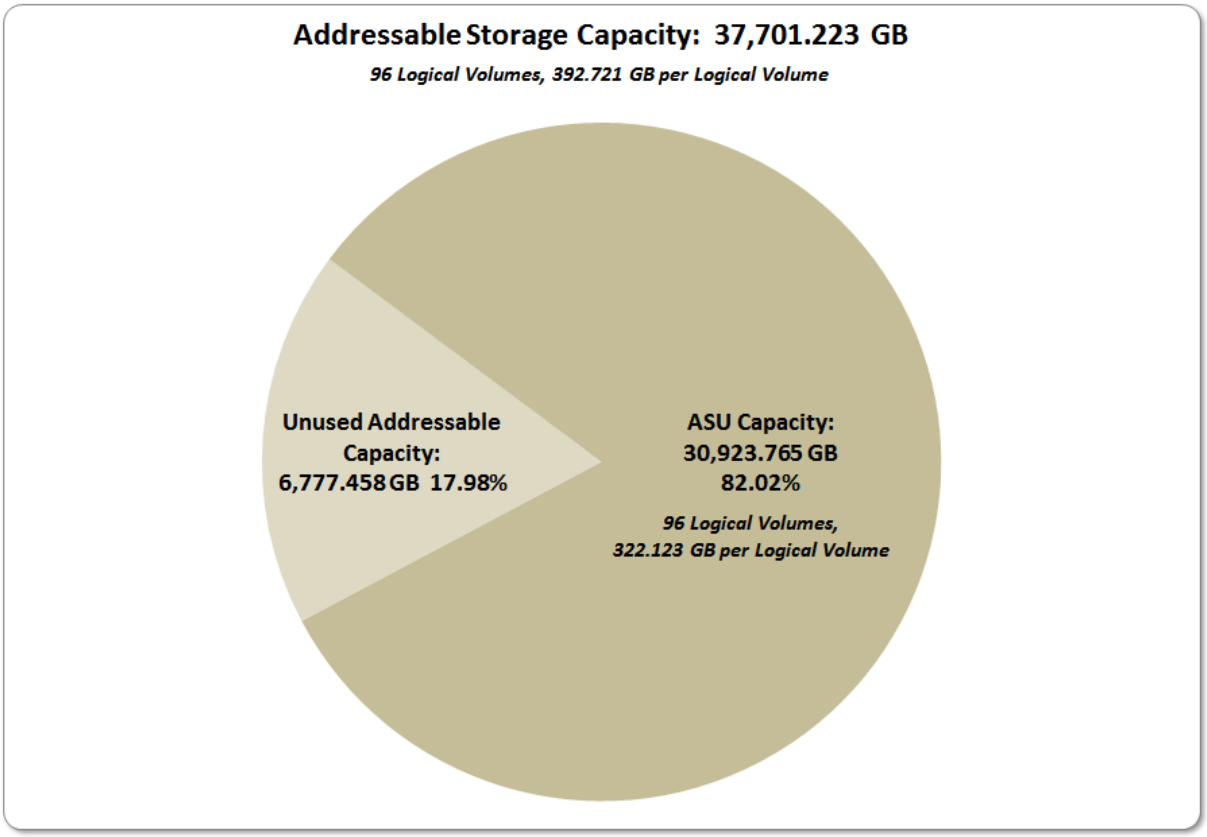
Storage Capacities, Relationships and Utilization

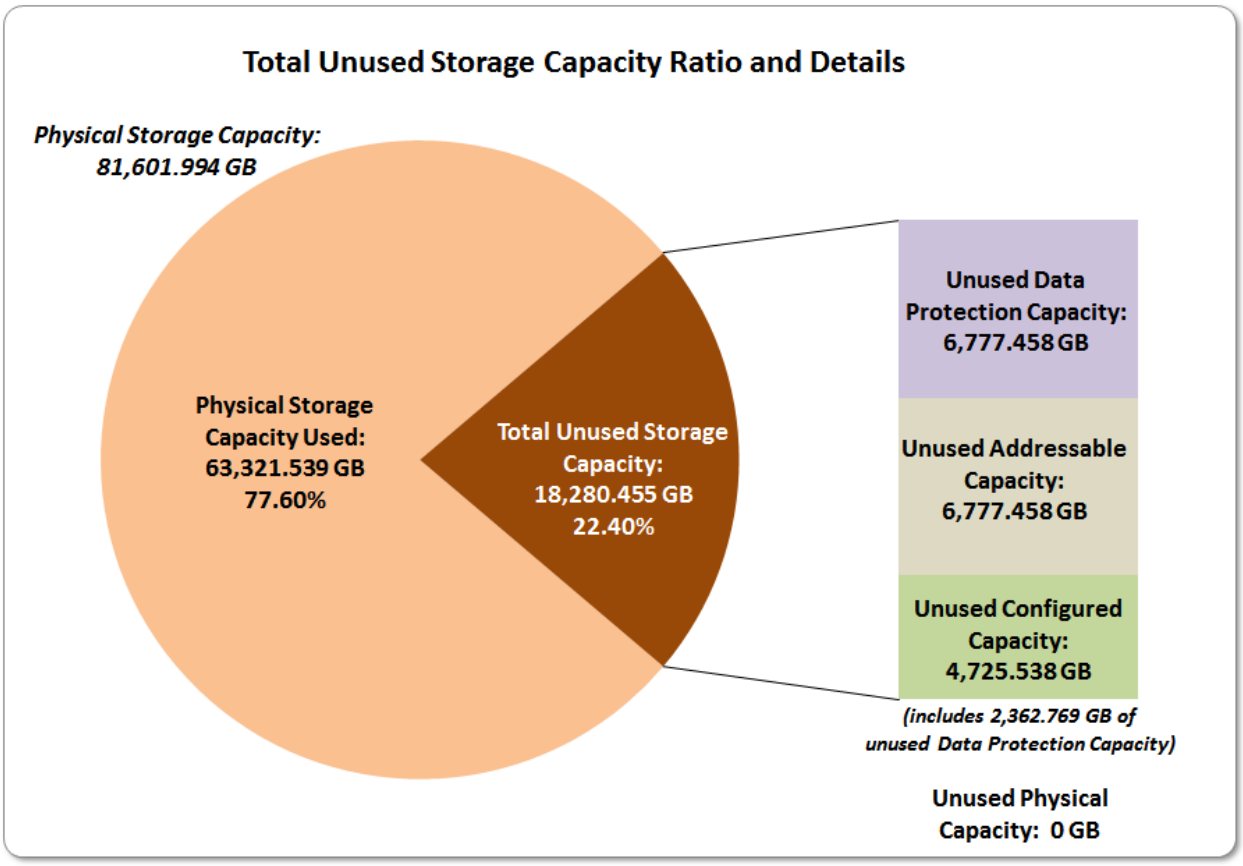
The following four charts and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.

The capacity values in each of the following four charts are listed as integer values, for readability, rather than the decimal values listed elsewhere in this document.




Configured Storage Capacity: 80,127.984 GB
Configured Storage Available for Application Use: 80,127.984 GB 100.00%
Addressable Storage Capacity: 37,701.223 GB 47.05%
Data Protection Capacity Used: 30,923.765 38.59%
Unused Data Protection Capacity: 6,777.458 GB 8.46%
Unused Configured Storage Capacity: 4,725.538 GB 5.90%


Addressable Storage Capacity: 37,701.223 GB
96 Logical Volumes, 392.721 GB per Logical Volume
Unused Addressable Capacity: 6,777.458 GB 17.98%
ASU Capacity: 30,923.765 GB 82.02%
96 Logical Volumes, 322.123 GB per Logical Volume



SPC-2 Storage Capacity Utilization	
Application Utilization	37.90%
Protected Application Utilization	75.79%
Unused Storage Ratio	22.40%

Application Utilization: ASU Capacity *(30,923.765 GB)* divided by Physical Storage Capacity *(81,601.994 GB)*.

Protected Application Utilization: ASU Capacity *(30,923.765 GB)* plus total Data Protection Capacity *(40,063.992 GB)* minus unused Data Protection Capacity *(6,777.458 GB)* divided by Physical Storage Capacity *(81,601.994 GB)*.

Unused Storage Ratio: Total Unused Capacity *(18,280.455 GB)* divided by Physical Storage Capacity *(81,601.994 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 33-34.

Priced Storage Configuration Pricing

Quantity	Part Number	Description	Unit List Price	Extended List Price
1	ET893SAU	ET DX8900 S3 BASE RM CONTR. X2	$990,000.00	$990,000.00
4	ETSMC12	DX87/8900S3 128G MEM.SET F.2CONTR.8X8DIM	$50,000.00	$200,000.00
1	ETSKA30	DX87/8900S3 EXT. CABLES F.FE 8X3M 4X3M	$3,187.50	$3,187.50
2	ETSKA50	DX87/8900S3 EXT. CABLES F.FE 8X3M 4X5M	$3,437.50	$6,875.00
16	ETSHFC4U	DX8X00 S3 INTERFCARD FC 4PORT 16G X1	$16,600.00	$265,600.00
1	ETEXP7S42UD-S3	DX8X00S3 EXP RACK SYM 700MM 42U ET-DOOR	$99,999.99	$99,999.99
1	ETBAS7S42UD-S3	DX8X00S3 BAS RACK SYM 700MM 42U ET-DOOR	$99,999.99	$99,999.99
13	S26361-F4530-E131	Dummy panel kit 1U plast.	$17.00	$221.00
17	S26361-F4530-E132	Dummy panel kit 2U plast.	$23.00	$391.00
4	S26361-F2262-E31	Socket strip 3phase 3x 8 sockets	$210.00	$840.00
3	ETSCAU	ET DX8900S3 CONTROLLERENCL. CONTR. X2	$119,178.57	$357,535.71
16	ETSEADU	ET DX8X00S3 DRIVEENCL. 2.5 X1	$8,705.55	$139,288.80
180	ETSSA4N	DX8X00S3 MLC SSD SAS 400GB 2.5 X1	$9,638.89	$1,735,000.20
12	ETSSA8N	DX8X00S3 MLC SSD SAS 800GB 2.5 X1	$17,111.11	$205,333.32
1	ET8900-W004360-AAF	Warranty, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite	$0.00	$0.00
Hardare & Software Subtotal with 36 Manths Support				**$4,104,272.51**
1	ET8900-N067005-AAF	during normal business hours,Eternus Installation, One Time billing	$6,300.00	$6,300.00
20	FCDX-INPSR	RACK INSTALLATION ETERNUS DX/JX PRODUCTS	$50.00	$1,000.00
Installation Subtotal				**$7,300.00**
64	61-343827-005	LC-LC 10 GIGABIT MULTIMODE OM3 LASER OPTIMIZED DUPLEX 50/125 FIBER PATCH CABLE RISER RATED AQUA - 5M	$140.00	$8,960.00
32	S26361-F4994-L502	PFC EP LPe16002	$2,114.00	$67,648.00
Additional Hardware Subtotal				**$76,608.00**

Product Category	List Price	Discount	Discounted Price
Hardware & Software Subtotal	$4,104,272.51	60%	$1,641,709.00
Service Subtotal	$7,300.00	20%	$5,840.00
Additional Hardware Subtotal	$76,608.00	20%	$61,286.40
Grand Total	**$4,188,180.51**		**$1,708,835.40**

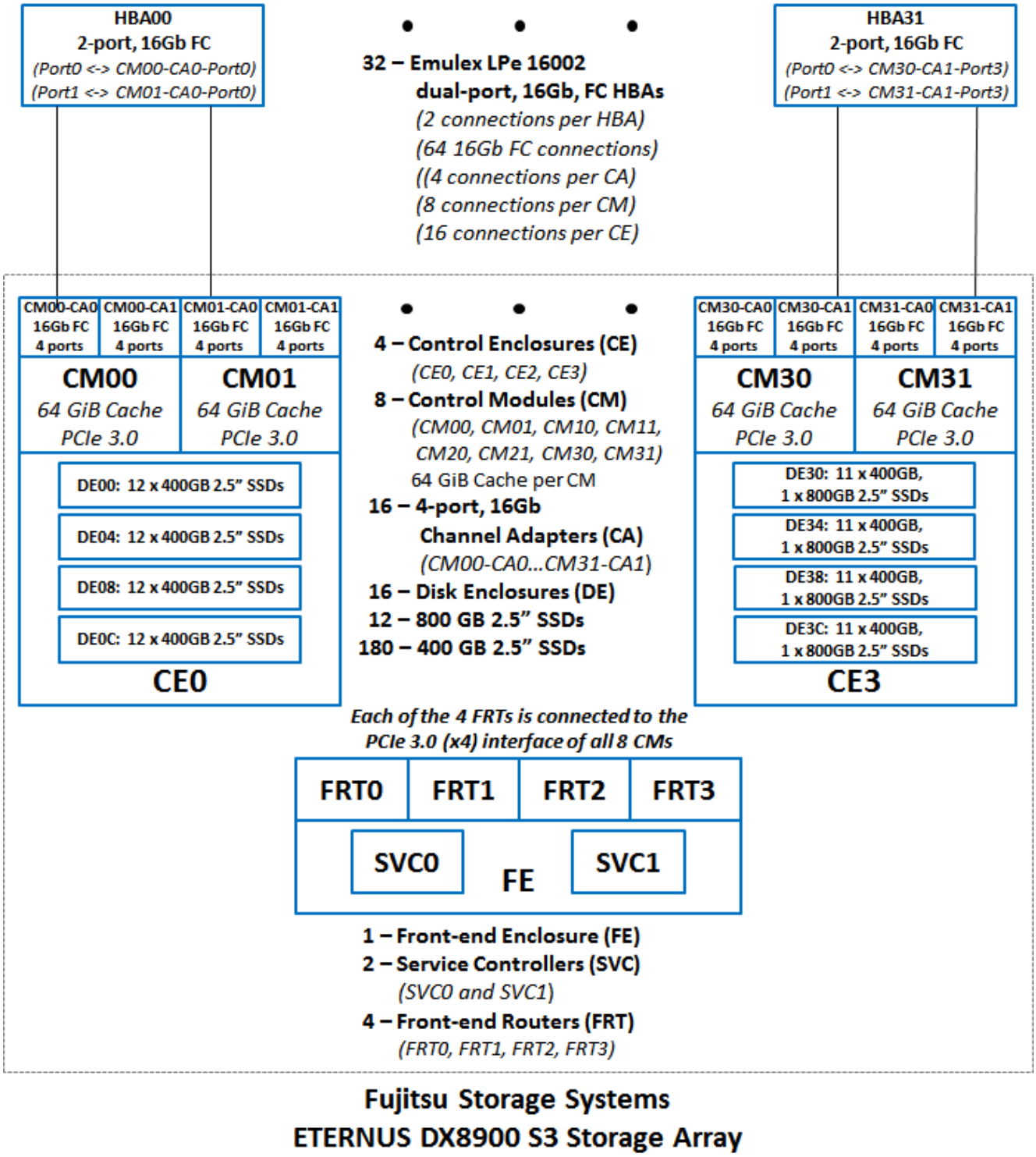
The above pricing includes the following:

- Acknowledgement of new and existing hardware and/or software problems within four hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration component.

Differences between the Tested Storage Configuration and Priced Storage Configuration

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

Priced Storage Configuration Diagram



Fujitsu Storage Systems
ETERNUS DX8900 S3 Storage Array

Priced Storage Configuration Components

Priced Storage Configuration
32 – Emulex LPe 16002 dual-port 16 Gbps FC HBAs
Fujitsu Storage Systems ETERNUS DX8900 S3 Storage Array 1 – Front-end Enclosure (FE) which includes: 2 – Service Controllers (SVC) 4 – Front-end Routers (FRT) 4 – DX8900 S3 Control Enclosures each with 2 – Control Modules (CM), 8 CMs total each with 64 GiB cache *(128 GiB total per CM, 1,024 GiB total)* 2 – Channel Adapters (CA), 16 CAs total each with 4 – 16Gbps FC Host Ports *(8 ports per CM total and used, 64 ports total and used)* 4 – SAS Expander Drive Interfaces with QSFP 12 Gbps SAS-3 *(1 – SAS-3 x4 link per interface)* *(4 links total and used per CM, 32 links total and used)* 4 – DX 8X00 S3 Drive Enclosures (DE), 16 DEs total
192 – 2.5" SSDs *(12 – 800 GB SSDs and 180 – 400 GB SSDs)* *(distribution of SSDs to DEs listed on page 26)*
1 – 42U DX 8X00 S3 Base Rack 1 – 42U DX 8X00 S3 Expansion Rack
4 – 3 phase PDU/socket strip *(3 x 8 sockets)*

The Front-end Enclosure (FE), Service Controller(SVC), Front-end Router FRT), Control Enclosure (CE), Control Modules and Channel Adapter (CA) relationships used in the Tested Storage Configuration are documented on page 27.

The HBA Port to Channel Adapter (CA) port connections are documented on page 28.

The Control Enclosure (CE) and Disk Enclosure (DE) relationships as well as the distribution of SSDs to Disk Enclosures are documented on page 26.

CONFIGURATION INFORMATION

This portion of the Full Disclosure Report documents and illustrates the detailed information necessary to recreate the Benchmark Configuration (BC), including the Tested Storage Configuration (TSC), so that the SPC-2 benchmark result produced by the BC may be independently reproduced.

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-2 benchmark specification, is stated in italics followed by the information to fulfill the stated requirement.

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

Clause 10.6.6

The FDR will contain a one page BC/TSC diagram that illustrates all major components of the BC/TSC.

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 22 *(Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram)*.

Storage Network Configuration

Clause 10.6.6.1

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration described in Clause 10.6.6 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 10.11.

The Tested Storage Configuration was configured with direct attached storage and, as such, did not utilize a storage network.

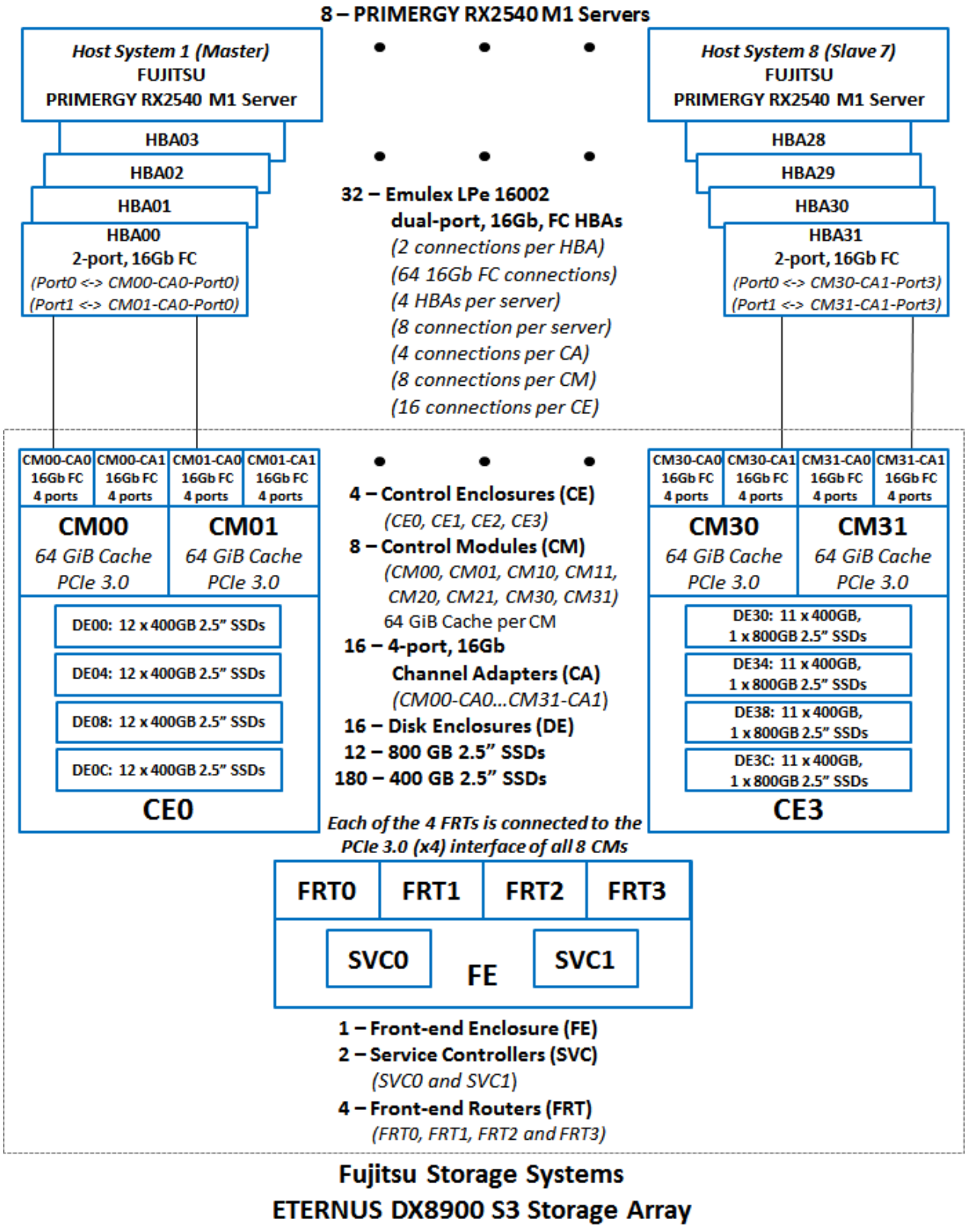
Host System and Tested Storage Configuration Table

Clause 10.6.6.2

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

The components that comprise each Host System and the Tested Storage Configuration are listed in the table that appears on page 23 *(Host System and Tested Storage Configuration Components)*.

Benchmark Configuration/Tested Storage Configuration Diagram



Fujitsu Storage Systems
ETERNUS DX8900 S3 Storage Array

Host System and Tested Storage Configuration Components

Host Systems
8 – Fujitsu PRIMERGY RX2540 M1 Servers, each with: 2 – Intel® Xeon® E5-2699 v3 GHz processor each with 18 cores, 1152 KB L1 cache, 4608 KB L2 cache, 46080 KB L3 cache 384 GB main memory Microsoft Windows Server 2008 R2 Enterprise (x64) 6.1 Build 7601, Service Pack 1 PCI-Express 3.0
Tested Storage Configuration (TSC)
32 – Emulex LPe 16002 dual-port 16 Gbps FC HBAs
Fujitsu Storage Systems ETERNUS DX8900 S3 Storage Array 1 – Front-end Enclosure (FE) which includes: 2 – Service Controllers (SVC) 4 – Front-end Routers (FRT) 4 – DX8900 S3 Control Enclosures each with 2 – Control Modules (CM), 8 CMs total each with 64 GiB cache *(128 GiB total per CM, 1,024 GiB total)* 2 – Channel Adapters (CA), 16 CAs total each with 4 – 16Gbps FC Host Ports *(8 ports per CM total and used, 64 ports total and used)* 4 – SAS Expander Drive Interfaces with QSFP 12 Gbps SAS-3 *(1 – SAS-3 x4 link per interface)* *(4 links total and used per CM, 32 links total and used)* 4 – DX 8X00 S3 Drive Enclosures (DE), 16 DEs total
192 – 2.5" SSDs *(12 – 800 GB SSDs and 180 – 400 GB SSDs)* *(distribution of SSDs to DEs listed on page 26)*
1 – 42U DX 8X00 S3 Base Rack 1 – 42U DX 8X00 S3 Expansion Rack
4 – 3 phase PDU/socket strip *(3 x 8 sockets)*

The Host System, Control Enclosure (CE), Control Modules and Channel Adapter (CA) relationships used in the Tested Storage Configuration are documented on page 26.

The Front-end Enclosure (FE), Service Controller(SVC), Front-end Router FRT), Control Enclosure (CE), Control Modules and Channel Adapter (CA) relationships used in the Tested Storage Configuration are documented on page 27.

The HBA Port to Channel Adapter (CA) port connections are documented on page 28.

The Control Enclosure (CE) and Disk Enclosure (DE) relationships as well as the distribution of SSDs to Disk Enclosures are documented on page 26.

Benchmark Configuration/Tested Storage Configuration Major Components, Major Component Relationships and Connections

This section provides more detailed documentation of relationships between the major components, which comprised the Benchmark Configuration/Tested Storage Configuration, and connections between those components.

Benchmark Configuration/Tested Storage Configuration Major Components

The Benchmark Configuration/Tested Storage Configuration consisted of following major components:

- 8 Host Systems:
  Host System 1, **Host System 2**, **Host System 3**, **Host System 4**,
  Host System 5, **Host System 6**, **Host System 7**, **Host System 8**
- 32 FC Dual-Port HBAs:
  HBA00…**HBA31** *(arbitrary names for identification)*
  4 HBAs per Host System
  8 ports per Host System, 32 ports total

Fujitsu Storage Systems ETERNUS DX8900 S3 Storage Array

- 1 Front-end Enclosure (FE), which includes:
  - 2 Service Controllers (SVC)
  - 4 Front-end Routers (FRT)
- 4 Control Enclosures (CE)
  CE0, **CE1**, **CE2** and **CE3**
- 8 Control Modules (CM):
  CM00, **CM01**, **CM10**, **CM11**, **CM20**, **CM21**, **CM30**, **CM31**

  2 CMs per CE:
  CE0: CM00, **CM01** **CE1: CM10**, **CM11** **CE2: CM20**, **CM21** **CE3: CM30**, **CM31**
- 16 Four-Port 16 Gb Channel Adapters (CA)
  2 CAs per CM, 4 CAs per CE
  8 ports per CM, 16 ports per CE, 64 ports total

  CE0: CM00-CA0 Port0-3, **CM00-CA1 Port0-3**
  CM01-CA0 Port0-3, **CM01-CA1 Port0-3**

  CE1: CM10-CA0 Port0-3, **CM10-CA1 Port0-3**
  CM11-CA0 Port0-3, **CM11-CA1 Port0-3**

  CE2: CM20-CA0 Port0-3, **CM20-CA1 Port0-3**
  CM21-CA0 Port0-3, **CM21-CA1 Port0-3**

  CE3: CM30-CA0 Port0-3, **CM30-CA1 Port0-3**
  CM31-CA0 Port0-3, **CM31-CA1 Port0-3**

- 16 Disk Enclosures (DE):
  4 DEs per CE
  CE0: DE00, **DE04**, **DE08**, **DE0C**
  CE1: DE10, **DE14**, **DE18**, **DE2C**
  CE2: DE20, **DE24**, **DE28**, **DE2C**
  CE3: DE30, **DE34**, **DE38**, **DE3C**
- 12 – 800 GB 2.5" SSDs
- 180 – 400 GB 2.5" SSDs

Host System, Control Enclosure (CE), Control Module (CM) and Channel Adapter (CA) Relationships

The relationships between the Host Systems, Control Enclosures (CE) Control Modules (CM) and Channel Adapters (CA) are illustrated in the following table.

Host System	Control Enclosure (CE)	Control Module (CM)	Channel Adapter (CA)
1 *(Master)*	CE0	CM00	CM00-CA0
			CM00-CA1
2 *(Slave)*		CM01	CM01-CA0
			CM01-CA1
3 *(Slave)*	CE1	CM10	CM10-CA0
			CM10-CA1
4 *(Slave)*		CM11	CM11-CA0
			CM11-CA1
5 *(Slave)*	CE2	CM20	CM20-CA0
			CM20-CA1
6 *(Slave)*		CM21	CM21-CA0
			CM21-CA1
7 *(Slave)*	CE3	CM30	CM30-CA0
			CM30-CA1
8 *(Slave)*		CM31	CM31-CA0
			CM31-CA1

- 8 Host Systems:
  Host System 1, **Host System 2**, **Host System 3**, **Host System 4**,
  Host System 5, **Host System 6**, **Host System 7**, **Host System 8**
  Each Host System has access to all 8 CMs

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- 4 Control Enclosures (CE)
  CE0, **CE1**, **CE2** and **CE3**
- 8 Control Modules (CM): **CM00**, **CM01**, **CM10**, **CM11**, **CM20**, **CM21**, **CM30**, **CM31**
  2 CMs per CE:
  CE0: CM00, **CM01** **CE1: CM10**, **CM11** **CE2: CM20**, **CM21** **CE3: CM30**, **CM31**
- 16 Four-Port 16 Gb Channel Adapters (CA)
  2 CAs per CM, 4 CAs per CE
  CE0: CM00-CA0, **CM00-CA1, CM01-CA0**, **CM01-CA1**
  CE1: CM10-CA0, **CM10-CA1, CM11-CA0**, **CM11-CA1**
  CE2: CM20-CA0, **CM20-CA1, CM21-CA0**, **CM21-CA1**
  CE3: CM30-CA0, **CM30-CA1, CM31-CA0**, **CM31-CA1**

Front-end Enclosure (FE) Service Controller (SVC) Front-end Router (FRT), Control Enclosure (CE), Control Module (CM) and Channel Adapter (CA) Relationships

The relationships between the Front-end Enclosure (FE), Service Controllers (SVD), Front-end Routers (FRT), Control Enclosures (CE) Control Modules (CM) and Channel Adapters (CA) are illustrated in the following table.

Front-end Enclosure (FE)	Service Controllers (SVC)	Front-end Routers (FRT)	Control Enclosure (CE)	Control Module (CM)	Channel Adapter (CA)
FE	SVC0	FRT0	CE0	CM00	CM00-CA0
					CM00-CA1
				CM01	CM01-CA0
					CM01-CA1
		FRT1	CE1	CM10	CM10-CA0
					CM10-CA1
				CM11	CM11-CA0
					CM11-CA1
	SVC1	FRT2	CE2	CM20	CM20-CA0
					CM20-CA1
				CM21	CM21-CA0
					CM21-CA1
		FRT3	CE3	CM30	CM30-CA0
					CM30-CA1
				CM31	CM31-CA0
					CM31-CA1

- 1 Front-end Enclosure (FE), which includes:
  - 2 Service Controllers (SVC)
  - 4 Front-end Routers (FRT)
    Each of the 4 Front-end Routers (FRT) is connected to all 8 Control Modules (CM) via the CM PCIe 3.0 (x4) interface.
- 4 Control Enclosures (CE)
  CE0, **CE1**, **CE2**, **CE3**
- 8 Control Modules (CM):
  CM00, **CM01**, **CM10**, **CM11**, **CM20**, **CM21**, **CM30**, **CM31**
  2 CMs per CE:
  CE0: CM00, **CM01 CE1: CM10**, **CM11 CE2: CM20**, **CM21 CE3: CM30**, **CM31**
- 16 Four-Port 16 Gb Channel Adapters (CA)
  2 CAs per CM, 4 CAs per CE
  CE0: CM00-CA0, **CM00-CA1, CM01-CA0**, **CM01-CA1**
  CE1: CM10-CA0, **CM10-CA1, CM11-CA0**, **CM11-CA1**
  CE2: CM20-CA0, **CM20-CA1, CM21-CA0**, **CM21-CA1**
  CE3: CM30-CA0, **CM30-CA1, CM31-CA0**, **CM31-CA1**

HBA Port to Channel Adapter (CA) Port Connections

The connections between HBA ports and Channel Adapter (CA) ports are illustrated in the following table.

Host System	HBA and HBA Port	Control Module (CM) Channel Adapter (CA) Port	HBA and HBA Port	Control Module (CM) Channel Adapter (CA) Port
1 *(Master)*	HBA00-Port0	CM00-CA0-Port0	HBA00-Port1	CM01-CA0-Port0
	HBA01-Port0	CM10-CA0-Port0	HBA01-Port1	CM11-CA0-Port0
	HBA02-Port0	CM20-CA0-Port0	HBA02-Port1	CM21-CA0-Port0
	HBA03-Port0	CM30-CA0-Port0	HBA03-Port1	CM31-CA0-Port0
2 *(Slave 1)*	HBA04-Port0	CM00-CA0-Port1	HBA04-Port1	CM01-CA0-Port1
	HBA05-Port0	CM10-CA0-Port1	HBA05-Port1	CM11-CA0-Port1
	HBA06-Port0	CM20-CA0-Port1	HBA06-Port1	CM21-CA0-Port1
	HBA07-Port0	CM30-CA0-Port1	HBA07-Port1	CM31-CA0-Port1
3 *(Slave 1)*	HBA08-Port0	CM00-CA0-Port2	HBA08-Port1	CM01-CA0-Port2
	HBA09-Port0	CM10-CA0-Port2	HBA09-Port1	CM11-CA0-Port2
	HBA10-Port0	CM20-CA0-Port2	HBA10-Port1	CM21-CA0-Port2
	HBA11-Port0	CM30-CA0-Port2	HBA11-Port1	CM31-CA0-Port2
4 *(Slave 1)*	HBA12-Port0	CM00-CA0-Port3	HBA12-Port1	CM01-CA0-Port3
	HBA13-Port0	CM10-CA0-Port3	HBA13-Port1	CM11-CA0-Port3
	HBA14-Port0	CM20-CA0-Port3	HBA14-Port1	CM21-CA0-Port3
	HBA15-Port0	CM30-CA0-Port3	HBA15-Port1	CM31-CA0-Port3
5 *(Slave 1)*	HBA16-Port0	CM00-CA1-Port0	HBA16-Port1	CM01-CA1-Port0
	HBA17-Port0	CM10-CA1-Port0	HBA17-Port1	CM11-CA1-Port0
	HBA18-Port0	CM20-CA1-Port0	HBA18-Port1	CM21-CA1-Port0
	HBA19-Port0	CM30-CA1-Port0	HBA19-Port1	CM31-CA1-Port0
6 *(Slave 1)*	HBA20-Port0	CM00-CA1-Port1	HBA20-Port1	CM01-CA1-Port1
	HBA21-Port0	CM10-CA1-Port1	HBA21-Port1	CM11-CA1-Port1
	HBA22-Port0	CM20-CA1-Port1	HBA22-Port1	CM21-CA1-Port1
	HBA23-Port0	CM30-CA1-Port1	HBA23-Port1	CM31-CA1-Port1
7 *(Slave 1)*	HBA24-Port0	CM00-CA1-Port2	HBA24-Port1	CM01-CA1-Port2
	HBA25-Port0	CM10-CA1-Port2	HBA25-Port1	CM11-CA1-Port2
	HBA26-Port0	CM20-CA1-Port2	HBA26-Port1	CM21-CA1-Port2
	HBA27-Port0	CM30-CA1-Port2	HBA27-Port1	CM31-CA1-Port2
7 *(Slave 1)*	HBA28-Port0	CM00-CA1-Port3	HBA28-Port1	CM01-CA1-Port3
	HBA29-Port0	CM10-CA1-Port3	HBA29-Port1	CM11-CA1-Port3
	HBA30-Port0	CM20-CA1-Port3	HBA30-Port1	CM21-CA1-Port3
	HBA31-Port0	CM30-CA1-Port3	HBA31-Port1	CM31-CA1-Port3

- 8 Host Systems:
  Host System 1, **Host System 2**, **Host System 3**, **Host System 4**,
  Host System 5, **Host System 6**, **Host System 7**, **Host System 8**
- 32 FC Dual-Port (**Port0** and **Port1**) HBAs:
  HBA00…**HBA31** *(arbitrary names for identification)*
  4 HBAs per Host System
  8 ports per Host System, 32 ports total

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- 8 Control Modules (CM):
  CM00, **CM01**, **CM10**, **CM11**, **CM20**, **CM21**, **CM30**, **CM31**
- 16 Four-Port (**Port0**, **Port1**, **Port2**, **Port3**) 16 Gb Channel Adapters (CA)
  2 CAs (**CA0** and **CA1**) per CM
  CM00-CA0-Port0-3, **CM00-CA1-Port0-3**, **CM01-CA0-Port0-3**, **CM01-CA1-Port0-3**
  CM10-CA0-Port0-3, **CM10-CA1-Port0-3**, **CM11-CA0-Port0-3**, **CM11-CA1-Port0-3**
  CM20-CA0-Port0-3, **CM20-CA1-Port0-3**, **CM21-CA0-Port0-3**, **CM21-CA1-Port0-3**
  CM30-CA0-Port0-3, **CM30-CA1-Port0-3**, **CM31-CA0-Port0-3**, **CM31-CA1-Port0-3**

Control Enclosure (CE), Disk Enclosure (DE) and SSD Relationships

The relationships between the Control Enclosures (CE) and Disk Enclosures (DE) in addition to the distribution of SSDs to Disk Enclosures are illustrated in the following table.

Control Enclosure (CE)	Disk Enclosure (DE)	SSD Distribution
CE0	DE00	12 - 400 GB SSDs
	DE04	12 - 400 GB SSDs
	DE08	12 - 400 GB SSDs
	DE0C	12 - 400 GB SSDs
CE1	DE10	12 - 400 GB SSDs
	DE14	12 - 400 GB SSDs
	DE18	12 - 400 GB SSDs
	DE1C	12 - 400 GB SSDs
CE2	DE20	12 - 400 GB SSDs
	DE24	12 - 400 GB SSDs
	DE28	8 - 400 GB and 4 - 800 GB SSDs
	DE2C	8 - 400 GB and 4 - 800 GB SSDs
CE3	DE30	11 - 400 GB and 1 - 800 GB SSDs
	DE34	11 - 400 GB and 1 - 800 GB SSDs
	DE38	11 - 400 GB and 1 - 800 GB SSDs
	DE3C	11 - 400 GB and 1 - 800 GB SSDs

- 4 Control Enclosures (CE)
  CE0, **CE1**, **CE2**, **CE3**
- 16 Disk Enclosures (DE):
  4 DEs per CE
  CE0: DE00, **DE04**, **DE08**, **DE0C**
  CE1: DE10, **DE14**, **DE18**, **DE2C**
  CE2: DE20, **DE24**, **DE28**, **DE2C**
  CE3: DE30, **DE34**, **DE38**, **DE3C**
- 12 – 800 GB 2.5" SSDs
- 180 – 400 GB 2.5" SSDs

Customer Tunable Parameters and Options

Clause 10.6.7.1

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

Tested Storage Configuration (TSC) Creation and Configuration

Clause 10.6.7.2

The Full Disclosure Report must include sufficient information to recreate the logical representation of the Tested Storage Configuration (TSC). In addition to customer tunable parameters and options (Clause10.6.6.1), 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 10.6.5.7 and the Storage Network Configuration Diagram in Clause 10.6.5.8.*
  - *The logical representation of the TSC, configured from the above components that will be presented to the SPC-2 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 75 contains the detailed information that describes how to create and configure the logical TSC.

SPC-2 Workload Generator Storage Configuration

Clause 10.6.7.3

The Full Disclosure Report will include all SPC-2 Workload Generator storage configuration commands and parameters used in the SPC-2 benchmark measurement.

The SPC-2 Workload Generator storage configuration commands and parameters for this measurement appear in Appendix D: SPC-2 Workload Generator Storage Commands and Parameter Files on page 87.

ASU Pre-Fill

Clause 6.3.3

The SPC-2 ASU is required to be completely filled with specified content prior to the execution of audited SPC-2 Tests. The content is required to consist of random data pattern such as that produced by an SPC recommended tool.

…

Clause 6.3.3.3

The required ASU pre-fill must be executed as the first step in the uninterrupted benchmark execution sequence described in Clause 6.4.2. That uninterrupted sequence will consist of: ASU Pre-Fill, Large File Processing, Large Database Query, Video on Demand Delivery and Persistence Test Run 1. The only exception to this requirement is described in Clause 6.3.3.4.

Clause 6.3.3.4

If approved by the Auditor, the Test Sponsor may complete the required ASU pre-fill prior to the execution of the audited SPC-2 Tests and not as part of the SPC-2 Test execution sequence.

The Auditor will verify the required random data pattern content in the ASU prior to the execution of the audited SPC-2 Tests. If that verification fails, the Test Sponsor is required to reload the specified content to the ASU.

The configuration file used to complete the required ASU pre-fill appears in Appendix D: SPC-2 Workload Generator Storage Commands and Parameter Files on page 87.

SPC-2 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-2 storage capacities and mappings used in the Tested Storage Configuration. SPC-2 Data Repository Definitions on page 69 contains definitions of terms specific to the SPC-2 Data Repository.

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-2 benchmark specification, is stated in italics followed by the information to fulfill the stated requirement.

SPC-2 Storage Capacities and Relationships

Clause 10.6.8.1

Two tables and four charts documenting the storage capacities and relationships of the SPC-2 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-2 Storage Capacities

The Physical Storage Capacity consisted of 81,601.994 GB distributed over 180 solid state devices (SSDs) each with a formatted capacity of 400.000 GB and 12 solid state devices (SSDs), each with a formatted capacity of 800.166 GB. There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 1,474.010 GB (1.81%) of the Physical Storage Capacity. There was 4,725.538 GB (5.90%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 82.02% of the Addressable Storage Capacity resulting in 6,777.458 GB (17.98%) of Unused Storage within the Addressable Storage Capacity. The Data Protection capacity *(Mirroring)* was 40,063.992 GB of which 6,777.458 GB was utilized. The total Unused Storage was 18,280.455 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.

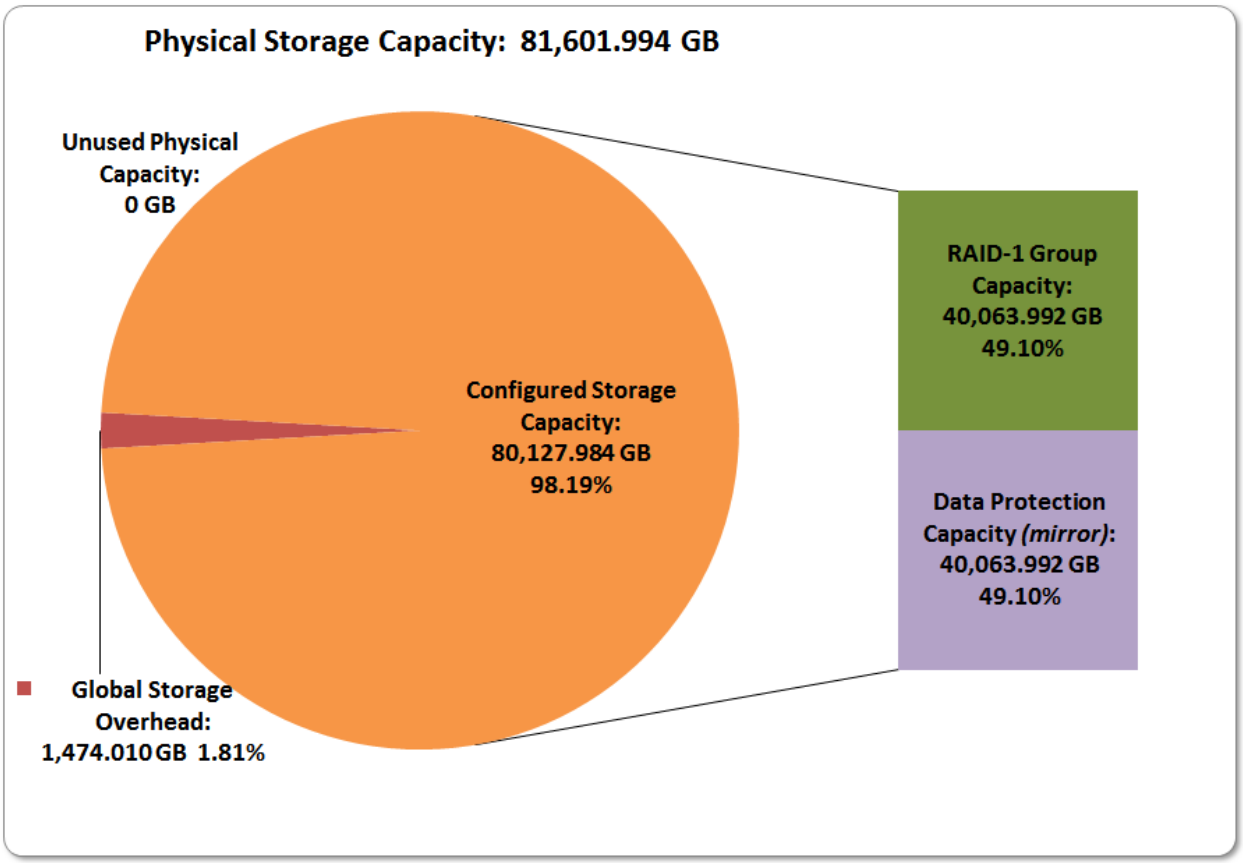
SPC-2 Storage Capacities

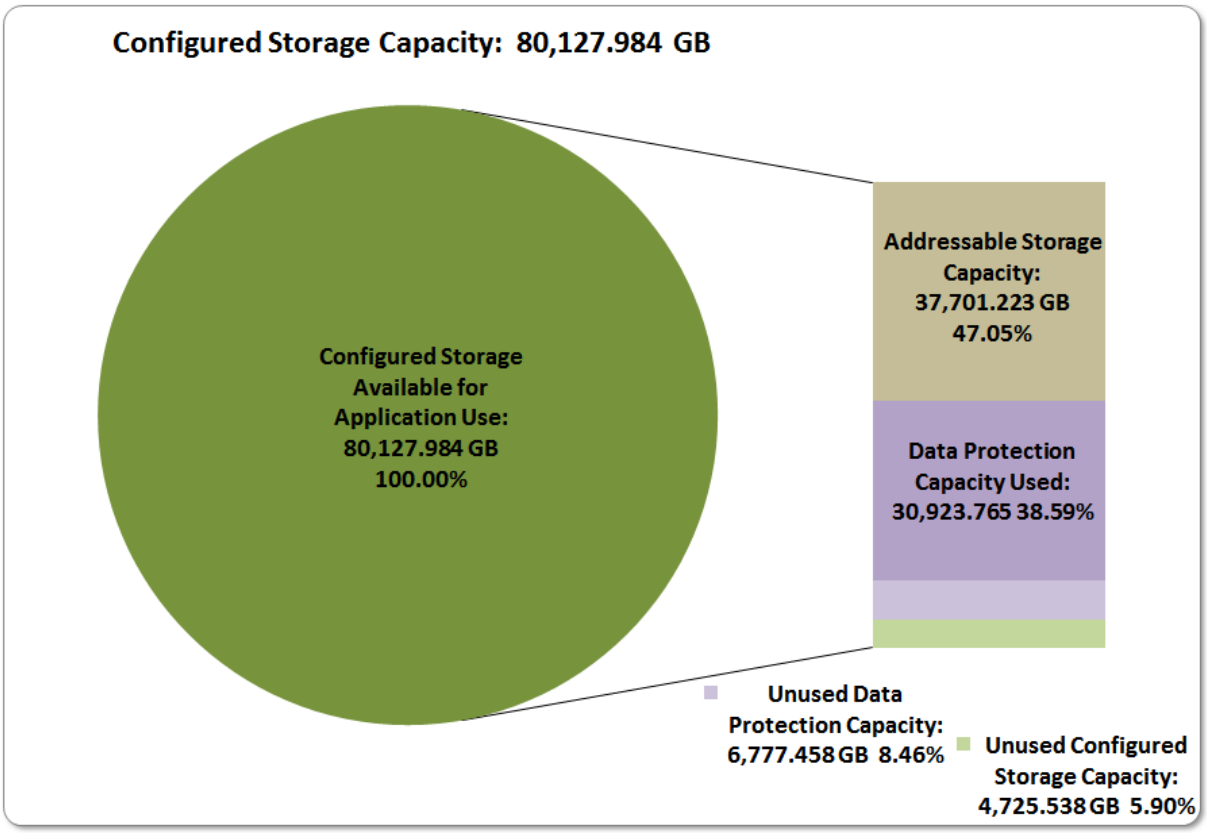
Storage Hierarchy Component	Units	Capacity
Total ASU Capacity	Gigabytes (GB)	30,923.765
Addressable Storage Capacity	Gigabytes (GB)	37,702.224
Configured Storage Capacity	Gigabytes (GB)	80,127.984
Physical Storage Capacity	Gigabytes (GB)	81,601.994
Data Protection *(Mirroring)*	Gigabytes (GB)	40,063.992
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	1,476.010
Total Unused Storage	Gigabytes (GB)	18,280.455

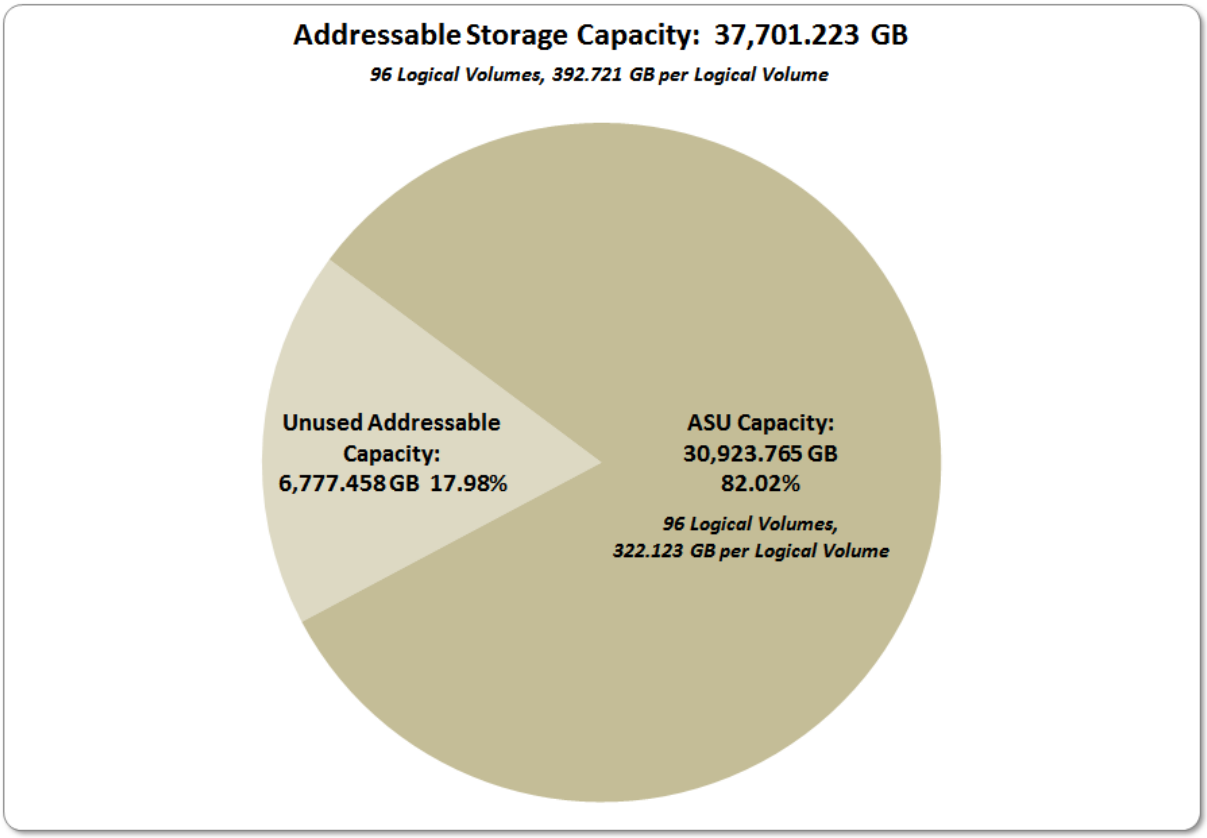
SPC-2 Storage Hierarchy Ratios

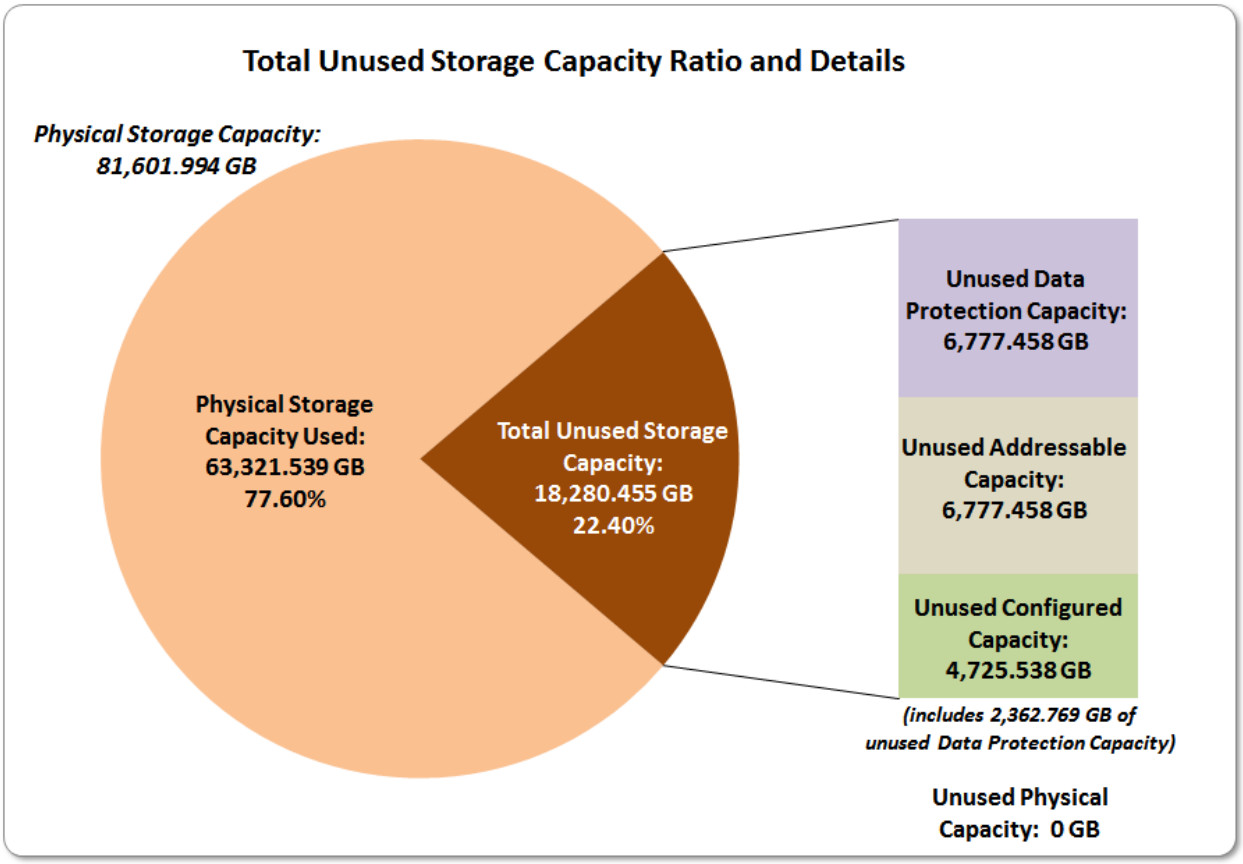
	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	82.02%	38.59%	37.80%
Data Protection *(Mirroring)*		50.00%	49.10%
Addressable Storage Capacity		47.05%	46.20%
Required Storage		0.00%	0.00%
Configured Storage Capacity			98.19%
Global Storage Overhead			1.81%
Unused Storage:			
Addressable	17.98%		
Configured		5.90%	
Physical			0.00%

SPC-2 Storage Capacity Charts




Configured Storage Capacity: 80,127.984 GB
Configured Storage Available for Application Use: 80,127.984 GB 100.00%
Addressable Storage Capacity: 37,701.223 GB 47.05%
Data Protection Capacity Used: 30,923.765 38.59%
Unused Data Protection Capacity: 6,777.458 GB 8.46%
Unused Configured Storage Capacity: 4,725.538 GB 5.90%


Addressable Storage Capacity: 37,701.223 GB
96 Logical Volumes, 392.721 GB per Logical Volume
Unused Addressable Capacity: 6,777.458 GB 17.98%
ASU Capacity: 30,923.765 GB 82.02%
96 Logical Volumes, 322.123 GB per Logical Volume



Storage Capacity Utilization

Clause 10.6.8.2

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-2 Storage Capacity Utilization	
Application Utilization	37.90%
Protected Application Utilization	75.79%
Unused Storage Ratio	22.40%

Logical Volume Capacity and ASU Mapping

Clause 10.6.8.3

A table illustrating the capacity of the Application Storage Unit (ASU) and the mapping of Logical Volumes to ASU will be provided in the FDR. Capacity must be stated in gigabytes (GB) as a value with a minimum of two digits to the right of the decimal point. Each Logical Volume will be sequenced in the table from top to bottom per its position in the contiguous address space of the ASU. Each Logical Volume entry will list its total capacity, the portion of that capacity used for the ASU, and any unused capacity.

Logical Volume (LV) Capacity and Mapping			
ASU (30,923.765 GB)			
	Total Capacity *(GB)*	Capacity Used *(GB)*	Capacity Unused *(GB)*
96 Logical Volumes	392.721 per LV	322.123 per LV	70.60 per LV

See the Storage Definition (sd) entries in Appendix D: SPC-2 Workload Generator Storage Commands and Parameter Files on page 87 for more detailed configuration information.

SPC-2 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-2 Tests, Test Phases, Test Run Sequences, and Test Runs. An SPC-2 glossary on page 69 contains definitions of terms specific to the SPC-2 Data Repository.

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-2 benchmark specification, is stated in italics followed by the information to fulfill the stated requirement.

SPC-2 Tests, Test Phases, Test Run Sequences, and Test Runs

The SPC-2 benchmark consists of the following Tests, Test Phases, Test Run Sequences, and Test Runs:

- **Data Persistence Test**
  - Data Persistence Test Run 1
  - Data Persistence Test Run 2
- **Large File Processing Test**
  - WRITE ONLY Test Phase
    - Test Run Sequence 1
      - ✓ Test Run 1 – 1024 KiB Transfer – maximum number of Streams
      - ✓ Test Run 2 – 1024 KiB Transfer – 50% of Test Run 1's Streams value
      - ✓ Test Run 3 – 1024 KiB Transfer – 25% of Test Run 1's Streams value
      - ✓ Test Run 4 – 1024 KiB Transfer – 12.5% of Test Run 1's Streams value
      - ✓ Test Run 5 – 1024 KiB Transfer – single (1) Stream
    - Test Run Sequence 2
      - ✓ Test Run 6 – 256 KiB Transfer – maximum number of Streams
      - ✓ Test Run 7 – 256 KiB Transfer – 50% of Test Run 6's Streams value
      - ✓ Test Run 8 – 256 KiB Transfer – 25% of Test Run 6's Streams value
      - ✓ Test Run 9 – 256 KiB Transfer – 12.5% of Test Run 6's Streams value
      - ✓ Test Run 10 – 256 KiB Transfer – single (1) Stream
  - READ-WRITE Test Phase
    - Test Run Sequence 3
      - ✓ Test Run 11 – 1024 KiB Transfer – maximum number of Streams
      - ✓ Test Run 12 – 1024 KiB Transfer – 50% of Test Run 11's Streams value
      - ✓ Test Run 13 – 1024 KiB Transfer – 25% of Test Run 11's Streams value
      - ✓ Test Run 14 – 1024 KiB Transfer – 12.5% of Test Run 11's Streams value
      - ✓ Test Run 15 – 1024 KiB Transfer – single (1) Stream
    - Test Run Sequence 4
      - ✓ Test Run 16 – 256 KiB Transfer – maximum number of Streams
      - ✓ Test Run 17 – 256 KiB Transfer – 50% of Test Run 16's Streams value
      - ✓ Test Run 18 – 256 KiB Transfer – 25% of Test Run 16's Streams value
      - ✓ Test Run 19 – 256 KiB Transfer – 12.5% of Test Run 16's Streams value
      - ✓ Test Run 20 – 256 KiB Transfer – single (1) Stream
  - READ ONLY Test Phase
    - Test Run Sequence 5
      - ✓ Test Run 21 – 1024 KiB Transfer – maximum number of Streams

- ✓ Test Run 22 – 1024 KiB Transfer – 50% of Test Run 21's Streams value
- ✓ Test Run 23 – 1024 KiB Transfer – 25% of Test Run 21's Streams value
- ✓ Test Run 24 – 1024 KiB Transfer – 12.5% of Test Run 21's Streams value
- ✓ Test Run 25 – 1024 KiB Transfer – single (1) Stream

- Test Run Sequence 6
  - ✓ Test Run 26 – 256 KiB Transfer – maximum number of Streams
  - ✓ Test Run 27 – 256 KiB Transfer – 50% of Test Run 26's Streams value
  - ✓ Test Run 28 – 256 KiB Transfer – 25% of Test Run 26's Streams value
  - ✓ Test Run 29 – 256 KiB Transfer – 12.5% of Test Run 26's Streams value
  - ✓ Test Run 30 – 256 KiB Transfer – single (1) Stream

- **Large Database Query Test**
  - 1024 KIB TRANSFER SIZE Test Phase
    - Test Run Sequence 1
      - ✓ Test Run 1 – 4 I/O Requests Outstanding – maximum number of Streams
      - ✓ Test Run 2 – 4 I/O Requests Outstanding – 50% of Test Run 1's Streams value
      - ✓ Test Run 3 – 4 I/O Requests Outstanding – 25% of Test Run 1's Streams value
      - ✓ Test Run 4 – 4 I/O Requests Outstanding – 12.5% of Test Run 1's Streams value
      - ✓ Test Run 5 – 4 I/O Requests Outstanding – single (1) Stream
    - Test Run Sequence 2
      - ✓ Test Run 6 – 1 I/O Request Outstanding – maximum number of Streams
      - ✓ Test Run 7 – 1 I/O Request Outstanding – 50% of Test Run 6's Streams value
      - ✓ Test Run 8 – 1 I/O Request Outstanding – 25% of Test Run 6's Streams value
      - ✓ Test Run 9 – 1 I/O Request Outstanding – 12.5% of Test Run 6's Streams value
      - ✓ Test Run 10 – 1 I/O Request Outstanding – single (1) Stream
  - 64 KIB TRANSFER SIZE Test Phase
    - Test Run Sequence 3
      - ✓ Test Run 11 – 4 I/O Requests Outstanding – maximum number of Streams
      - ✓ Test Run 12 – 4 I/O Requests Outstanding – 50% of Test Run 11's Streams value
      - ✓ Test Run 13 – 4 I/O Requests Outstanding – 25% of Test Run 11's Streams value
      - ✓ Test Run 14 – 4 I/O Requests Outstanding – 12.5% of Test Run 11's Streams value
      - ✓ Test Run 15 – 4 I/O Requests Outstanding – single (1) Stream
    - Test Run Sequence 4
      - ✓ Test Run 16 – 1 I/O Request Outstanding – maximum number of Streams
      - ✓ Test Run 17 – 1 I/O Request Outstanding – 50% of Test Run 16's Streams value
      - ✓ Test Run 18 – 1 I/O Request Outstanding – 25% of Test Run 16's Streams value
      - ✓ Test Run 19 – 1 I/O Request Outstanding – 12.5% of Test Run 16's Streams value
      - ✓ Test Run 20 – 1 I/O Request Outstanding – single (1) Stream

- **Video on Demand Delivery Test**
  - Video on Demand Delivery Test Run

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 Tests may be executed in any sequence.

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

Large File Processing Test

Clause 6.4.3.1

The Large File Processing Test consists of the I/O operations associated with the type of applications, in a wide range of fields, which require simple sequential processing of one or more large files. Specific examples of those types of applications include scientific computing and large-scale financial processing

Clause 6.4.3.2

The Large File Processing Test has three Test Phases, which shall be executed in the following uninterrupted sequence:

1. *WRITE ONLY*
2. *READ-WRITE*
3. *READ ONLY*

The BC shall not be restarted or manually disturbed, altered, or adjusted during the execution of the Large File Processing Test. If power is lost to the BC during this Test all results shall be rendered invalid and the Test re-run in its entirety.

Clause 10.6.9.1

The Full Disclosure Report will contain the following content for the Large File Processing Test:

1. *A listing of the SPC-2 Workload Generator commands and parameters used to execute each of the Test Runs in the Large File Processing Test.*
2. *The human readable SPC-2 Test Results File for each of the Test Runs in the Large File Processing Test.*
3. *The following three tables:*
    - *Average Data Rate: The average Data Rate, in MB per second for the Measurement Interval of each Test Run in the Large File Processing Test.*
    - *Average Data Rate per Stream: The average Data Rate per Stream, in MB per second, for the Measurement Interval of each Test Run in the Large File Processing Test.*
    - *Average Response Time: The average response time, in milliseconds (ms), for the Measurement Interval of each Test Run in the Large File Processing Test.*
4. *Average Data Rate, Average Data Rate per Stream and Average Response Time graphs as defined in Clauses 10.1.1, 10.1.2 and 10.1.3.*

SPC-2 Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Large File Processing Test Runs are documented in Appendix E: SPC-2 Workload Generator Execution Commands and Parameters on Page 102.

SPC-2 Test Results File

A link to the SPC-2 Test Results file generated from the Large File Processing Test Runs is listed below.

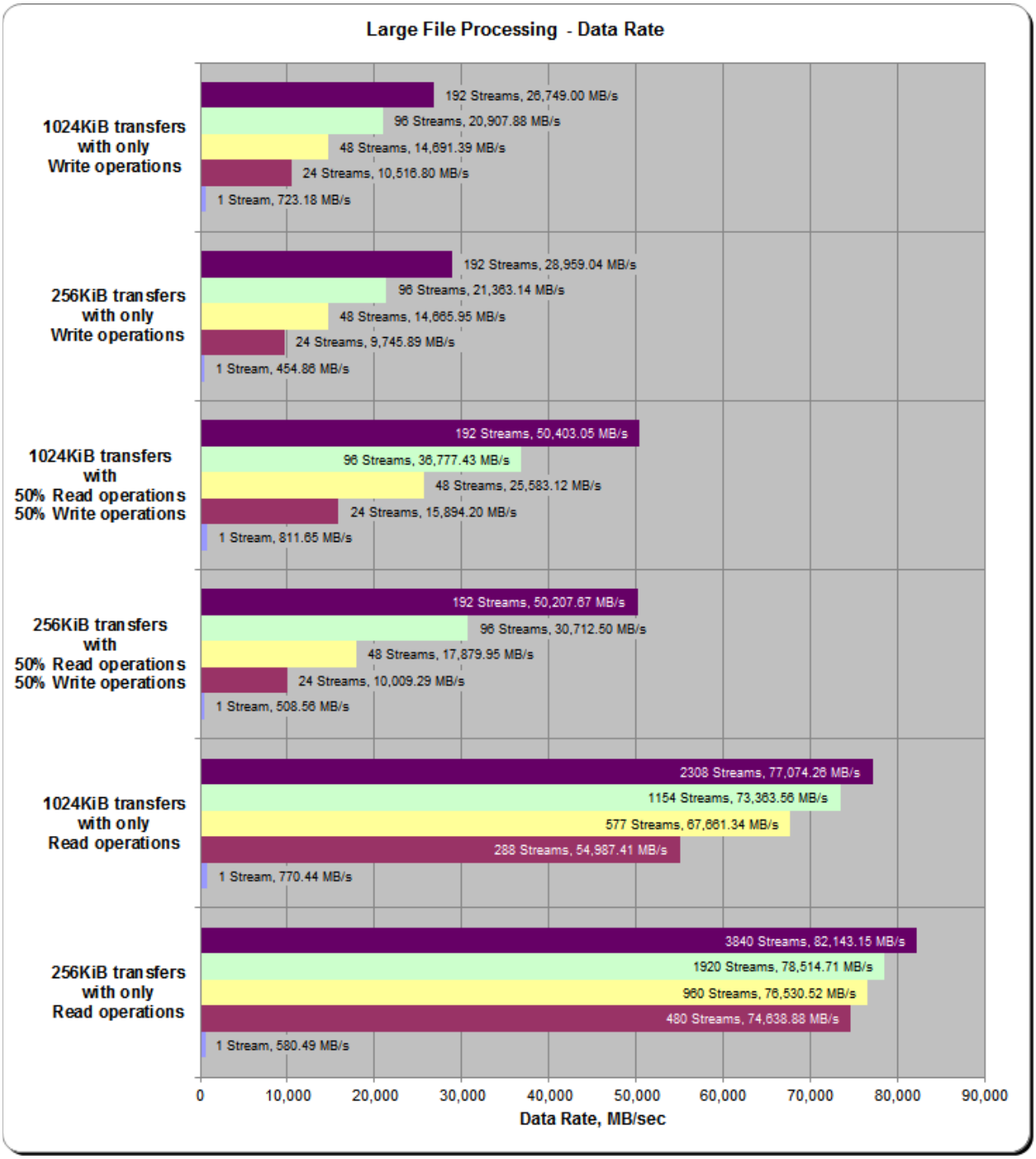
SPC-2 Large File Processing Test Results File

SPC-2 Large File Processing Average Data Rates (MB/s)

The average Data Rate (MB/s) for each Test Run in the three Test Phases of the SPC-2 Large File Processing Test is listed in the table below as well as illustrated in the following graph.

Test Run Sequence	1 Stream	24 Streams	48 Streams	96 Streams	192 Streams
Write 1024KiB	723.18	10,516.80	14,691.39	20,907.88	26,749.00
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Write 256KiB	454.86	9,745.89	14,665.95	21,363.14	28,959.04
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Read/Write 1024KiB	811.65	15,894.20	25,583.12	36,777.43	50,403.05
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Read/Write 256KiB	508.56	10,009.29	17,879.95	30,712.50	50,207.67
Test Run Sequence	**1 Stream**	**288 Streams**	**577 Streams**	**1154 Streams**	**2308 Streams**
Read 1024KiB	770.44	54,987.41	67,661.34	73,363.56	77,074.26
Test Run Sequence	**1 Stream**	**480 Streams**	**960 Streams**	**1920 Streams**	**3840 Streams**
Read 256KiB	580.49	74,638.88	76,530.52	78,514.71	82,143.15

SPC-2 Large File Processing Average Data Rates Graph

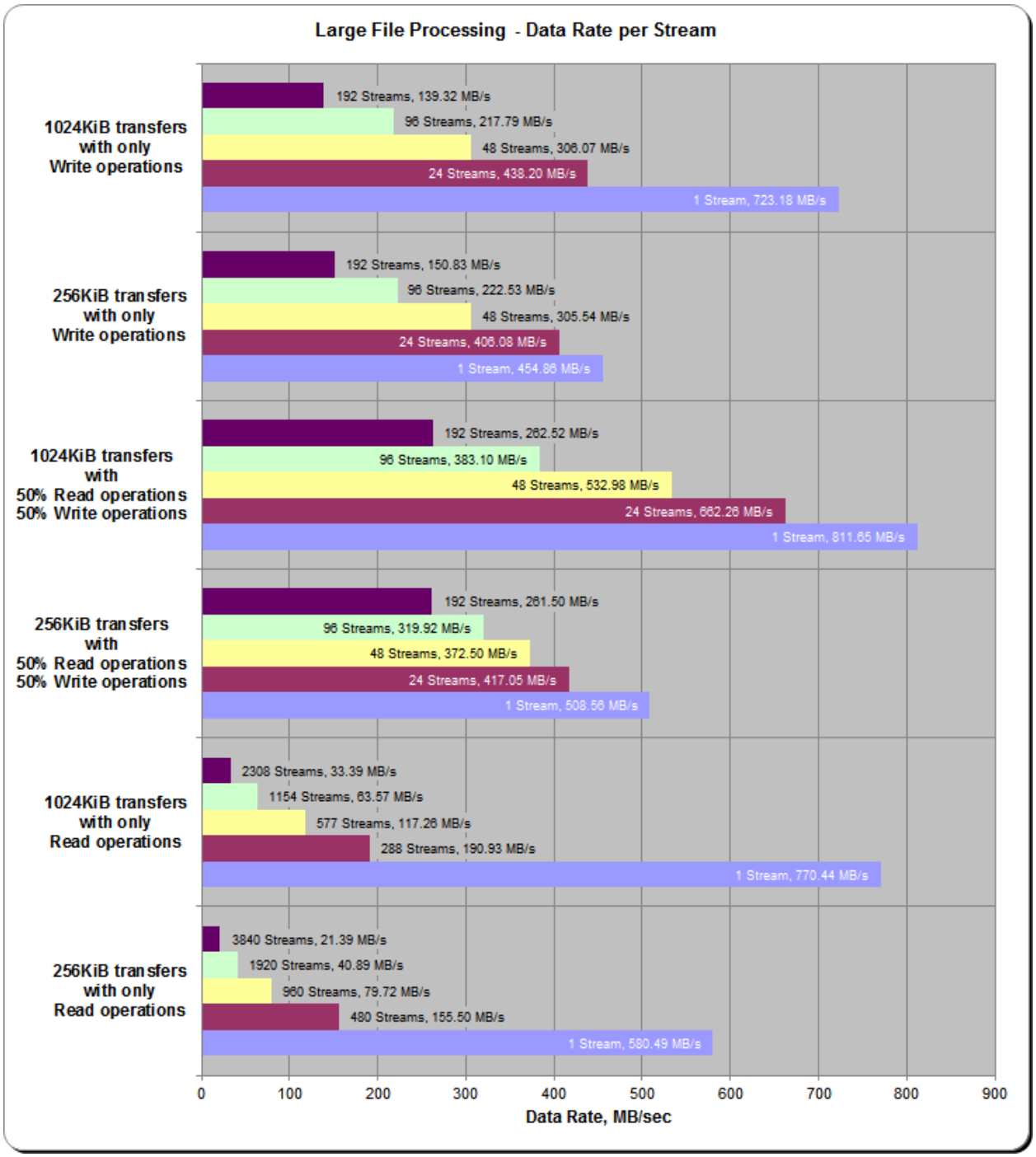


SPC-2 Large File Processing Average Data Rate per Stream

The average Data Rate per Stream for each Test Run in the three Test Phases of the SPC-2 Large File Processing Test is listed in the table below as well as illustrated in the following graph.

Test Run Sequence	1 Stream	24 Streams	48 Streams	96 Streams	192 Streams
Write 1024KiB	723.18	438.20	306.07	217.79	139.32
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Write 256KiB	454.86	406.08	305.54	222.53	150.83
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Read/Write 1024KiB	811.65	662.26	532.98	383.10	262.52
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Read/Write 256KiB	508.56	417.05	372.50	319.92	261.50
Test Run Sequence	**1 Stream**	**288 Streams**	**577 Streams**	**1154 Streams**	**2308 Streams**
Read 1024KiB	770.44	190.93	117.26	63.57	33.39
Test Run Sequence	**1 Stream**	**480 Streams**	**960 Streams**	**1920 Streams**	**3840 Streams**
Read 256KiB	580.49	155.50	79.72	40.89	21.39

SPC-2 Large File Processing Average Data Rate per Stream Graph

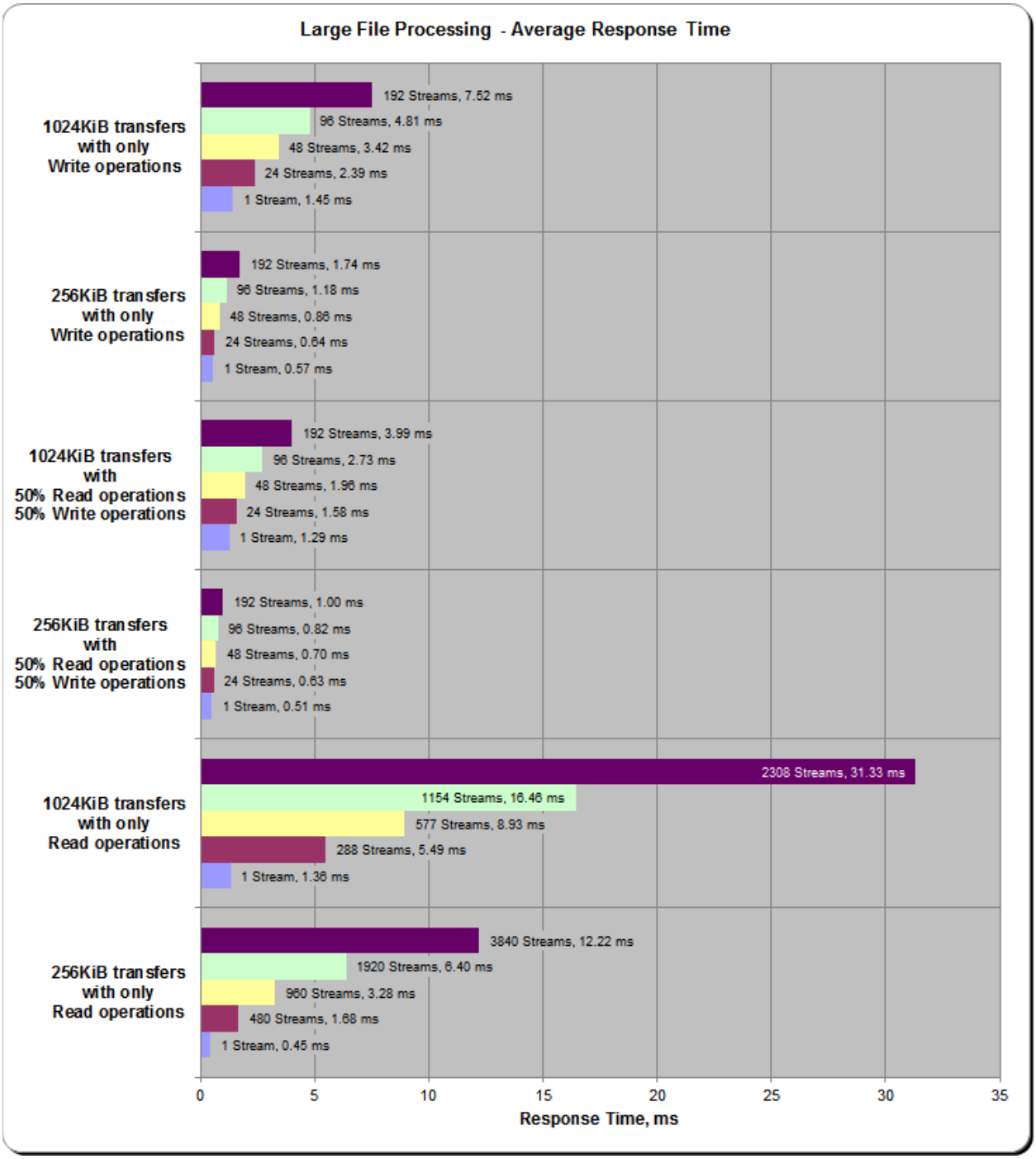


SPC-2 Large File Processing Average Response Time

The average Response Time, milliseconds (ms), for each Test Run in the three Test Phases of the SPC-2 Large File Processing Test is listed in the table below as well as illustrated in the following graph.

Test Run Sequence	1 Stream	24 Streams	48 Streams	96 Streams	192 Streams
Write 1024KiB	1.45	2.39	3.42	4.81	7.52
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Write 256KiB	0.57	0.64	0.86	1.18	1.74
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Read/Write 1024KiB	1.29	1.58	1.96	2.73	3.99
Test Run Sequence	**1 Stream**	**24 Streams**	**48 Streams**	**96 Streams**	**192 Streams**
Read/Write 256KiB	0.51	0.63	0.70	0.82	1.00
Test Run Sequence	**1 Stream**	**288 Streams**	**577 Streams**	**1154 Streams**	**2308 Streams**
Read 1024KiB	1.36	5.49	8.93	16.46	31.33
Test Run Sequence	**1 Stream**	**480 Streams**	**960 Streams**	**1920 Streams**	**3840 Streams**
Read 256KiB	0.45	1.68	3.28	6.40	12.22

SPC-2 Large File Processing Average Response Time Graph



Large File Processing Test – WRITE ONLY Test Phase

Clause 10.6.9.1.1

1. *A table that will contain the following information for each "WRITE ONLY, 1024 KiB Transfer Size" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
2. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "WRITE ONLY, 1024 KiB Transfer Size" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*
3. *A table that will contain the following information for each "WRITE ONLY, 256 KiB Transfer Size" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
4. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "WRITE ONLY, 256 KiB Transfer Size" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*

A hyperlink for each of the above tables and graphs may appear in the FDR to provide access to the table or graph.

A hyperlink to a table with the SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" Test Run data appears on the next page. That entry is followed by hyperlinks to graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table and graphs present the data at five-second intervals.

Immediately following the above SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" entries will be hyperlinks for SPC-2 "Large File Processing/WRITE ONLY/256 KiB Transfer Size" table and graphs. The table contains the Test Run data and the graphs illustrate the average Data Rate, average Data Rate per Stream, and average Response Time produced by the Test Runs.

SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" Test Run Data

SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream Average Response Time

SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" graphs
(four pages, 1 graph per page)

SPC-2 "Large File Processing/WRITE ONLY/256 KiB Transfer Size" Test Run Data

SPC-2 "Large File Processing/WRITE ONLY/256 KiB Transfer Size" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large File Processing/WRITE ONLY/256 KiB Transfer Size" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large File Processing/WRITE ONLY/256 KiB Transfer Size" graphs
(four pages, 1 graph per page)

Large File Processing Test – READ-WRITE Test Phase

Clause 10.6.9.1.2

1. *A table that will contain the following information for each "READ-WRITE, 1024 KiB Transfer Size" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
2. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "READ-WRITE, 1024 KiB Transfer Size" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*
3. *A table that will contain the following information for each " READ-WRITE, 256 KiB Transfer Size" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
4. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "READ-WRITE, 256 KiB Transfer Size" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*

A hyperlink for each of the above tables and graphs may appear in the FDR to provide access to the table or graph.

A hyperlink to a table with the SPC-2 "Large File Processing/READ-WRITE/1024 KiB Transfer Size" Test Run data appears on the next page. That entry is followed by hyperlinks to graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table and graphs present the data at five-second intervals.

Immediately following the above SPC-2 "Large File Processing/READ-WRITE/1024 KiB Transfer Size" entries will be hyperlinks for SPC-2 "Large File Processing/READ-WRITE/256 KiB Transfer Size" table and graphs. The table contains the Test Run data and the graphs illustrate the average Data Rate, average Data Rate per Stream, and average Response Time produced by the Test Runs.

SPC-2 "Large File Processing/READ-WRITE/1024 KiB Transfer Size" Test Run Data

SPC-2 "Large File Processing/READ-WRITE/1024 KiB Transfer Size" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large File Processing/READ-WRITE/1024 KIB Transfer Size" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large File Processing/READ-WRITE/1024 KiB Transfer Size" graphs
(four pages, 1 graph per page)

SPC-2 "Large File Processing/READ-WRITE/256 KiB Transfer Size" Test Run Data

SPC-2 "Large File Processing/READ-WRITE/256 KiB Transfer Size" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large File Processing/READ-WRITE/256 KiB Transfer Size" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large File Processing/READ-WRITE/256 KiB Transfer Size" graphs
(four pages, 1 graph per page)

Large File Processing Test – READ ONLY Test Phase

Clause 10.6.9.1.3

- *A table that will contain the following information for each "READ ONLY, 1024 KiB Transfer Size" Test Run:*
  - *The number of Streams specified.*
  - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
- *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "READ ONLY, 1024 KiB Transfer Size" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*
- *A table that will contain the following information for each "READ ONLY, 256 KiB Transfer Size" Test Run:*
  - *The number of Streams specified.*
  - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
- *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "READ ONLY, 256 KiB Transfer Size" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*

A hyperlink for each of the above tables and graphs may appear in the FDR to provide access to the table or graph.

A hyperlink to a table with the SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" Test Run data appears on the next page. That entry is followed by hyperlinks to graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table and graphs present the data at five-second intervals.

Immediately following the above SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" entries will be hyperlinks for SPC-2 "Large File Processing/READ ONLY/256 KiB Transfer Size" table and graphs. The table contains the Test Run data and the graphs illustrate the average Data Rate, average Data Rate per Stream, and average Response Time produced by the Test Runs.

SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" Test Run Data

SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" graphs
(four pages, 1 graph per page)

SPC-2 "Large File Processing/READ ONLY/256 KiB Transfer Size" Test Run Data

SPC-2 "Large File Processing/READ ONLY/256 KiB Transfer Size" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large File Processing/READ ONLY/256 KiB Transfer Size" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large File Processing/READ ONLY/256 KiB Transfer Size" graphs
(four pages, 1 graph per page)

Large Database Query Test

Clause 6.4.4.1

The Large Database Query Test is comprised of a set of I/O operations representative of scans or joins of large relational tables such as those performed for data mining or business intelligence.

Clause 6.4.4.2

The Large Database Query Test has two Test Phases, which shall be executed in the following uninterrupted sequence:

1. *1024 KIB TRANSFER SIZE*
2. *64 KIB TRANSFER SIZE*

The BC shall not be restarted or manually disturbed, altered, or adjusted during the execution of the Large File Processing Test. If power is lost to the BC during this Test all results shall be rendered invalid and the Test re-run in its entirety.

Clause 10.6.9.2

The Full Disclosure Report will contain the following content for the Large Database Query Test:

1. *A listing of the SPC-2 Workload Generator commands and parameters used to execute each of the Test Runs in the Large Database Query Test.*
2. *The human readable SPC-2 Test Results File for each of the Test Runs in the Large Database Query Test.*
3. *A table that contains the following information for each Test Run in the two Test Phases of the Large Database Query Test:*
    - *Average Data Rate: The average Data Rate, in MB per second for the Measurement Interval of each Test Run in the Large Database Query Test.*
    - *Average Data Rate per Stream: The average Data Rate per Stream, in MB per second, for the Measurement Interval of each Test Run in the Large Database Query Test.*
    - *Average Response Time: The average response time, in milliseconds (ms), for the Measurement Interval of each Test Run in the Large Database Query Test.*
4. *Average Data Rate, Average Data Rate per Stream and Average Response time graphs as defined in Clauses 10.1.1, 10.1.2 and 10.1.3.*

SPC-2 Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Large Database Query Test Runs are documented in Appendix E: SPC-2 Workload Generator Execution Commands and Parameters on Page 102.

SPC-2 Test Results File

A link to the SPC-2 Test Results file generated from the Large Database Query Test Runs is listed below.

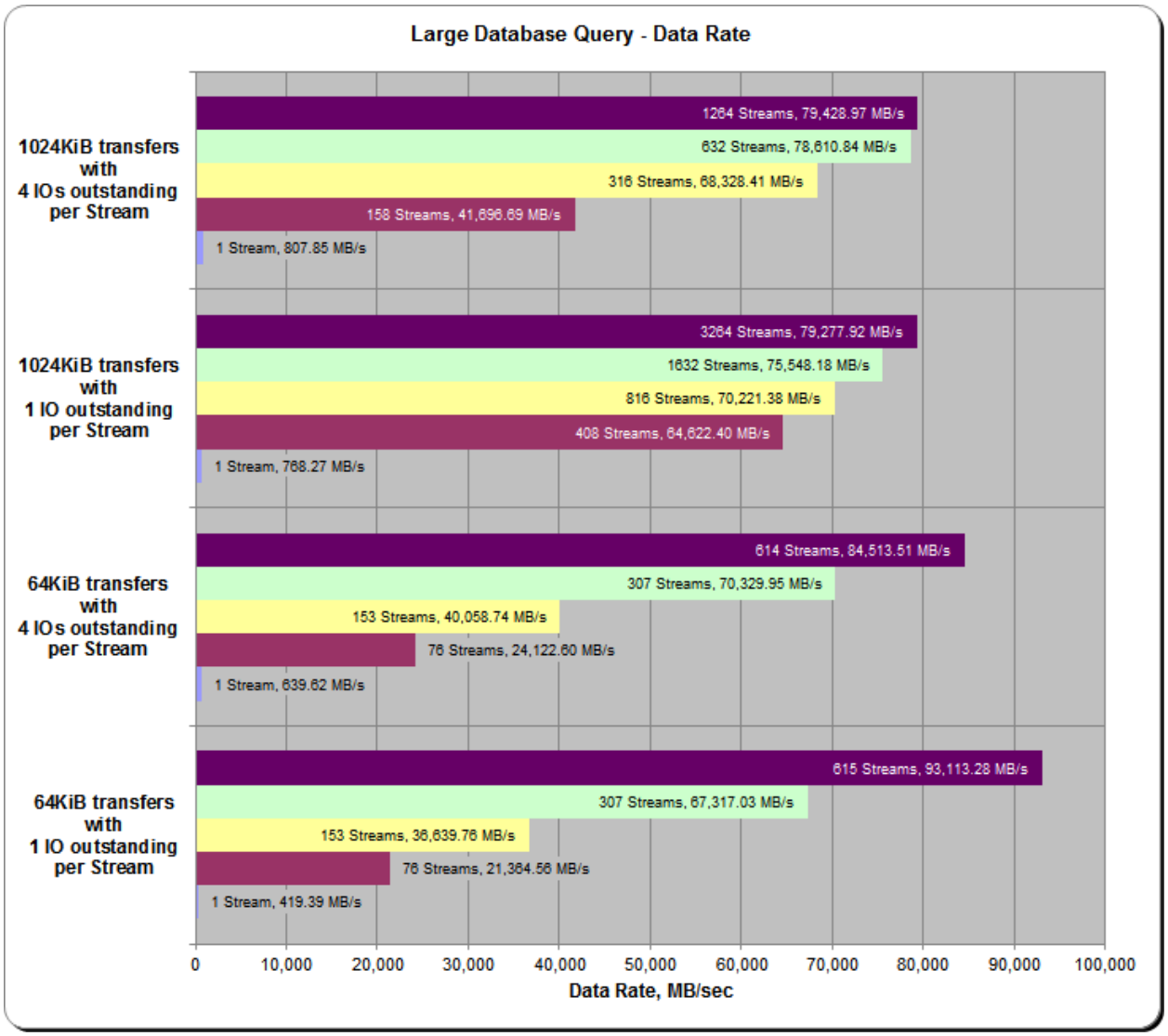
SPC-2 Large Database Query Test Results File

SPC-2 Large Database Query Average Data Rates (MB/s)

The average Data Rate (MB/s) for each Test Run in the two Test Phases of the SPC-2 Large Database Query Test is listed in the table below as well as illustrated in the following graph.

Test Run Sequence	1 Stream	158 Streams	316 Streams	632 Streams	1264 Streams
1024KiB w/ 4 IOs/Stream	807.85	41,696.69	68,328.41	78,610.84	79,428.97
Test Run Sequence	**1 Stream**	**408 Streams**	**816 Streams**	**1632 Streams**	**3264 Streams**
1024KiB w/ 1 IO/Stream	768.27	64,622.40	70,221.38	75,548.18	79,277.92
Test Run Sequence	**1 Stream**	**76 Streams**	**153 Streams**	**307 Streams**	**614 Streams**
64KiB w/ 4 IOs/Stream	639.62	24,122.60	40,058.74	70,329.95	84,513.51
Test Run Sequence	**1 Stream**	**76 Streams**	**153 Streams**	**307 Streams**	**615 Streams**
64KiB w/ 1 IO/Stream	419.39	21,364.56	36,639.76	67,317.03	93,113.28

SPC-2 Large Database Query Average Data Rates Graph

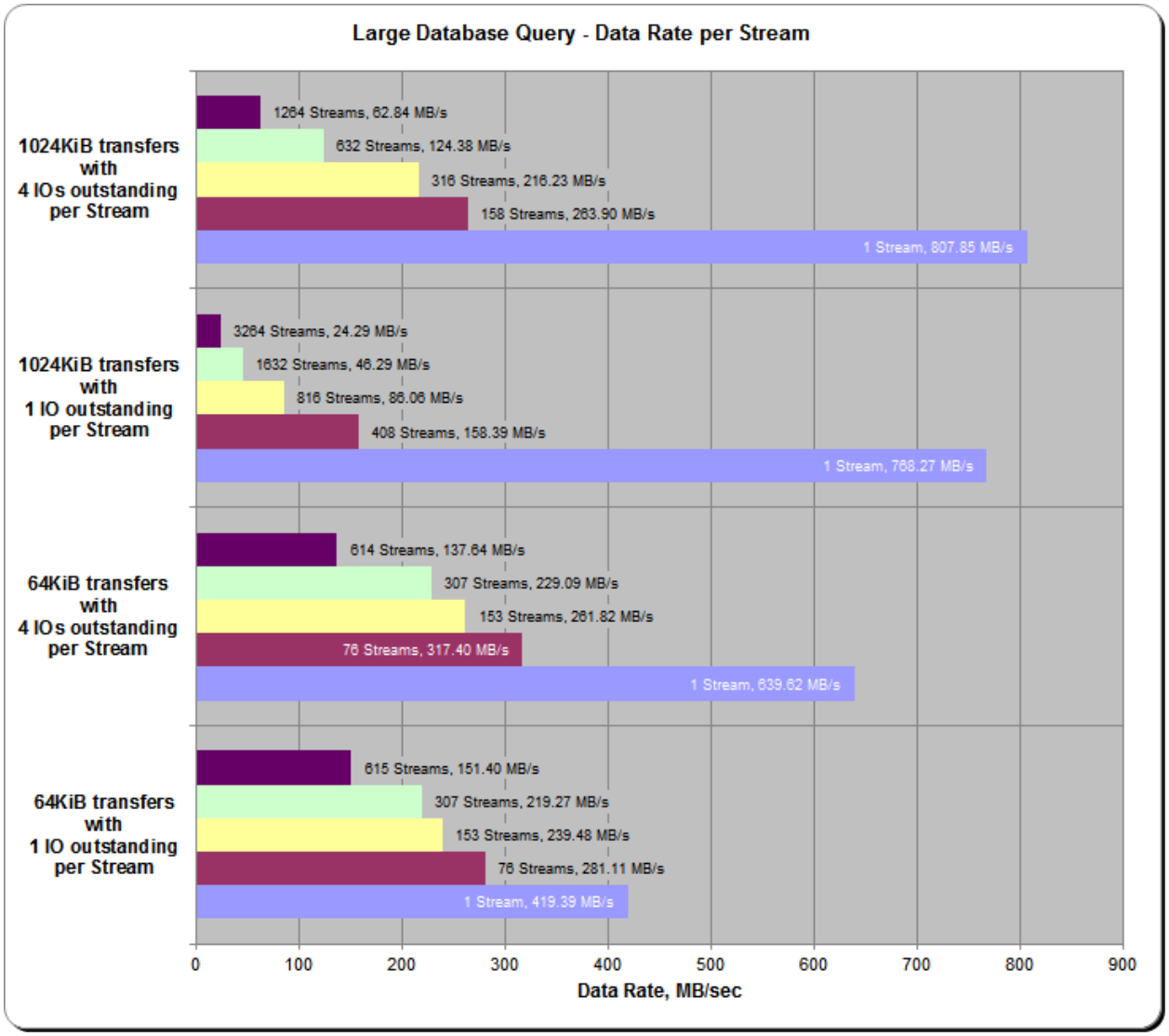


SPC-2 Large Database Query Average Data Rate per Stream

The average Data Rate per Stream for each Test Run in the two Test Phases of the SPC-2 Large Database Query Test is listed in the table below as well as illustrated in the following graph.

Test Run Sequence	1 Stream	158 Streams	316 Streams	632 Streams	1264 Streams
1024KiB w/ 4 IOs/Stream	807.85	263.90	216.23	124.38	62.84
Test Run Sequence	**1 Stream**	**408 Streams**	**816 Streams**	**1632 Streams**	**3264 Streams**
1024KiB w/ 1 IO/Stream	768.27	158.39	86.06	46.29	24.29
Test Run Sequence	**1 Stream**	**76 Streams**	**153 Streams**	**307 Streams**	**614 Streams**
64KiB w/ 4 IOs/Stream	639.62	317.40	261.82	229.09	137.64
Test Run Sequence	**1 Stream**	**76 Streams**	**153 Streams**	**307 Streams**	**615 Streams**
64KiB w/ 1 IO/Stream	419.39	281.11	239.48	219.27	151.40

SPC-2 Large Database Query Average Data Rate per Stream Graph

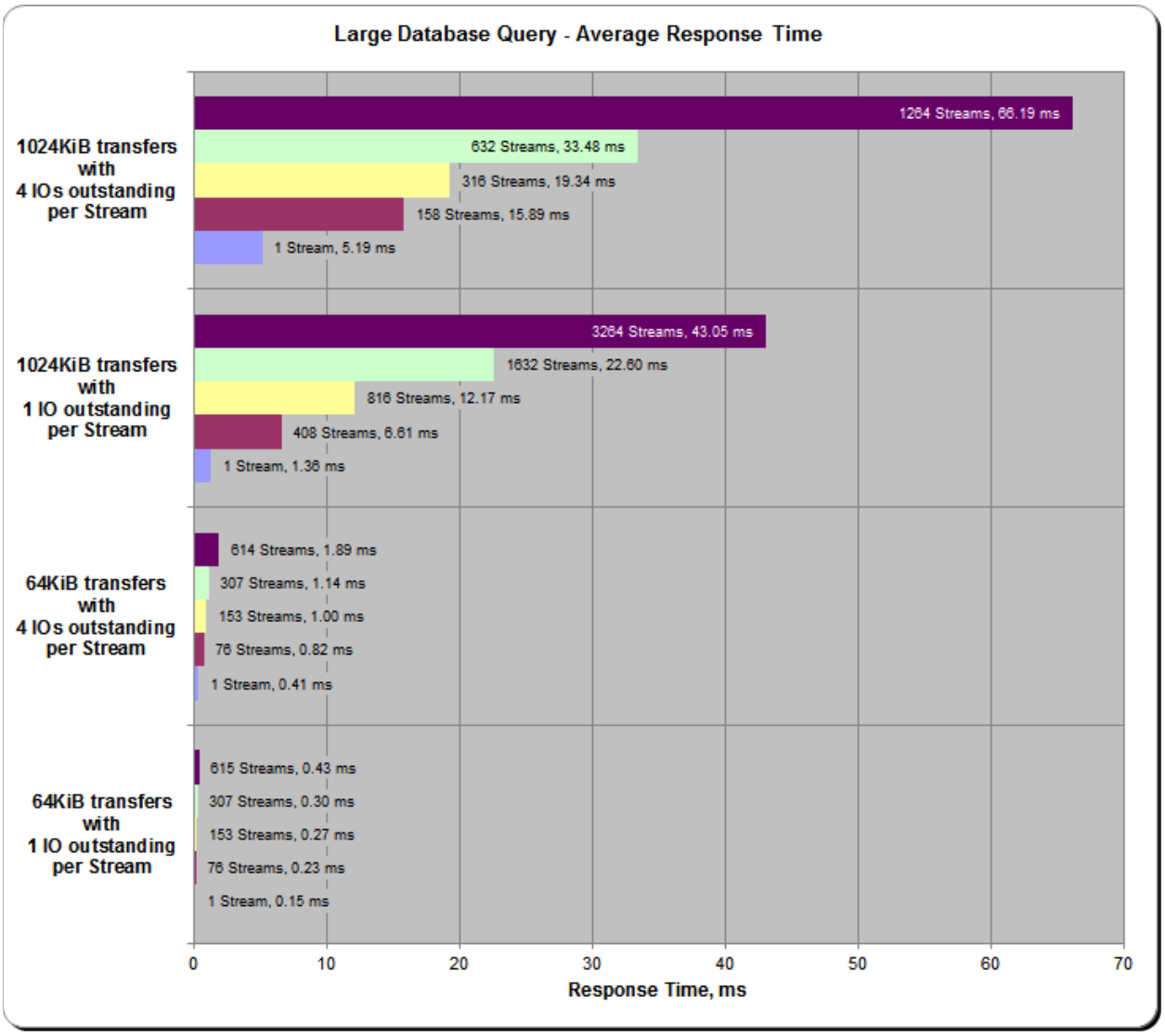


SPC-2 Large Database Query Average Response Time

The average Response Time, in milliseconds, for each Test Run in the two Test Phases of the SPC-2 Large Database Query Test is listed in the table below as well as illustrated in the following graph.

Test Run Sequence	1 Stream	158 Streams	316 Streams	632 Streams	1264 Streams
1024KiB w/ 4 IOs/Stream	5.19	15.89	19.34	33.48	66.19
Test Run Sequence	**1 Stream**	**408 Streams**	**816 Streams**	**1632 Streams**	**3264 Streams**
1024KiB w/ 1 IO/Stream	1.36	6.61	12.17	22.60	43.05
Test Run Sequence	**1 Stream**	**76 Streams**	**153 Streams**	**307 Streams**	**614 Streams**
64KiB w/ 4 IOs/Stream	0.41	0.82	1.00	1.14	1.89
Test Run Sequence	**1 Stream**	**76 Streams**	**153 Streams**	**307 Streams**	**615 Streams**
64KiB w/ 1 IO/Stream	0.15	0.23	0.27	0.30	0.43

SPC-2 Large Database Query Average Response Time Graph



Large Database Query Test – 1024 KIB TRANSFER SIZE Test Phase

Clause 10.6.9.2.1

1. *A table that will contain the following information for each "1024 KiB Transfer Size, 4 Outstanding I/Os" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
2. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "1024 KiB Transfer Size, 4 Outstanding I/Os" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*
3. *A table that will contain the following information for each "1024 KiB Transfer Size, 1 Outstanding I/O" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
4. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "1024 KiB Transfer Size, 1 Outstanding I/O" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*

A hyperlink for each of the above tables and graphs may appear in the FDR to provide access to the table or graph.

A hyperlink to a table with the SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os" Test Run data appears on the next page. That entry is followed by hyperlinks to graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table and graphs present the data at five-second intervals.

Immediately following the above SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os" entries will be hyperlinks for SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O" table and graphs. The table contains the Test Run data and the graphs illustrate the average Data Rate, average Data Rate per Stream, and average Response Time produced by the Test Runs.

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os" Test Run Data

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os" Graphs

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os" graphs
(four pages, 1 graph per page)

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O" Test Run Data

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O" Graphs

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

SPC-2 "Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O" graphs
(four pages, 1 graph per page)

Large Database Query Test – 64 KiB TRANSFER SIZE Test Phase

Clause 10.6.9.2.2

1. *A table that will contain the following information for each "64 KiB Transfer Size, 4 Outstanding I/Os" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
2. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "64 KiB Transfer Size, 4 Outstanding I/Os" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*
3. *A table that will contain the following information for each "64 KiB Transfer Size, 1 Outstanding I/O" Test Run:*
   - *The number of Streams specified.*
   - *The Average Data Rate, Average Data Rate per Stream, and Average Response Time reported at five second intervals.*
4. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the "64 KiB Transfer Size, 1 Outstanding I/O" Test Runs as specified in Clauses 10.1.4 – 10.1.6.*

A hyperlink for each of the above tables and graphs may appear in the FDR to provide access to the table or graph.

A hyperlink to a table with the SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/4 Outstanding I/Os" Test Run data appears on the next page. That entry is followed by hyperlinks to graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table and graphs present the data at five-second intervals.

Immediately following the above SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/4 Outstanding I/Os" entries will be hyperlinks for SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/1 Outstanding I/O" table and graphs. The table contains the Test Run data and the graphs illustrate the average Data Rate, average Data Rate per Stream, and average Response Time produced by the Test Runs.

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/4 Outstanding I/Os" Test Run Data

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/4 Outstanding I/Os" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/4 Outstanding I/Os" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/4 Outstanding I/Os" graphs
(four pages, 1 graph per page)

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/1 Outstanding I/O" Test Run Data

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/1 Outstanding I/O" Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods
(3 pages)

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/1 Outstanding I/O" Graphs

- Average Data Rate – Complete Test Run
- Average Data Rate – Measurement Interval (MI) Only
- Average Data Rate per Stream
- Average Response Time

SPC-2 "Large Database Query/64 KIB TRANSFER SIZE/1 Outstanding I/O" graphs
(four pages, 1 graph per page)

Video on Demand Delivery Test

Clause 6.4.5.1

The Video on Demand Delivery Test represents the I/O operations required to enable individualized video entertainment for a community of subscribers, which draw from a digital film library.

Clause 6.4.5.2

The Video on Demand Delivery Test consists of one (1) Test Run.

The BC shall not be restarted or manually disturbed, altered, or adjusted during the execution of the Video on Demand Delivery Test. If power is lost to the BC during this Test all results shall be rendered invalid and the Test re-run in its entirety.

Clause 10.6.9.3

The Full Disclosure Report will contain the following content for the Video on Demand Delivery Test:

1. *A listing of the SPC-2 Workload Generator commands and parameters used to execute the Test Run in the Video on Demand Delivery Test.*
2. *The human readable SPC-2 Test Results File for the Test Run in the Video on Demand Delivery Test.*
3. *A table that contains the following information for the Test Run in the Video on Demand Delivery Test:*
    - *The number Streams specified.*
    - *The Ramp-Up duration in seconds.*
    - *The Measurement Interval duration in seconds.*
    - *The average data rate, in MB per second, for the Measurement Interval.*
    - *The average data rate, in MB per second, per Stream for the Measurement Interval.*
4. *A table that contains the following information for the single Video on Demand Delivery Test Run:*
    - *The number Streams specified.*
    - *The average data rate, average data rate per stream, average Response Time, and Maximum Response Time reported at 60 second intervals.*
5. *Average Data Rate by Intervals, Average Data Rate per Stream by Intervals, and Average Response Time by Intervals graphs for the single Video on Demand Delivery Test Run as specified in Clause 10.1.8.*
6. *A Maximum Response Time (intervals) graph as specified in Clause 10.1.8.*

SPC-2 Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Video on Demand Delivery Test Run are documented in Appendix E: SPC-2 Workload Generator Execution Commands and Parameters on Page 102..

SPC-2 Test Results File

A link to the SPC-2 Test Results file generated from the Video on Demand Delivery Test Run is listed below.

SPC-2 Video on Demand Delivery Test Results File

SPC-2 Video on Demand Delivery Test Run Data

The number of Streams specified, Ramp-Up duration in seconds, Measurement Interval duration in seconds, average Data Rate for the Measurement Interval, and average Data Rate per Stream for the Measurement Interval are listed in the following table.

SPC-2-VOD	TR1
Number of Streams	93,700
Ramp-up Time, sec	12,001
Measurement Interval, sec	7,200
Average Data Rate, MB/sec	73,689.99
Per Stream Data Rate, MB/sec	0.79
Average Response Time, ms	9.66
Average Max Response Time, ms	284.59

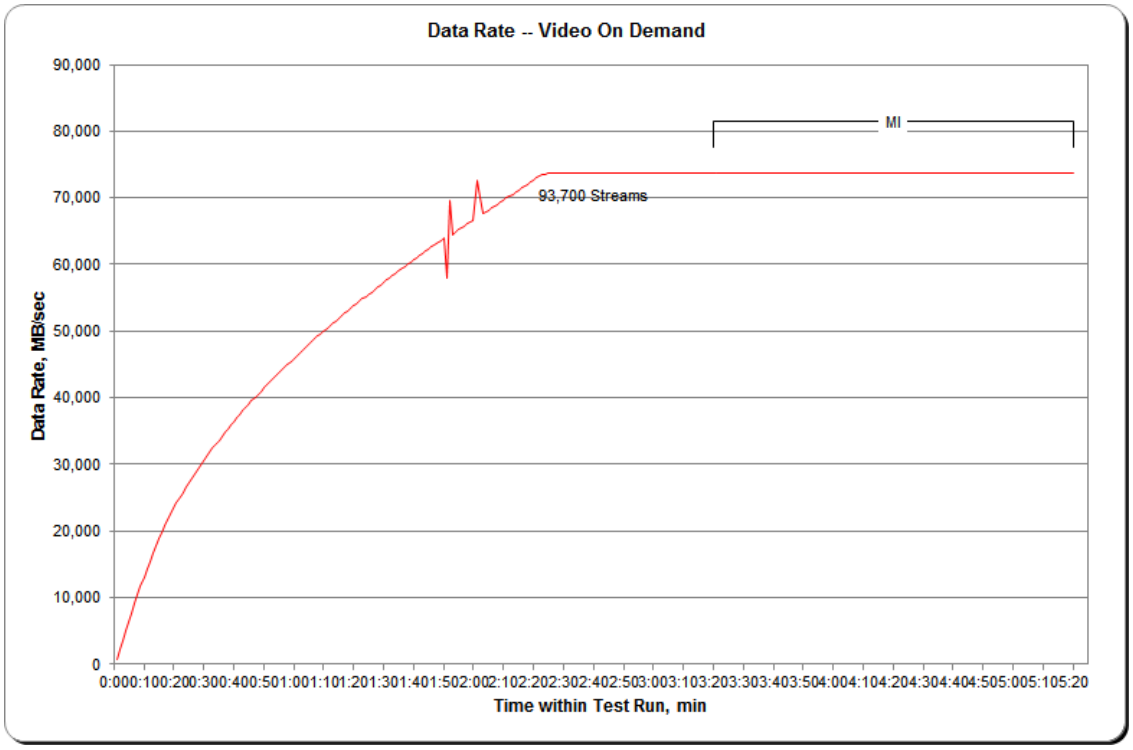
Video on Demand Delivery Test – TEST RUN DATA BY INTERVAL

The SPC-2 Video on Demand Delivery Test Run data is contained in the table that due to the duration of the Test Run and resultant size of the data table, the data table is not embedded in this document. The data table may be viewed and/or downloaded from the following URL.

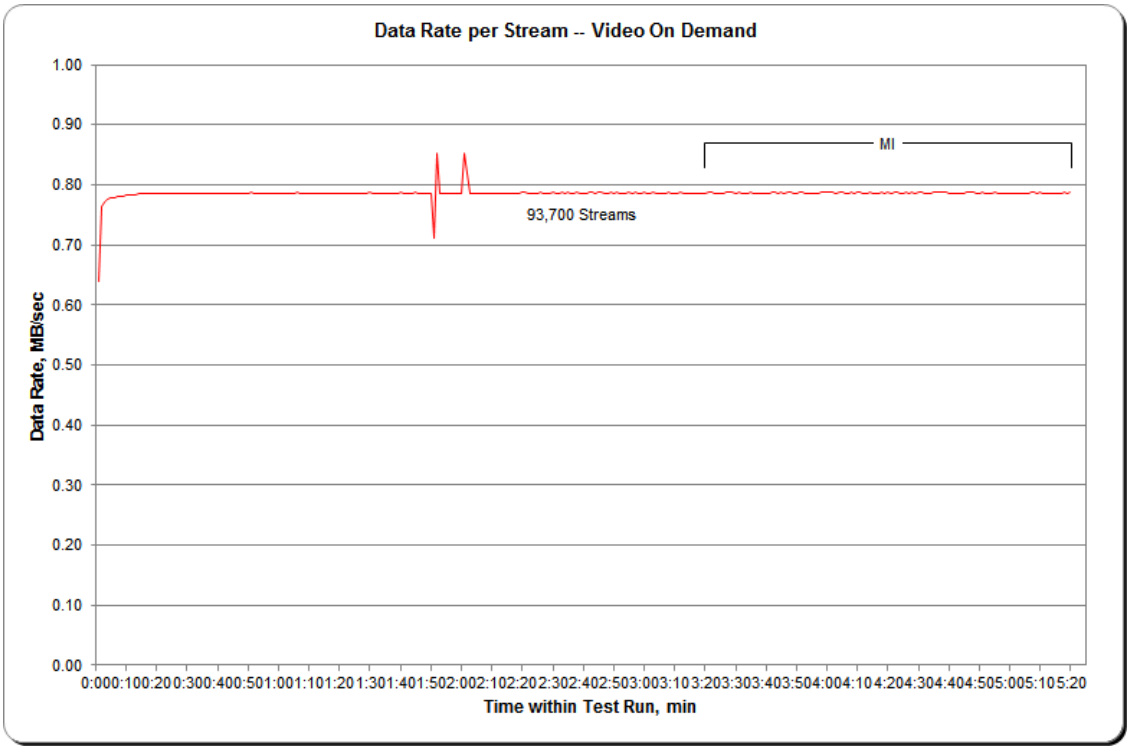
Video on Demand Delivery Test Run Data by Interval

The next two pages include graphs illustrating the average Data Rate, average Data Rate per Stream, Average Response Time and Maximum Response Time produced by the same Test Runs. The table and graphs present the data at sixty second intervals.

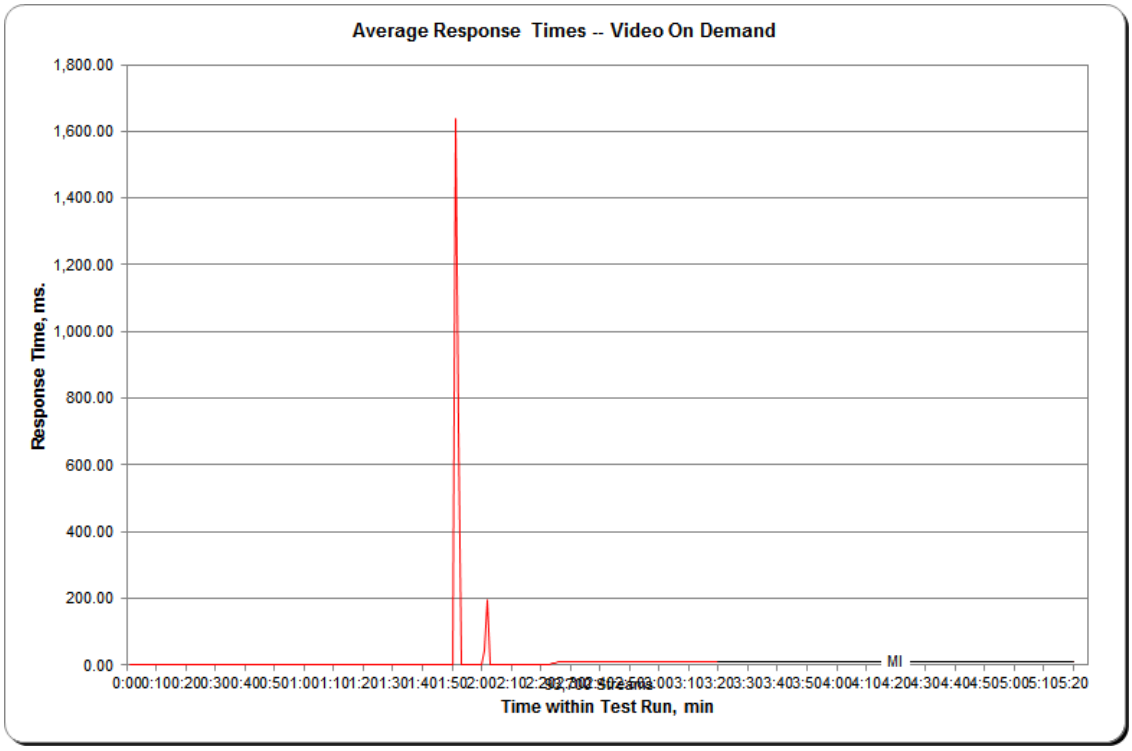
SPC-2 Video on Demand Delivery Average Data Rate Graph



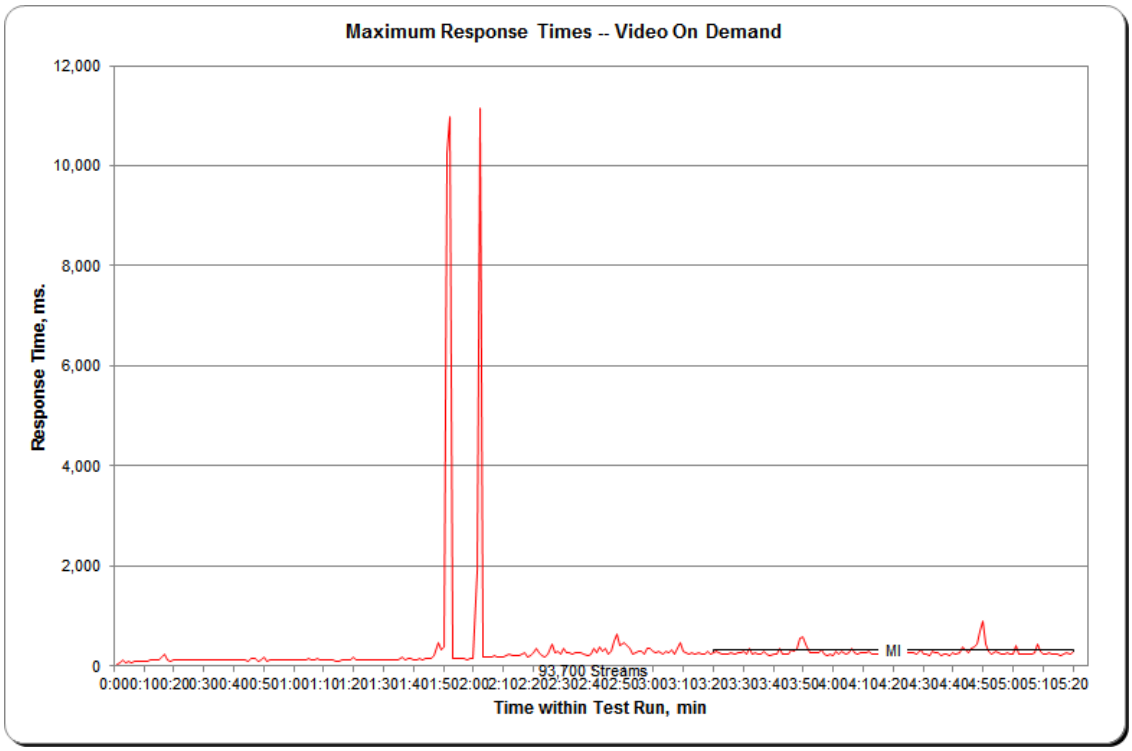
SPC-2 Video on Demand Delivery Average Data Rate per Stream Graph



SPC-2 Video on Demand Delivery Average Response Time Graph



SPC-2 Video on Demand Delivery Maximum Response Time Graph



Data Persistence Test

Clause 7

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-2 Workload Generator will write a specific pattern at randomly selected locations throughout the Total ASU Capacity (Persistence Test Run 1). The SPC-2 Workload Generator will retain the information necessary to later validate the pattern written at each location.

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

Restart the TSC, and if the Host System(s) were shutdown and powered off, restart the Host System(s).

The SPC-2 Workload Generator will utilize the retained data from Persistence Test Run 1 to verify (Persistence Run 2) the bit patterns written in Persistence Test Run 1 and their corresponding location.

Clause 10.6.9.4

The Full Disclosure Report will contain the following content for the Data Persistence Test:

1. *A listing of the SPC-2 Workload Generator commands and parameters used to execute each of the Test Runs in the Persistence Test.*
2. *The human readable SPC-2 Test Results File for each of the Test Runs in the Data Persistence Test.*
3. *A table from the successful Persistence Test, which contains the results from the test.*

SPC-2 Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Persistence Test Runs are documented in Appendix E: SPC-2 Workload Generator Execution Commands and Parameters on Page 102.

Data Persistence Test Results File

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

Persistence 1 Test Run *(write phase)* Results File

Persistence 2 Test Run *(read phase)* Results File

Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Number: 1	
Total Number of Logical Blocks Written	2,138.919
Total Number of Logical Blocks Re-referenced	79,514
Total Number of Logical Blocks Verified	2,059,405
Total Number of Logical Blocks that Failed Verification	0
Number of Failed I/O Requests in the process of the Test	0

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 10.6.9

The committed delivery date for general availability (Availability Date) of all products that comprise the Priced Storage Configuration must be reported. When the Priced Storage Configuration includes products or components with different availability dates, the reported Availability Date must be the date at which all components are committed to be available. All availability dates, whether for individual components or for the Priced Storage Configuration as a whole, must be disclosed to a precision of one day.

The Availability Data shall be stated in either a combination of specific alphanumeric month, numeric day and numeric year or as "Currently Available".

The Fujitsu Storage Systems ETERNUS DX8900 S3 Storage Array, as documented in this SPC-2 Full Disclosure Report, is currently available for customer purchase and shipment.

ANOMALIES OR IRREGULARITIES

Clause 10.6.12

The FDR shall include a clear and complete description of any anomalies or irregularities encountered in the course of executing the SPC-2 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-2 Onsite Audit of the Fujitsu Storage Systems ETERNUS DX8900 S3 Storage Array.

APPENDIX A: SPC-2 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-2 Data Repository Definitions

Total ASU Capacity: The total storage capacity read and written in the course of executing the SPC-2 benchmark.

Application Storage Unit (ASU): The logical interface between the storage and SPC-2 Workload Generator. The ASU is 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-2 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-2 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 ASU.

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 sum of unused storage capacity within the Physical Storage Capacity, Configured Storage Capacity, and Addressable Storage Capacity.

SPC-2 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-2 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-2 Data Repository.

SPC-2 Test Execution Definitions

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

Completion Time: The time recorded by the Workload Generator when an I/O Request is completed by the Tested Storage Configuration (TSC) as signaled by System Software.

Data Rate: The data volume, in MB, transferred by all Measured I/O Requests in an SPC-2 Test Run divided by the length of the Test Run in seconds.

Failed I/O Request: Any I/O Request issued by the SPC-2 Workload Generator that meets one of the following conditions *(see "I/O Completion Types" illustrated below)*:

- The I/O Request was signaled as failed by System Software.
- The I/O Request started within the Measurement Interval, but did not complete prior to the end of the appropriate Run-Out period..
- The I/O Request started within the Run-Out period, but did not complete prior to the end of the appropriate Ramp-Down period.

I/O Request Throughput: The total number of Measured I/O Requests in an SPC-2 Test Run divided by the duration of the Measurement Interval in seconds.

Measured I/O Request: A Completed I/O Request that begins (Start Time) within a Measurement Interval and completes (Completion Time) prior to the end of the appropriate Ramp Down *(see "I/O Completion Types" illustrated below).*

Measurement Interval: A specified, contiguous period of time, after the TSC has reached Steady State, when data is collected by the Workload Generator to produce the test results for a SPC-2 Test Run *(see "SPC-2 Test Run Components" illustrated below, Test Run 1: T_2-T_3 and Test Run 2: T_7-T_8).*

Outstanding I/O Requests: The Outstanding I/O Requests parameter specifies the maximum number of concurrent I/O Requests, associated with a give Stream, which have been issued but not yet completed. *(Clause 3.4.4 of the SPC-2 Benchmark Specification).*

Ramp-Down: A specified, contiguous period of time in which the TSC is required to complete I/O Requests started but not completed during the preceding Run-Out period. Ramp-Down begins at the end of the preceding Run-Out period *(see "SPC-2 Test Run Components" illustrated below, Test Run 1: T_4-T_5 and Test Run 2: T_9-T_{10}).* The Workload Generator will not submit any I/O Requests during the Ramp-Down.

Ramp-Up: A specified, contiguous period of 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. The Ramp-Up period ends at the beginning of the Measurement Interval *(see "SPC-2 Test Run Components" illustrated below, Test Run 1: T_0-T_2 and Test Run 2: T_5-T_7).*

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

Run-Out: A specified, contiguous period of time in which the TSC is required to complete I/O Requests started but not completed during the preceding Measurement Interval. The Run-Out period begins at the end of the preceding Measurement Interval and is a component of the Steady State period *(see "SPC-2 Test Run Components" illustrated below, Test Run 1: T_3-T_4 and Test Run 2: T_9-T_{10}).* The Workload Generator will continue to submit I/O Requests at the Test Run's specified rate during the Run-Out period.

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 TSC.

Steady State: The period during which the workload presented to the TSC by the SPC-2 Workload Generator is constant and the resulting TSC I/O Request Throughput is both consistent and sustainable. The Steady State period includes both the Measurement Interval and Run-Out periods *(see "SPC-2 Test Run Components" illustrated below, Test Run 1: T_1-T_4 and Test Run 2: T_6-T_9).*

Steady State is achieved only after caches in the TSC have filled and as a result the I/O Request Throughput of the TSC has stabilized.

Stream: A collection of Stream Segments that started within a Test Run.

Stream Segment: A sequentially organized pattern of I/O requests, which transfers a contiguous range of data.

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

Test Phase: A collection of one or more SPC-2 Test Runs sharing a common objective and intended to be run in a specific sequence.

Test Run: The execution of SPC-2 that produces specific SPC-2 test results. SPC-2 Test Runs have specified, measured Ramp-Up, Measurement Interval, Run-Out and Ramp-Down periods. "SPC-2 Test Run Components" *(see below)* illustrates the Ramp-Up, Steady State, Measurement Interval, Run-Out, and Ramp-Down components contained in two uninterrupted SPC-2 Test Runs *(Test Run 1: T_0-T_5 and Test Run 2: T_5-T_{10})*.

Test Run Sequence: A related sequence of Large File Processing (LFP) or Large Database Query (LDQ) Test Runs. Each Test Run Sequence will consist of five Test Runs, which vary the number of Streams as follows:

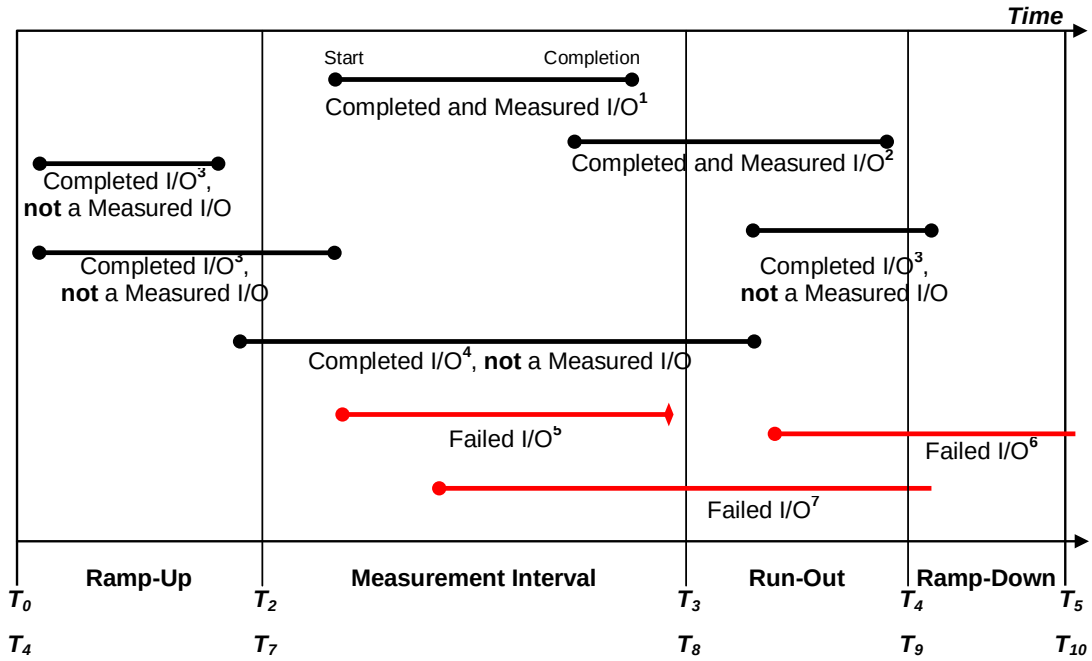
- Test Run 1: Maximum number of Streams, which is selected by the Test Sponsor
- Test Run 2: 50% of the maximum number of Streams used in Test Run 1.
- Test Run 3: 25% of the maximum number of Streams used in Test Run 1.
- Test Run 4: 12.5% of the maximum number of Streams used in Test Run 1.
- Test Run 5: 1 Stream.

Each of the five Test Runs in a Test Run Sequence will share the same attributes with the exception of the number of Streams. For example:

- Large File Processing, Read, 1024 KiB Transfer Size: Maximum Streams
- Large File Processing, Read, 1024 KiB Transfer Size: 50% of Maximum Streams
- Large File Processing, Read, 1024 KiB Transfer Size: 25% of Maximum Streams
- Large File Processing, Read, 1024 KiB Transfer Size: 12.5% of Maximum Streams
- Large File Processing, Read, 1024 KiB Transfer Size: 1 Stream

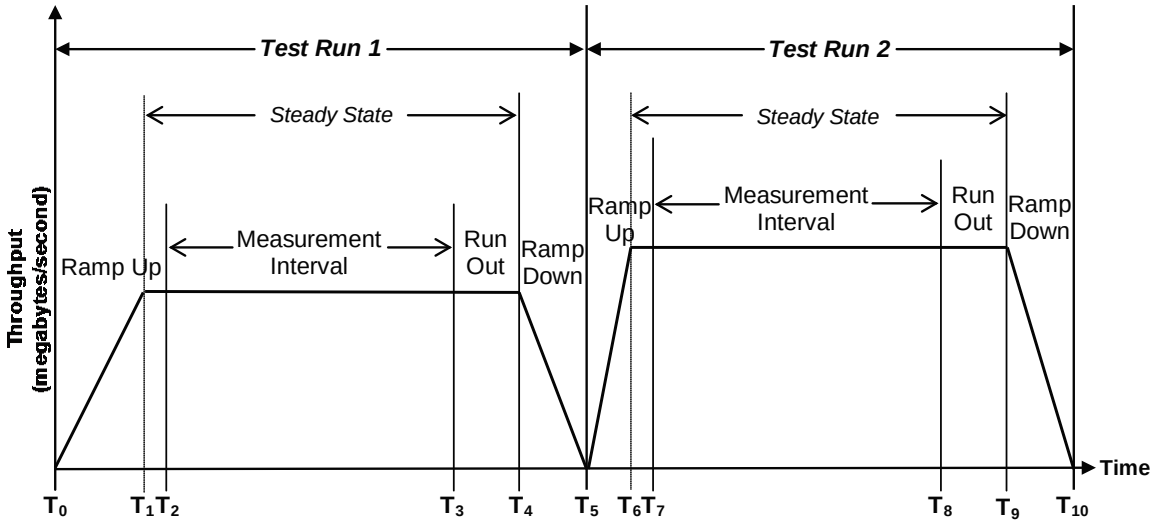
Transfer Size: The Transfer Size parameter specifies the number of bytes in KiB to transfer. *(Clause 3.4.7 of the SPC-2 Benchmark Specification)*

I/O Completion Types



Completed and Measured I/O[1]: *I/O started and completed within the Measurement Interval.*
Completed and Measured I/O[2]: *I/O started within the Measurement Interval and completed within Ramp Down.*
Completed I/O[3]: *I/O started before or after the Measurement Interval – not measured.*
Completed I/O[4]: *I/O started before and completed after the Measurement Interval – not measured.*
Failed I/O[5]: *Signaled as failed by System Software.*
Failed I/O[6]: *I/O did not complete prior to the end of Ramp-Down.*
Failed I/O[7]: *I/O did not complete prior to the end of Run-Out.*

SPC-2 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

The **expect** script, **DX8900S3_Tuning.exp**, as documented in "*Appendix C: Tested Storage Configuration (TSC) Creation*", changed the **Prefetch Limit** cache parameter from a default of 8 to 2 for all of the SPC-2 Logical Volumes.

The **Prefetch Limit** parameter value specifies the amount of prefetched data when a sequential operation is detected. If a sequential READ operation is detected, in a manner specified by the Sequential Detection parameters, the prefetch amount is determined by the following:

> ***(Prefetch Limit** value) * (transfer length of the READ command for which the sequential operation was detected)*

For example, if a sequential access is detected with READ command using a transfer length of 64 (32 KiB), the prefetch amount would be 8 * 32 KiB (256 KiB) with the default setting of 8. Changing the setting to 2, the prefetch amount would be 2 * 32 KiB (64 KiB).

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

In the plan for the SPC-2 benchmark, there were 96 RAID(1+1) groups defined based on 192 SSD devices. Twelve of the SSD devices have an 800GB capacity and 180 SSD devices have a 400GB capacity.

Each RAID Group is created from a pair of SSD devices with equal capacity and assigned a name with sequential number *(e.g.: "R1-0"," R1-1" through "R1-95")*.

A single Logical Volume was defined within each RAID group. The full capacity of the RAID Group was allocated to the Logical Volume for the RAID Groups with 400GB devices and only half of the capacity was allocated to the Logical Volume for the RAID Groups with 800GB devices so that the Logical Volume size was equal regardless of the SSD device size.

Each Logical Volume was mapped to a Control Module (CM) based on which CM the RAID group belongs to.

From this planning information, a standard Fujitsu Command Line tool (CLI) script was defined, using the **cygwin** packages **expect** and **openssh**. The **expect** script, **DX8900S3_20160307.exp** including the **docli** procedure, was used to issue the CLI commands to the array. That procedure used **ssh** for communication with the array. A second procedure in the script, **doexit**, was used to conclude the execution sequence at the end of the script.

The **expect** script **DX8900S3_20160307.exp** is called by a parent bash script **doFDRcfg.sh** which invokes the **expect** script and then waits for the physical format to complete by polling the format status every 20 minutes. The physical format status is returned by calling another **expect** script, **showFormatStatus.exp.**

After completion of the storage creation script the Windows 2008 R2 Host Systems made the initial discovery of the target LUNs. Since each Windows 2008 R2 Host System places the Windows "physical disk" in Offline state after initial discovery it is necessary to issue an explicit command to place each "physical disk" in an Online state. This was done by using the Disk Management tool in the Windows GUI. The operation to set the "physical disks" in Online State needs to be done only once after initial creation.

Steps 1-3, detailed below, document the items completed within the **expect** script **DX8900S3_20160307.exp** to create the SPC-2 Tested Storage Configuration (TSC).

The Crosscheck on LV Addressing section documents the validation step to ensure the correct mapping was implemented as part of the TSC creation/configuration process.

The Performance Tuning Parameter section documents the customer parameter that was changed for the benchmark execution.

All referenced scripts appear in the TSC Creation/Configuration Scripts section.

Step 1 – Creation of the RAID Groups

A total of 96 RAID Groups were created, per the plan. Each RAID Group was made up of 2 disk drives in a RAID1 configuration, and assigned to a specific Controller Module (CM) . The RAID Groups were named **R1-0** through **R1-95**.

Step 2 – Creation of the Logical Volumes

Within each of the RAID Groups, one Logical Volume was created with a capacity of 374528 MiB, per the plan. The names, **CM00_R1_0** through **CM31_R1-95**, were assigned to the volumes as part of their creation. (***CMXX*** *in the name designates the preferred Control Module number for the RAID Group and thus the volume,* ***R1_YY*** *designates the RAID Group name where the volume resides).*

Step 3 – Assignment of LUN Mapping for Host Access

The port LUN mapping was assigned, based on the scheme described below.

The 96 Logical Volumes were divided into 8 groups of 24 SSD devices each and each group was mapped into 8 ports assigned to the preferred CM.

For example, the following command assigned the SSD device groups that have **CM00** as the preferred Control Module *(volumes: 0-5,12-17)* and they are mapped to the ports that belong to **CM00** *(port numbers are defined as* ***XXYY*** *where* ***XX*** *designate the CM number).*

docli set mapping -port 0000,0001,0002,0003,0010,0011,0012,0013 -volume-number 0-5,12-17 -lun 0-11

Crosscheck on LV Addressing

As the last step in the TSC creation, the **getAllHostInfo.sh** script was executed on the Master Host System, which in turn invoked the **getHostInfo.sh** script on the Master Host system all Slave Host Systems.

The **getAllHostInfo.sh** script executed the Emulex CLI command, ***HBACmd.exe***, which completed the following steps:

- Generate a list of all of the Emulex HBA using the ***ListHBAs*** subcommand.
- For each port WWN (initiator) in the above list, execute the **TargetMapping** subcommand to generate a list of target LUNs discovered by the initiator. Each entry in the generated list is displayed as follows:

```
FCP LUN 18      : 0018 0000 0000 0000
SCSI OS Lun     : 24
Lun Device Name: \\.\PhysicalDrive0
Vendor ID       : FUJITSU
Product ID      : ETERNUS_DXH
Product Version: 1052
Type            : 0
SCSI Capacity   : 365.75 GB
Block Size      : 512 Bytes
```

The above **SCSI OS Lun** entry contains the LUN number *(decimal)*, as seen from the Host System and the above **Lun Device Name** entry contains the device name assigned by Windows, which is used in the configuration/parameter files for the SPC-2 benchmark.

The **getHostInfo.sh** script will then parse and correlate the **SCSI OS Lun** and **Lun Device Name** fields, sorting by the **SCSI OS Lun** field to generate the Cross Check list.

For example, following shows that **LUN 0** in the LUNMAP is assigned to Windows **PhysicalDrive24**:

SCSI OS Lun : 0 Lun; ***Device Name: \\.\PhysicalDrive24***

Performance Tuning Parameter

After the TSC creation process is completed, as documented above, the Prefetch Limit cache parameter, documented in *"Appendix B: Customer Tunable Parameters and Options"*, is changed from its default value by execution of the **DX8900S3_Tuning.exp** script.

TSC Creation/Configuration Scripts

doFDRcfg.sh

```
#!/bin/bash
#
# Do the configuration steps required for the SPC2 benchmark
#
# create tmp directory for spc2 if it does not exist
if [ ! -d /tmp/spc2 ]; then
mkdir /tmp/spc2
fi
ROOT=/cygdrive/c/spc/fdr
SCRIPTS=${ROOT}/07_Execution
CONFIGURE=${ROOT}/06_Creation
#
# confID uniquely identifies the configuration of the array
confID=DX8900S3_20160307

#
# obtain cjobID based on the timestamp
# cjobID uniquely identifies the configuration job
cjobID=C`date +%y%m%d%H%M%S`
#
echo job start time `date` > /tmp/spc2/${cjobID}_message.txt
echo This is an array configuration job >> /tmp/spc2/${cjobID}_message.txt
echo job confID=$confID >> /tmp/spc2/${cjobID}_message.txt
echo job cjobID=$cjobID >> /tmp/spc2/${cjobID}_message.txt
${SCRIPTS}/recordStatus.sh "Starting Configuration Job=${cjobID}"
${cjobID}_message.txt
#
# Configure Array using the Expect script to issue CLI commands
#
${SCRIPTS}/recordStatus.sh "Starting Eternus CLI script for configuration
Job=${cjobID}" ${cjobID}_message.txt
${CONFIGURE}/${confID}.exp
${SCRIPTS}/recordStatus.sh "Completed Eternus CLI script for configuration
Job=${cjobID}" ${cjobID}_message.txt
#
```

```
#
# Wait for physical format to complete
#
PollingInterval=600 #wait 10 minutes to check format status
#
LUNS=999
while [ $LUNS -gt 0 ]; do
 cat  /tmp/spc2/fmt_${cjobID}.txt >> /tmp/spc2/${cjobID}_message.txt
 ${CONFIGURE}/showFormatStatus.exp dx8900s3 root root /tmp/spc2/fmt_${cjobID}.txt
 LUNS=`grep Available /tmp/spc2/fmt_${cjobID}.txt |wc |awk '{print $1}'`
 echo "-------------------------------------------"  >>
/tmp/spc2/${cjobID}_message.txt
 ${SCRIPTS}/recordStatus.sh "Currently formatting $LUNS LUNS Job=${cjobID}"
${cjobID}_message.txt
 sleep $PollingInterval
done
${SCRIPTS}/recordStatus.sh "Physical format complete please proceed. Job=${cjobID}"
${cjobID}_message.txt
```

DX8900S3_20160307.exp

```
#!/usr/bin/expect
# script to setup initial configuration for DX8900S3
# for SPC-2 benchmark
# Requirment: no ssh public key for this server registered to the array
set timeout 600
set user root
spawn ssh dx8900s3 -l $user
#expect "password: "
#send "root\r"
expect "CLI>"
# procedure to execute DX cli command
proc docli { cmd args } {
send "$cmd $args\r"
expect "CLI>"
}
# procedure to exit
proc doexit {} {
send "exit\r"
}

## Create 96 RAID Groups ##

docli create raid-group -name R1-0 -disks 0000,0400 -level 1 -assigned-cm 00
docli create raid-group -name R1-1 -disks 0001,0401 -level 1 -assigned-cm 00
docli create raid-group -name R1-2 -disks 0002,0402 -level 1 -assigned-cm 00
docli create raid-group -name R1-3 -disks 0003,0403 -level 1 -assigned-cm 00
docli create raid-group -name R1-4 -disks 0004,0404 -level 1 -assigned-cm 00
docli create raid-group -name R1-5 -disks 0005,0405 -level 1 -assigned-cm 00
docli create raid-group -name R1-6 -disks 0006,0406 -level 1 -assigned-cm 01
docli create raid-group -name R1-7 -disks 0007,0407 -level 1 -assigned-cm 01
docli create raid-group -name R1-8 -disks 0008,0408 -level 1 -assigned-cm 01
docli create raid-group -name R1-9 -disks 0009,0409 -level 1 -assigned-cm 01
docli create raid-group -name R1-10 -disks 0010,0410 -level 1 -assigned-cm 01
docli create raid-group -name R1-11 -disks 0011,0411 -level 1 -assigned-cm 01
docli create raid-group -name R1-12 -disks 0800,0c00 -level 1 -assigned-cm 00
docli create raid-group -name R1-13 -disks 0801,0c01 -level 1 -assigned-cm 00
docli create raid-group -name R1-14 -disks 0802,0c02 -level 1 -assigned-cm 00
docli create raid-group -name R1-15 -disks 0803,0c03 -level 1 -assigned-cm 00
docli create raid-group -name R1-16 -disks 0804,0c04 -level 1 -assigned-cm 00
```

```
docli create raid-group -name R1-17 -disks 0805,0c05 -level 1 -assigned-cm 00
docli create raid-group -name R1-18 -disks 0806,0c06 -level 1 -assigned-cm 01
docli create raid-group -name R1-19 -disks 0807,0c07 -level 1 -assigned-cm 01
docli create raid-group -name R1-20 -disks 0808,0c08 -level 1 -assigned-cm 01
docli create raid-group -name R1-21 -disks 0809,0c09 -level 1 -assigned-cm 01
docli create raid-group -name R1-22 -disks 0810,0c10 -level 1 -assigned-cm 01
docli create raid-group -name R1-23 -disks 0811,0c11 -level 1 -assigned-cm 01
docli create raid-group -name R1-24 -disks 1000,1400 -level 1 -assigned-cm 10
docli create raid-group -name R1-25 -disks 1001,1401 -level 1 -assigned-cm 10
docli create raid-group -name R1-26 -disks 1002,1402 -level 1 -assigned-cm 10
docli create raid-group -name R1-27 -disks 1003,1403 -level 1 -assigned-cm 10
docli create raid-group -name R1-28 -disks 1004,1404 -level 1 -assigned-cm 10
docli create raid-group -name R1-29 -disks 1005,1405 -level 1 -assigned-cm 10
docli create raid-group -name R1-30 -disks 1006,1406 -level 1 -assigned-cm 11
docli create raid-group -name R1-31 -disks 1007,1407 -level 1 -assigned-cm 11
docli create raid-group -name R1-32 -disks 1008,1408 -level 1 -assigned-cm 11
docli create raid-group -name R1-33 -disks 1009,1409 -level 1 -assigned-cm 11
docli create raid-group -name R1-34 -disks 1010,1410 -level 1 -assigned-cm 11
docli create raid-group -name R1-35 -disks 1011,1411 -level 1 -assigned-cm 11
docli create raid-group -name R1-36 -disks 1800,1c00 -level 1 -assigned-cm 10
docli create raid-group -name R1-37 -disks 1801,1c01 -level 1 -assigned-cm 10
docli create raid-group -name R1-38 -disks 1802,1c02 -level 1 -assigned-cm 10
docli create raid-group -name R1-39 -disks 1803,1c03 -level 1 -assigned-cm 10
docli create raid-group -name R1-40 -disks 1804,1c04 -level 1 -assigned-cm 10
docli create raid-group -name R1-41 -disks 1805,1c05 -level 1 -assigned-cm 10
docli create raid-group -name R1-42 -disks 1806,1c06 -level 1 -assigned-cm 11
docli create raid-group -name R1-43 -disks 1807,1c07 -level 1 -assigned-cm 11
docli create raid-group -name R1-44 -disks 1808,1c08 -level 1 -assigned-cm 11
docli create raid-group -name R1-45 -disks 1809,1c09 -level 1 -assigned-cm 11
docli create raid-group -name R1-46 -disks 1810,1c10 -level 1 -assigned-cm 11
docli create raid-group -name R1-47 -disks 1811,1c11 -level 1 -assigned-cm 11
docli create raid-group -name R1-48 -disks 2000,2400 -level 1 -assigned-cm 20
docli create raid-group -name R1-49 -disks 2001,2401 -level 1 -assigned-cm 20
docli create raid-group -name R1-50 -disks 2002,2402 -level 1 -assigned-cm 20
docli create raid-group -name R1-51 -disks 2003,2403 -level 1 -assigned-cm 20
docli create raid-group -name R1-52 -disks 2004,2404 -level 1 -assigned-cm 20
docli create raid-group -name R1-53 -disks 2005,2405 -level 1 -assigned-cm 20
docli create raid-group -name R1-54 -disks 2006,2406 -level 1 -assigned-cm 21
docli create raid-group -name R1-55 -disks 2007,2407 -level 1 -assigned-cm 21
docli create raid-group -name R1-56 -disks 2008,2408 -level 1 -assigned-cm 21
docli create raid-group -name R1-57 -disks 2009,2409 -level 1 -assigned-cm 21
docli create raid-group -name R1-58 -disks 2010,2410 -level 1 -assigned-cm 21
docli create raid-group -name R1-59 -disks 2011,2411 -level 1 -assigned-cm 21
docli create raid-group -name R1-60 -disks 2800,2c00 -level 1 -assigned-cm 20
docli create raid-group -name R1-61 -disks 2801,2c01 -level 1 -assigned-cm 20
docli create raid-group -name R1-62 -disks 2802,2c02 -level 1 -assigned-cm 20
docli create raid-group -name R1-63 -disks 2803,2c03 -level 1 -assigned-cm 20
docli create raid-group -name R1-64 -disks 2804,2c04 -level 1 -assigned-cm 20
docli create raid-group -name R1-65 -disks 2805,2c05 -level 1 -assigned-cm 20
docli create raid-group -name R1-66 -disks 2806,2c06 -level 1 -assigned-cm 21
docli create raid-group -name R1-67 -disks 2807,2c07 -level 1 -assigned-cm 21
docli create raid-group -name R1-68 -disks 2808,2c08 -level 1 -assigned-cm 21
docli create raid-group -name R1-69 -disks 2809,2c09 -level 1 -assigned-cm 21
docli create raid-group -name R1-70 -disks 2810,2c10 -level 1 -assigned-cm 21
docli create raid-group -name R1-71 -disks 2811,2c11 -level 1 -assigned-cm 21
docli create raid-group -name R1-72 -disks 3000,3400 -level 1 -assigned-cm 30
docli create raid-group -name R1-73 -disks 3001,3401 -level 1 -assigned-cm 30
docli create raid-group -name R1-74 -disks 3002,3402 -level 1 -assigned-cm 30
docli create raid-group -name R1-75 -disks 3003,3403 -level 1 -assigned-cm 30
docli create raid-group -name R1-76 -disks 3004,3404 -level 1 -assigned-cm 30
docli create raid-group -name R1-77 -disks 3005,3405 -level 1 -assigned-cm 30
docli create raid-group -name R1-78 -disks 3006,3406 -level 1 -assigned-cm 31
```

```
docli create raid-group -name R1-79 -disks 3007,3407 -level 1 -assigned-cm 31
docli create raid-group -name R1-80 -disks 3008,3408 -level 1 -assigned-cm 31
docli create raid-group -name R1-81 -disks 3009,3409 -level 1 -assigned-cm 31
docli create raid-group -name R1-82 -disks 3010,3410 -level 1 -assigned-cm 31
docli create raid-group -name R1-83 -disks 3011,3411 -level 1 -assigned-cm 31
docli create raid-group -name R1-84 -disks 3800,3c00 -level 1 -assigned-cm 30
docli create raid-group -name R1-85 -disks 3801,3c01 -level 1 -assigned-cm 30
docli create raid-group -name R1-86 -disks 3802,3c02 -level 1 -assigned-cm 30
docli create raid-group -name R1-87 -disks 3803,3c03 -level 1 -assigned-cm 30
docli create raid-group -name R1-88 -disks 3804,3c04 -level 1 -assigned-cm 30
docli create raid-group -name R1-89 -disks 3805,3c05 -level 1 -assigned-cm 30
docli create raid-group -name R1-90 -disks 3806,3c06 -level 1 -assigned-cm 31
docli create raid-group -name R1-91 -disks 3807,3c07 -level 1 -assigned-cm 31
docli create raid-group -name R1-92 -disks 3808,3c08 -level 1 -assigned-cm 31
docli create raid-group -name R1-93 -disks 3809,3c09 -level 1 -assigned-cm 31
docli create raid-group -name R1-94 -disks 3810,3c10 -level 1 -assigned-cm 31
docli create raid-group -name R1-95 -disks 3811,3c11 -level 1 -assigned-cm 31

## Create 96 Volumes ##

docli create volume -name CM00_R1-0 -rg-name R1-0 -count 1 -type open -size 374528mb
docli create volume -name CM00_R1-1 -rg-name R1-1 -count 1 -type open -size 374528mb
docli create volume -name CM00_R1-2 -rg-name R1-2 -count 1 -type open -size 374528mb
docli create volume -name CM00_R1-3 -rg-name R1-3 -count 1 -type open -size 374528mb
docli create volume -name CM00_R1-4 -rg-name R1-4 -count 1 -type open -size 374528mb
docli create volume -name CM00_R1-5 -rg-name R1-5 -count 1 -type open -size 374528mb
docli create volume -name CM01_R1-6 -rg-name R1-6 -count 1 -type open -size 374528mb
docli create volume -name CM01_R1-7 -rg-name R1-7 -count 1 -type open -size 374528mb
docli create volume -name CM01_R1-8 -rg-name R1-8 -count 1 -type open -size 374528mb
docli create volume -name CM01_R1-9 -rg-name R1-9 -count 1 -type open -size 374528mb
docli create volume -name CM01_R1-10 -rg-name R1-10 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-11 -rg-name R1-11 -count 1 -type open -size
374528mb


docli create volume -name CM00_R1-12 -rg-name R1-12 -count 1 -type open -size
374528mb
docli create volume -name CM00_R1-13 -rg-name R1-13 -count 1 -type open -size
374528mb
docli create volume -name CM00_R1-14 -rg-name R1-14 -count 1 -type open -size
374528mb
docli create volume -name CM00_R1-15 -rg-name R1-15 -count 1 -type open -size
374528mb
docli create volume -name CM00_R1-16 -rg-name R1-16 -count 1 -type open -size
374528mb
docli create volume -name CM00_R1-17 -rg-name R1-17 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-18 -rg-name R1-18 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-19 -rg-name R1-19 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-20 -rg-name R1-20 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-21 -rg-name R1-21 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-22 -rg-name R1-22 -count 1 -type open -size
374528mb
docli create volume -name CM01_R1-23 -rg-name R1-23 -count 1 -type open -size
374528mb
```

```
docli create volume -name CM10_R1-24 -rg-name R1-24 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-25 -rg-name R1-25 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-26 -rg-name R1-26 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-27 -rg-name R1-27 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-28 -rg-name R1-28 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-29 -rg-name R1-29 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-30 -rg-name R1-30 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-31 -rg-name R1-31 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-32 -rg-name R1-32 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-33 -rg-name R1-33 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-34 -rg-name R1-34 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-35 -rg-name R1-35 -count 1 -type open -size
374528mb


docli create volume -name CM10_R1-36 -rg-name R1-36 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-37 -rg-name R1-37 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-38 -rg-name R1-38 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-39 -rg-name R1-39 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-40 -rg-name R1-40 -count 1 -type open -size
374528mb
docli create volume -name CM10_R1-41 -rg-name R1-41 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-42 -rg-name R1-42 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-43 -rg-name R1-43 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-44 -rg-name R1-44 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-45 -rg-name R1-45 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-46 -rg-name R1-46 -count 1 -type open -size
374528mb
docli create volume -name CM11_R1-47 -rg-name R1-47 -count 1 -type open -size
374528mb


docli create volume -name CM20_R1-48 -rg-name R1-48 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-49 -rg-name R1-49 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-50 -rg-name R1-50 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-51 -rg-name R1-51 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-52 -rg-name R1-52 -count 1 -type open -size
374528mb
```

```
docli create volume -name CM20_R1-53 -rg-name R1-53 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-54 -rg-name R1-54 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-55 -rg-name R1-55 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-56 -rg-name R1-56 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-57 -rg-name R1-57 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-58 -rg-name R1-58 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-59 -rg-name R1-59 -count 1 -type open -size
374528mb


docli create volume -name CM20_R1-60 -rg-name R1-60 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-61 -rg-name R1-61 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-62 -rg-name R1-62 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-63 -rg-name R1-63 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-64 -rg-name R1-64 -count 1 -type open -size
374528mb
docli create volume -name CM20_R1-65 -rg-name R1-65 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-66 -rg-name R1-66 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-67 -rg-name R1-67 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-68 -rg-name R1-68 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-69 -rg-name R1-69 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-70 -rg-name R1-70 -count 1 -type open -size
374528mb
docli create volume -name CM21_R1-71 -rg-name R1-71 -count 1 -type open -size
374528mb


docli create volume -name CM30_R1-72 -rg-name R1-72 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-73 -rg-name R1-73 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-74 -rg-name R1-74 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-75 -rg-name R1-75 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-76 -rg-name R1-76 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-77 -rg-name R1-77 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-78 -rg-name R1-78 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-79 -rg-name R1-79 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-80 -rg-name R1-80 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-81 -rg-name R1-81 -count 1 -type open -size
374528mb
```

```
docli create volume -name CM31_R1-82 -rg-name R1-82 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-83 -rg-name R1-83 -count 1 -type open -size
374528mb


docli create volume -name CM30_R1-84 -rg-name R1-84 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-85 -rg-name R1-85 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-86 -rg-name R1-86 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-87 -rg-name R1-87 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-88 -rg-name R1-88 -count 1 -type open -size
374528mb
docli create volume -name CM30_R1-89 -rg-name R1-89 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-90 -rg-name R1-90 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-91 -rg-name R1-91 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-92 -rg-name R1-92 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-93 -rg-name R1-93 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-94 -rg-name R1-94 -count 1 -type open -size
374528mb
docli create volume -name CM31_R1-95 -rg-name R1-95 -count 1 -type open -size
374528mb

## Set Mapping for each port
docli set mapping -port 0000,0001,0002,0003,0010,0011,0012,0013 -volume-number 0-
5,12-17 -lun 0-11
docli set mapping -port 0100,0101,0102,0103,0110,0111,0112,0113 -volume-number 6-
11,18-23 -lun 12-23
docli set mapping -port 1000,1001,1002,1003,1010,1011,1012,1013 -volume-number 24-
29,36-41 -lun 24-35
docli set mapping -port 1100,1101,1102,1103,1110,1111,1112,1113 -volume-number 30-
35,42-47 -lun 36-47
docli set mapping -port 2000,2001,2002,2003,2010,2011,2012,2013 -volume-number 48-
53,60-65 -lun 48-59
docli set mapping -port 2100,2101,2102,2103,2110,2111,2112,2113 -volume-number 54-
59,66-71 -lun 60-71
docli set mapping -port 3000,3001,3002,3003,3010,3011,3012,3013 -volume-number 72-
77,84-89 -lun 72-83
docli set mapping -port 3100,3101,3102,3103,3110,3111,3112,3113 -volume-number 78-
83,90-95 -lun 84-95

## Logout ##
doexit
```

showFormatStatus.exp

```
#!/usr/bin/expect -f
# Create volumes from the array
# getFormatStatus  <array> <arrayid> <arraypass> <file>
# assumption: array's ssh port has ssh-key-pre-registered no no password is required
# please register ssh-keys
# procedure to execute commands
proc docli {cmd args} {
send "$cmd $args\r"
expect "CLI>"
}
# procedure to exit
proc doexit {} {
send "exit \r"
}
set array [lindex $argv 0]
set arrayid [lindex $argv 1]
set arraypass [lindex $argv 2]
set file [lindex $argv 3]
#set file /tmp/formatstatus.txt
# login
spawn ssh $arrayid@$array
#expect "password: "
#send "$arraypass\r"
set timeout 40
expect "CLI>"
if [catch {open $file "w" } output] {
  puts "$output"
  exit
}
send "show volume-progress\r"
expect "CLI>"
puts $output "Output = $expect_out(buffer)"
close $output
doexit
close
```

getAllHostInfo.sh

```
NUMHOSTS=8
# get localhost
./getHostInfo.sh fdr_RX2540M1-1
# get fromremote hosts
for (( i=1;i<NUMHOSTS;i+=1 ))
do
       h=$(( $i + 1 ))
       ssh Administrator@slavew-${i} "rm -f fdr_RX2540M1-${h}*"
       ssh Administrator@slavew-${i}
"/cygdrive/c/spc/fdr/04_ReferenceInfo/getHostInfo.sh fdr_RX2540M1-${h}"
       scp Administrator@slavew-${i}:*fdr_RX2540M1-${h}*  .
done
```

getHostInfo.sh

```
#!/usr/bin/bash -x
# Functions for SPC2 jobs definitions
# Fileprefix=$1
function GetHostInfo()
{
    #Get environment info for the host system using PrimeCollect.
     OutFile=${1}_HostInfo
     tmpprefix=/tmp/gest_$$
     PCSYSSCN=/cygdrive/c/PrimeCollect64/SVIM/MDP/Agent/Tools/PCSysScan.exe
     "${PCSYSSCN}" -htmlreport `cygpath -w ${OutFile}_Pt1.html`
     echo "<h1>Supplemental Host Information</h1>" > ${OutFile}_Pt2.html
     timestamp=`date --rfc-3339='seconds'`
     echo "<pre>TIME CREATED:${timestamp}</pre>" >> ${OutFile}_Pt2.html
     # Java information
     echo "<h2>Java Information (Oracle SE) </h2>" >> ${OutFile}_Pt2.html
     echo "<pre>" >> ${OutFile}_Pt2.html
     /cygdrive/c/Java/jre7/bin/java -version &>> ${OutFile}_Pt2.html
     echo "</pre>" >> ${OutFile}_Pt2.html
     # HBA information
     echo "<h2>HBA Information (Emulex) </h2>" >> ${OutFile}_Pt2.html
     echo "<pre>" >> ${OutFile}_Pt2.html
     HC=/cygdrive/c/Program\ Files/Emulex/Util/OCManager/HbaCmd.exe
     "${HC}"  ListHBAs  >> ${OutFile}_Pt2.html
     echo "</pre>" >> ${OutFile}_Pt2.html
     for i in `"${HC}" ListHBAs |awk '/Port WWN/{print $4}'`
     do
     echo "<h3>Target Mapping</h3>" >> ${OutFile}_Pt2.html
     echo "<pre>" >> ${OutFile}_Pt2.html
     "${HC}" TargetMapping $i  |tee ${tmpprefix}_$i.txt >> ${OutFile}_Pt2.html
     echo "</pre>" >> ${OutFile}_Pt2.html
     echo "<h3>HBA Attributes</h3>" >> ${OutFile}_Pt2.html
     echo "<pre>" >> ${OutFile}_Pt2.html
     "${HC}" HBAAttributes $i >> ${OutFile}_Pt2.html
     echo "</pre>" >> ${OutFile}_Pt2.html
     echo "<h3>Port Attributes</h3>" >> ${OutFile}_Pt2.html
     echo "<pre>" >> ${OutFile}_Pt2.html
     "${HC}" PortAttributes $i >> ${OutFile}_Pt2.html
     echo "</pre>" >> ${OutFile}_Pt2.html
     done
     echo "<h2>Disk LUN Mapping -Sorted by LUN</h2>" >> ${OutFile}_Pt2.html
     echo "<pre>" >> ${OutFile}_Pt2.html
     grep Lun --no-filename ${tmpprefix}_*.txt > ${tmpprefix}_luns.txt
    sed -n '/^SCSI/{
    N
    s/\n/ /p
    }' ${tmpprefix}_luns.txt >  ${tmpprefix}_etluns.txt
    /usr/bin/sort -k5.1n ${tmpprefix}_etluns.txt >> ${OutFile}_Pt2.html
     echo "</pre>" >> ${OutFile}_Pt2.html
}
GetHostInfo $1
```

DX8900S3_Tuning.exp

```
#!/usr/bin/expect
# script to apply tuning parameters
# for SPC-2 benchmark
# Requirment: no ssh public key for this server registered to the array
set timeout 600
set user root
spawn ssh dx8900s3 -l $user
#expect "password: "
#send "root\r"
expect "CLI>"
# procedure to execute DX cli command
proc docli { cmd args } {
send "$cmd $args\r"
expect "CLI>"
}
# procedure to exit
proc doexit {} {
send "exit\r"
}

## Set Prefetch limit = 1 to 96 Volumes ##

docli set cache-parameters -volume-number 0-95 -pl 2

## Logout ##
doexit
```

APPENDIX D: SPC-2 WORKLOAD GENERATOR STORAGE COMMANDS AND PARAMETER FILES

ASU Pre-Fill

The ASU pre-fill was completed by 8 separate processes, each executing simultaneously on a single Host System to reduce the duration of the pre-fill process.

The command and parameter file for each of the 8 processes is listed below.

Host System 0, Logical Volumes 0-11

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd0,lun=\\.\PhysicalDrive0
sd=sd1,lun=\\.\PhysicalDrive1
sd=sd2,lun=\\.\PhysicalDrive2
sd=sd3,lun=\\.\PhysicalDrive3
sd=sd4,lun=\\.\PhysicalDrive4
sd=sd5,lun=\\.\PhysicalDrive5
sd=sd6,lun=\\.\PhysicalDrive6
sd=sd7,lun=\\.\PhysicalDrive7
sd=sd8,lun=\\.\PhysicalDrive8
sd=sd9,lun=\\.\PhysicalDrive9
sd=sd10,lun=\\.\PhysicalDrive10
sd=sd11,lun=\\.\PhysicalDrive11
*
wd=wd0,sd=sd0,rdpct=0,seek=-1,xfersize=256K
wd=wd1,sd=sd1,rdpct=0,seek=-1,xfersize=256K
wd=wd2,sd=sd2,rdpct=0,seek=-1,xfersize=256K
wd=wd3,sd=sd3,rdpct=0,seek=-1,xfersize=256K
wd=wd4,sd=sd4,rdpct=0,seek=-1,xfersize=256K
wd=wd5,sd=sd5,rdpct=0,seek=-1,xfersize=256K
wd=wd6,sd=sd6,rdpct=0,seek=-1,xfersize=256K
wd=wd7,sd=sd7,rdpct=0,seek=-1,xfersize=256K
wd=wd8,sd=sd8,rdpct=0,seek=-1,xfersize=256K
wd=wd9,sd=sd9,rdpct=0,seek=-1,xfersize=256K
wd=wd10,sd=sd10,rdpct=0,seek=-1,xfersize=256K
wd=wd11,sd=sd11,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 1, Logical Volumes 12-23

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd12,lun=\\.\PhysicalDrive12
sd=sd13,lun=\\.\PhysicalDrive13
sd=sd14,lun=\\.\PhysicalDrive14
sd=sd15,lun=\\.\PhysicalDrive15
sd=sd16,lun=\\.\PhysicalDrive16
sd=sd17,lun=\\.\PhysicalDrive17
sd=sd18,lun=\\.\PhysicalDrive18
sd=sd19,lun=\\.\PhysicalDrive19
sd=sd20,lun=\\.\PhysicalDrive20
sd=sd21,lun=\\.\PhysicalDrive21
sd=sd22,lun=\\.\PhysicalDrive22
sd=sd23,lun=\\.\PhysicalDrive23
*
wd=wd12,sd=sd12,rdpct=0,seek=-1,xfersize=256K
wd=wd13,sd=sd13,rdpct=0,seek=-1,xfersize=256K
wd=wd14,sd=sd14,rdpct=0,seek=-1,xfersize=256K
wd=wd15,sd=sd15,rdpct=0,seek=-1,xfersize=256K
wd=wd16,sd=sd16,rdpct=0,seek=-1,xfersize=256K
wd=wd17,sd=sd17,rdpct=0,seek=-1,xfersize=256K
wd=wd18,sd=sd18,rdpct=0,seek=-1,xfersize=256K
wd=wd19,sd=sd19,rdpct=0,seek=-1,xfersize=256K
wd=wd20,sd=sd20,rdpct=0,seek=-1,xfersize=256K
wd=wd21,sd=sd21,rdpct=0,seek=-1,xfersize=256K
wd=wd22,sd=sd22,rdpct=0,seek=-1,xfersize=256K
wd=wd23,sd=sd23,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 2, Logical Volumes 24-35

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd24,lun=\\.\PhysicalDrive24
sd=sd25,lun=\\.\PhysicalDrive25
sd=sd26,lun=\\.\PhysicalDrive26
```

```
sd=sd27,lun=\\.\PhysicalDrive27
sd=sd28,lun=\\.\PhysicalDrive28
sd=sd29,lun=\\.\PhysicalDrive29
sd=sd30,lun=\\.\PhysicalDrive30
sd=sd31,lun=\\.\PhysicalDrive31
sd=sd32,lun=\\.\PhysicalDrive32
sd=sd33,lun=\\.\PhysicalDrive33
sd=sd34,lun=\\.\PhysicalDrive34
sd=sd35,lun=\\.\PhysicalDrive35
*
wd=wd24,sd=sd24,rdpct=0,seek=-1,xfersize=256K
wd=wd25,sd=sd25,rdpct=0,seek=-1,xfersize=256K
wd=wd26,sd=sd26,rdpct=0,seek=-1,xfersize=256K
wd=wd27,sd=sd27,rdpct=0,seek=-1,xfersize=256K
wd=wd28,sd=sd28,rdpct=0,seek=-1,xfersize=256K
wd=wd29,sd=sd29,rdpct=0,seek=-1,xfersize=256K
wd=wd30,sd=sd30,rdpct=0,seek=-1,xfersize=256K
wd=wd31,sd=sd31,rdpct=0,seek=-1,xfersize=256K
wd=wd32,sd=sd32,rdpct=0,seek=-1,xfersize=256K
wd=wd33,sd=sd33,rdpct=0,seek=-1,xfersize=256K
wd=wd34,sd=sd34,rdpct=0,seek=-1,xfersize=256K
wd=wd35,sd=sd35,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 3, Logical Volumes 36-47

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd36,lun=\\.\PhysicalDrive36
sd=sd37,lun=\\.\PhysicalDrive37
sd=sd38,lun=\\.\PhysicalDrive38
sd=sd39,lun=\\.\PhysicalDrive39
sd=sd40,lun=\\.\PhysicalDrive40
sd=sd41,lun=\\.\PhysicalDrive41
sd=sd42,lun=\\.\PhysicalDrive42
sd=sd43,lun=\\.\PhysicalDrive43
sd=sd44,lun=\\.\PhysicalDrive44
sd=sd45,lun=\\.\PhysicalDrive45
sd=sd46,lun=\\.\PhysicalDrive46
sd=sd47,lun=\\.\PhysicalDrive47
*
wd=wd36,sd=sd36,rdpct=0,seek=-1,xfersize=256K
wd=wd37,sd=sd37,rdpct=0,seek=-1,xfersize=256K
wd=wd38,sd=sd38,rdpct=0,seek=-1,xfersize=256K
wd=wd39,sd=sd39,rdpct=0,seek=-1,xfersize=256K
```

```
wd=wd40,sd=sd40,rdpct=0,seek=-1,xfersize=256K
wd=wd41,sd=sd41,rdpct=0,seek=-1,xfersize=256K
wd=wd42,sd=sd42,rdpct=0,seek=-1,xfersize=256K
wd=wd43,sd=sd43,rdpct=0,seek=-1,xfersize=256K
wd=wd44,sd=sd44,rdpct=0,seek=-1,xfersize=256K
wd=wd45,sd=sd45,rdpct=0,seek=-1,xfersize=256K
wd=wd46,sd=sd46,rdpct=0,seek=-1,xfersize=256K
wd=wd47,sd=sd47,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 4, Logical Volumes 48-59

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd48,lun=\\.\PhysicalDrive48
sd=sd49,lun=\\.\PhysicalDrive49
sd=sd50,lun=\\.\PhysicalDrive50
sd=sd51,lun=\\.\PhysicalDrive51
sd=sd52,lun=\\.\PhysicalDrive52
sd=sd53,lun=\\.\PhysicalDrive53
sd=sd54,lun=\\.\PhysicalDrive54
sd=sd55,lun=\\.\PhysicalDrive55
sd=sd56,lun=\\.\PhysicalDrive56
sd=sd57,lun=\\.\PhysicalDrive57
sd=sd58,lun=\\.\PhysicalDrive58
sd=sd59,lun=\\.\PhysicalDrive59
*
wd=wd48,sd=sd48,rdpct=0,seek=-1,xfersize=256K
wd=wd49,sd=sd49,rdpct=0,seek=-1,xfersize=256K
wd=wd50,sd=sd50,rdpct=0,seek=-1,xfersize=256K
wd=wd51,sd=sd51,rdpct=0,seek=-1,xfersize=256K
wd=wd52,sd=sd52,rdpct=0,seek=-1,xfersize=256K
wd=wd53,sd=sd53,rdpct=0,seek=-1,xfersize=256K
wd=wd54,sd=sd54,rdpct=0,seek=-1,xfersize=256K
wd=wd55,sd=sd55,rdpct=0,seek=-1,xfersize=256K
wd=wd56,sd=sd56,rdpct=0,seek=-1,xfersize=256K
wd=wd57,sd=sd57,rdpct=0,seek=-1,xfersize=256K
wd=wd58,sd=sd58,rdpct=0,seek=-1,xfersize=256K
wd=wd59,sd=sd59,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
```

```
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 5, Logical Volumes 60-71

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd60,lun=\\.\PhysicalDrive60
sd=sd61,lun=\\.\PhysicalDrive61
sd=sd62,lun=\\.\PhysicalDrive62
sd=sd63,lun=\\.\PhysicalDrive63
sd=sd64,lun=\\.\PhysicalDrive64
sd=sd65,lun=\\.\PhysicalDrive65
sd=sd66,lun=\\.\PhysicalDrive66
sd=sd67,lun=\\.\PhysicalDrive67
sd=sd68,lun=\\.\PhysicalDrive68
sd=sd69,lun=\\.\PhysicalDrive69
sd=sd70,lun=\\.\PhysicalDrive70
sd=sd71,lun=\\.\PhysicalDrive71
*
wd=wd60,sd=sd60,rdpct=0,seek=-1,xfersize=256K
wd=wd61,sd=sd61,rdpct=0,seek=-1,xfersize=256K
wd=wd62,sd=sd62,rdpct=0,seek=-1,xfersize=256K
wd=wd63,sd=sd63,rdpct=0,seek=-1,xfersize=256K
wd=wd64,sd=sd64,rdpct=0,seek=-1,xfersize=256K
wd=wd65,sd=sd65,rdpct=0,seek=-1,xfersize=256K
wd=wd66,sd=sd66,rdpct=0,seek=-1,xfersize=256K
wd=wd67,sd=sd67,rdpct=0,seek=-1,xfersize=256K
wd=wd68,sd=sd68,rdpct=0,seek=-1,xfersize=256K
wd=wd69,sd=sd69,rdpct=0,seek=-1,xfersize=256K
wd=wd70,sd=sd70,rdpct=0,seek=-1,xfersize=256K
wd=wd71,sd=sd71,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 6, Logical Volumes 72-83

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
```

```
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd72,lun=\\.\PhysicalDrive72
sd=sd73,lun=\\.\PhysicalDrive73
sd=sd74,lun=\\.\PhysicalDrive74
sd=sd75,lun=\\.\PhysicalDrive75
sd=sd76,lun=\\.\PhysicalDrive76
sd=sd77,lun=\\.\PhysicalDrive77
sd=sd78,lun=\\.\PhysicalDrive78
sd=sd79,lun=\\.\PhysicalDrive79
sd=sd80,lun=\\.\PhysicalDrive80
sd=sd81,lun=\\.\PhysicalDrive81
sd=sd82,lun=\\.\PhysicalDrive82
sd=sd83,lun=\\.\PhysicalDrive83
*
wd=wd72,sd=sd72,rdpct=0,seek=-1,xfersize=256K
wd=wd73,sd=sd73,rdpct=0,seek=-1,xfersize=256K
wd=wd74,sd=sd74,rdpct=0,seek=-1,xfersize=256K
wd=wd75,sd=sd75,rdpct=0,seek=-1,xfersize=256K
wd=wd76,sd=sd76,rdpct=0,seek=-1,xfersize=256K
wd=wd77,sd=sd77,rdpct=0,seek=-1,xfersize=256K
wd=wd78,sd=sd78,rdpct=0,seek=-1,xfersize=256K
wd=wd79,sd=sd79,rdpct=0,seek=-1,xfersize=256K
wd=wd80,sd=sd80,rdpct=0,seek=-1,xfersize=256K
wd=wd81,sd=sd81,rdpct=0,seek=-1,xfersize=256K
wd=wd82,sd=sd82,rdpct=0,seek=-1,xfersize=256K
wd=wd83,sd=sd83,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Host System 7, Logical Volumes 84-95

```
*
* Prefill vdbench parameter file for SPC2 DX8900S3 2016/03/04
* single server version
*
* This will produce a random data pattern of the entire LBA range using LSFR
* 32 bit
*
compratio=1
*
sd=default,host=localhost,size=300g,threads=32
sd=sd84,lun=\\.\PhysicalDrive84
sd=sd85,lun=\\.\PhysicalDrive85
sd=sd86,lun=\\.\PhysicalDrive86
sd=sd87,lun=\\.\PhysicalDrive87
sd=sd88,lun=\\.\PhysicalDrive88
sd=sd89,lun=\\.\PhysicalDrive89
sd=sd90,lun=\\.\PhysicalDrive90
sd=sd91,lun=\\.\PhysicalDrive91
sd=sd92,lun=\\.\PhysicalDrive92
sd=sd93,lun=\\.\PhysicalDrive93
sd=sd94,lun=\\.\PhysicalDrive94
```

```
sd=sd95,lun=\\.\PhysicalDrive95
*
wd=wd84,sd=sd84,rdpct=0,seek=-1,xfersize=256K
wd=wd85,sd=sd85,rdpct=0,seek=-1,xfersize=256K
wd=wd86,sd=sd86,rdpct=0,seek=-1,xfersize=256K
wd=wd87,sd=sd87,rdpct=0,seek=-1,xfersize=256K
wd=wd88,sd=sd88,rdpct=0,seek=-1,xfersize=256K
wd=wd89,sd=sd89,rdpct=0,seek=-1,xfersize=256K
wd=wd90,sd=sd90,rdpct=0,seek=-1,xfersize=256K
wd=wd91,sd=sd91,rdpct=0,seek=-1,xfersize=256K
wd=wd92,sd=sd92,rdpct=0,seek=-1,xfersize=256K
wd=wd93,sd=sd93,rdpct=0,seek=-1,xfersize=256K
wd=wd94,sd=sd94,rdpct=0,seek=-1,xfersize=256K
wd=wd95,sd=sd95,rdpct=0,seek=-1,xfersize=256K
*
*==================================
* Use 10 hours as a maximum elapsed time,
* which should ensure the entire LBA range
* will be written before the time elapses
*==================================
rd=asu_prefill,wd=wd*,iorate=max,elapsed=36000,interval=10
* The above "elapsed=36000" may have to be increased to ensure that the utility will
reach
* the end of the LUN ("seek=-1") prior to the end of the specified elapsed time
```

Common Commands/Parameters – LFP, LDQ. VOD and Persistence Tests

The following command/parameter lines appear in each of the command and parameter files for the Large File Processing (LFP), Large Database Query (LDQ), Video on Demand (VOD) and Persistence Tests. The command lines are only listed below to eliminate redundancy.

```
sd=default,size=300g
sd=sd0,lun=\\.\PhysicalDrive0
sd=sd1,lun=\\.\PhysicalDrive1
sd=sd2,lun=\\.\PhysicalDrive2
sd=sd3,lun=\\.\PhysicalDrive3
sd=sd4,lun=\\.\PhysicalDrive4
sd=sd5,lun=\\.\PhysicalDrive5
sd=sd6,lun=\\.\PhysicalDrive6
sd=sd7,lun=\\.\PhysicalDrive7
sd=sd8,lun=\\.\PhysicalDrive8
sd=sd9,lun=\\.\PhysicalDrive9
sd=sd10,lun=\\.\PhysicalDrive10
sd=sd11,lun=\\.\PhysicalDrive11
sd=sd12,lun=\\.\PhysicalDrive12
sd=sd13,lun=\\.\PhysicalDrive13
sd=sd14,lun=\\.\PhysicalDrive14
sd=sd15,lun=\\.\PhysicalDrive15
sd=sd16,lun=\\.\PhysicalDrive16
sd=sd17,lun=\\.\PhysicalDrive17
sd=sd18,lun=\\.\PhysicalDrive18
sd=sd19,lun=\\.\PhysicalDrive19
sd=sd20,lun=\\.\PhysicalDrive20
sd=sd21,lun=\\.\PhysicalDrive21
sd=sd22,lun=\\.\PhysicalDrive22
sd=sd23,lun=\\.\PhysicalDrive23
sd=sd24,lun=\\.\PhysicalDrive24
sd=sd25,lun=\\.\PhysicalDrive25
sd=sd26,lun=\\.\PhysicalDrive26
sd=sd27,lun=\\.\PhysicalDrive27
sd=sd28,lun=\\.\PhysicalDrive28
sd=sd29,lun=\\.\PhysicalDrive29
sd=sd30,lun=\\.\PhysicalDrive30
sd=sd31,lun=\\.\PhysicalDrive31
sd=sd32,lun=\\.\PhysicalDrive32
sd=sd33,lun=\\.\PhysicalDrive33
sd=sd34,lun=\\.\PhysicalDrive34
sd=sd35,lun=\\.\PhysicalDrive35
sd=sd36,lun=\\.\PhysicalDrive36
sd=sd37,lun=\\.\PhysicalDrive37
sd=sd38,lun=\\.\PhysicalDrive38
sd=sd39,lun=\\.\PhysicalDrive39
sd=sd40,lun=\\.\PhysicalDrive40
sd=sd41,lun=\\.\PhysicalDrive41
sd=sd42,lun=\\.\PhysicalDrive42
sd=sd43,lun=\\.\PhysicalDrive43
sd=sd44,lun=\\.\PhysicalDrive44
sd=sd45,lun=\\.\PhysicalDrive45
sd=sd46,lun=\\.\PhysicalDrive46
sd=sd47,lun=\\.\PhysicalDrive47
sd=sd48,lun=\\.\PhysicalDrive48
sd=sd49,lun=\\.\PhysicalDrive49
sd=sd50,lun=\\.\PhysicalDrive50
sd=sd51,lun=\\.\PhysicalDrive51
```

```
sd=sd52,lun=\\.\PhysicalDrive52
sd=sd53,lun=\\.\PhysicalDrive53
sd=sd54,lun=\\.\PhysicalDrive54
sd=sd55,lun=\\.\PhysicalDrive55
sd=sd56,lun=\\.\PhysicalDrive56
sd=sd57,lun=\\.\PhysicalDrive57
sd=sd58,lun=\\.\PhysicalDrive58
sd=sd59,lun=\\.\PhysicalDrive59
sd=sd60,lun=\\.\PhysicalDrive60
sd=sd61,lun=\\.\PhysicalDrive61
sd=sd62,lun=\\.\PhysicalDrive62
sd=sd63,lun=\\.\PhysicalDrive63
sd=sd64,lun=\\.\PhysicalDrive64
sd=sd65,lun=\\.\PhysicalDrive65
sd=sd66,lun=\\.\PhysicalDrive66
sd=sd67,lun=\\.\PhysicalDrive67
sd=sd68,lun=\\.\PhysicalDrive68
sd=sd69,lun=\\.\PhysicalDrive69
sd=sd70,lun=\\.\PhysicalDrive70
sd=sd71,lun=\\.\PhysicalDrive71
sd=sd72,lun=\\.\PhysicalDrive72
sd=sd73,lun=\\.\PhysicalDrive73
sd=sd74,lun=\\.\PhysicalDrive74
sd=sd75,lun=\\.\PhysicalDrive75
sd=sd76,lun=\\.\PhysicalDrive76
sd=sd77,lun=\\.\PhysicalDrive77
sd=sd78,lun=\\.\PhysicalDrive78
sd=sd79,lun=\\.\PhysicalDrive79
sd=sd80,lun=\\.\PhysicalDrive80
sd=sd81,lun=\\.\PhysicalDrive81
sd=sd82,lun=\\.\PhysicalDrive82
sd=sd83,lun=\\.\PhysicalDrive83
sd=sd84,lun=\\.\PhysicalDrive84
sd=sd85,lun=\\.\PhysicalDrive85
sd=sd86,lun=\\.\PhysicalDrive86
sd=sd87,lun=\\.\PhysicalDrive87
sd=sd88,lun=\\.\PhysicalDrive88
sd=sd89,lun=\\.\PhysicalDrive89
sd=sd90,lun=\\.\PhysicalDrive90
sd=sd91,lun=\\.\PhysicalDrive91
sd=sd92,lun=\\.\PhysicalDrive92
sd=sd93,lun=\\.\PhysicalDrive93
sd=sd94,lun=\\.\PhysicalDrive94
sd=sd95,lun=\\.\PhysicalDrive95

reportinginterval=5
```

Large File Processing Test (LFP)

```
* Large File Processing(LFP)
host=localhost
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
maxstreams=100
HOST=(192.168.1.22,slave-1),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-1,
maxstreams=100
host=(192.168.1.23,slave-2),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-2,
maxstreams=100
host=(192.168.1.24,slave-3),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-3,
maxstreams=100
host=(192.168.1.25,slave-4),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-4,
maxstreams=100
host=(192.168.1.26,slave-5),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-5,
maxstreams=100
host=(192.168.1.27,slave-6),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-6,
maxstreams=100
host=(192.168.1.28,slave-7),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=10,
output=C:/spc/fdr/09_Results/03lfp/out_lfp_fdr_slave-7,
maxstreams=100
```

common commands and parameters

```
maxlatestart=1
segmentlength=512m

rd=default,rampup=180,periods=90,measurement=180,runout=45,rampdown=15,buffers=1

* LFP, Write Phase

rd=default,rdpct=0,xfersize=1024k
```

```
rd=TR1_SPC-2-FP,streams=192
rd=TR2_SPC-2-FP,streams=96
rd=TR3_SPC-2-FP,streams=48
rd=TR4_SPC-2-FP,streams=24
rd=TR5_SPC-2-FP,streams=1
*
*
rd=default,rdpct=0,xfersize=256k
rd=TR6_SPC-2-FP,streams=192
rd=TR7_SPC-2-FP,streams=96
rd=TR8_SPC-2-FP,streams=48
rd=TR9_SPC-2-FP,streams=24
rd=TR10_SPC-2-FP,streams=1
*
*
** LFP, Read/Write Phase
*
rd=default,rdpct=50,xfersize=1024k
rd=TR11_SPC-2-FP,streams=192
rd=TR12_SPC-2-FP,streams=96
rd=TR13_SPC-2-FP,streams=48
rd=TR14_SPC-2-FP,streams=24
rd=TR15_SPC-2-FP,streams=1
*
rd=default,rdpct=50,xfersize=256k
rd=TR16_SPC-2-FP,streams=192
rd=TR17_SPC-2-FP,streams=96
rd=TR18_SPC-2-FP,streams=48
rd=TR19_SPC-2-FP,streams=24
rd=TR20_SPC-2-FP,streams=1

* LFP, Read Phase

rd=default,rdpct=100,xfersize=1024k
rd=TR21_SPC-2-FP,streams=2308
rd=TR22_SPC-2-FP,streams=1154
rd=TR23_SPC-2-FP,streams=577
rd=TR24_SPC-2-FP,streams=288
rd=TR25_SPC-2-FP,streams=1

rd=default,rdpct=100,xfersize=256k
rd=TR26_SPC-2-FP,streams=3840
rd=TR27_SPC-2-FP,streams=1920
rd=TR28_SPC-2-FP,streams=960
rd=TR29_SPC-2-FP,streams=480
rd=TR30_SPC-2-FP,streams=1
```

Large Database Query Test (LDQ)

```
* Large Data Query(LDQ)
host=localhost
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
maxstreams=80
HOST=(192.168.1.22,slave-1),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-1,
maxstreams=80
host=(192.168.1.23,slave-2),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-2,
maxstreams=80
host=(192.168.1.24,slave-3),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-3,
maxstreams=80
host=(192.168.1.25,slave-4),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-4,
maxstreams=80
host=(192.168.1.26,slave-5),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-5,
maxstreams=80
host=(192.168.1.27,slave-6),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-6,
maxstreams=80
host=(192.168.1.28,slave-7),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m  -Xss128k -Xincgc"),
shell=spc2,
jvms=8,
output=C:/spc/fdr/09_Results/04ldq/out_ldq_fdr_slave-7,
maxstreams=80
```

common commands and parameters

```
maxlatestart=1
segmentlength=512m

rd=default,rampup=180,periods=90,measurement=180,runout=45,rampdown=15,rdpct=99

* LDQ, 1024KiB Phase

rd=default,buffers=4,xfersize=1024k
```

```
rd=TR1_SPC-2-DQ,streams=1264
rd=TR2_SPC-2-DQ,streams=632
rd=TR3_SPC-2-DQ,streams=316
rd=TR4_SPC-2-DQ,streams=158
rd=TR5_SPC-2-DQ,streams=1

rd=default,buffers=1,xfersize=1024k
rd=TR6_SPC-2-DQ,streams=3264
rd=TR7_SPC-2-DQ,streams=1632
rd=TR8_SPC-2-DQ,streams=816
rd=TR9_SPC-2-DQ,streams=408
rd=TR10_SPC-2-DQ,streams=1

* LDQ, 64KiB Phase

rd=default,buffers=4,xfersize=64k
rd=TR11_SPC-2-DQ,streams=614
rd=TR12_SPC-2-DQ,streams=307
rd=TR13_SPC-2-DQ,streams=153
rd=TR14_SPC-2-DQ,streams=76
rd=TR15_SPC-2-DQ,streams=1

rd=default,buffers=1,xfersize=64k
rd=TR16_SPC-2-DQ,streams=615
rd=TR17_SPC-2-DQ,streams=307
rd=TR18_SPC-2-DQ,streams=153
rd=TR19_SPC-2-DQ,streams=76
rd=TR20_SPC-2-DQ,streams=1
```

Video on Demand Delivery (VOD)

```
* Video On Demand(VOD)
host=localhost,
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
maxstreams=500
host=(192.168.1.22,slave-1),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-1,
maxstreams=500
host=(192.168.1.23,slave-2),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-2,
maxstreams=500
host=(192.168.1.24,slave-3),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-3,
maxstreams=500
host=(192.168.1.25,slave-4),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-4,
maxstreams=500
host=(192.168.1.26,slave-5),
```

```
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-5,
maxstreams=500
host=(192.168.1.27,slave-6),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-6,
maxstreams=500
host=(192.168.1.28,slave-7),
java=("C:/Java/jre7/bin/java.exe","-d64 -Xmx4096m -Xms4096m -Xss128k -Xincgc"),
shell=spc2,
jvms=24,
output=C:/spc/fdr/09_Results/05vod/out_vod_fdr_slave-7,
maxstreams=500
```

common commands and parameters

```
maxlatestart=0
reportinginterval=5
maxlatevod=0
videosegmentduration=1200

rd=default,rampup=12000,measurement=7200,runout=45,rampdown=15,buffers=8

rd=TR1_SPC-2-VOD,streams=93700
```

SPC-2 Persistence Test Run 1 (write phase)

```
* Persistence Write (PRST-W)
host=localhost,
jvms=4,
java=("C:/Java/jre7/bin/java.exe","-d64 -Xms1024m -Xmx1024m -Xss128k")
```

common commands and parameters

```
maxlatestart=0
reportinginterval=5
segmentlength=512m

rd=default,rampup=180,periods=90,measurement=300,runout=0,rampdown=0
rd=default,buffers=1,rdpct=0,xfersize=1024k

rd=TR1_SPC-2-persist-w,streams=192
```

SPC-2 Persistence Test Run 2 *(read phase)*

```
* Persistence Read (PRST-R)
host=localhost,
jvms=4,
java=("C:/Java/jre7/bin/java.exe","-d64 -Xms1024m -Xmx1024m -Xss128k"),
```

common commands and parameters

```
maxlatestart=0
reportinginterval=5
segmentlength=512m


rd=default,buffers=1,rdpct=100,xfersize=1024k

rd=TR1_SPC-2-persist-r
```

APPENDIX E: SPC-2 WORKLOAD GENERATOR EXECUTION COMMANDS AND PARAMETERS

The 7 remote Host Systems were started manually, using the ***RemoteStart*** command, as the first step in the benchmark execution.

The following script, **dofdr1.bat**, was executed to complete the following in an uninterrupted execution sequence:

- Execute the required ASU pre-fill as follows.
  - The ASU pre-fill operation is executed simultaneously on all 8 Host Systems, with each Host System prefilling 12 of the 96 Logical Volumes, in order to reduce the duration of the ASU pre-fill operation.
  - The ASU pre-fill operation is started on the Master Host System and the **startPrefillS.sh** script is started by the **dofdr1.bat** script, which in turn starts the **doPrefillS.sh** script on each of the 7 remote Host Systems and that script starts the **doPrefillS.bat** script to begin remote Host System's ASU pre-fill operation of the 12 assigned Logical Volumes.
  - In order to ensure the ASU pre-fill operation on each remote Host System has completed before starting the next step in the benchmark execution, the **rendezvous.sh** script is executed to verify completion of the ASU pre-fill operation on each remote Host System.
- Create the first detailed storage configuration listing as part of the onsite audit submission.
- Initialize the 96 Logical Volumes with sequence 'flags' to maintain the correct order that comprises the ASU.
- Execute the SPC-2 Tests in the following order:
  - Video on Demand (VOD)
  - Large File Processing (LFP)
  - Large Database Query (LDQ) Test
  - SPC-2 Persistence Test Run 1 *(write phase)*.

The script, **dofdr2.bat**, was executed after the required TSC power off/power on cycle to complete the SPC-2 benchmark execution, as follows, in an uninterrupted sequence:

- The SPC-2 Persistence Test Run 2 *(read phase)*.
- Create the second detailed storage configuration listing as part of the onsite audit submission.

All referenced scripts appear in the Benchmark Execution Scripts section.

Benchmark Execution Scripts

dofdr1.bat

The first 'master' benchmark execution script started by the Test Sponsor.

```
rem part 1 of full SPC2 run from Prefill to Persist-w
set bsh=c:\cygwin64\bin\bash.exe
chdir c:\spc\work\vdbench
rem run prefill script on localhost and slave-1
%bsh% c:\spc\fdr\07_Execution\startPrefillS.sh
call vdbench.bat -f c:\spc\fdr\08_Parameters\DX8900S3_20160307_prefill_m_0.txt -o
c:\spc\fdr\09_Results\01prefill\01prefill_m_0
rem wait for all slaves to complete
%bsh% c:\spc\fdr\07_Execution\rendezvous.sh
rem save before log
%bsh% c:\spc\fdr\07_Execution\saveArrayLog.sh Before
chdir c:\spc\spc2
rem init volumes
call spc2.bat -f c:\spc\fdr\08_Parameters\parm_doFDR_lfp.txt -o
c:\spc\fdr\09_Results\02init -init
rem vod test
call spc2.bat -f c:\spc\fdr\08_Parameters\parm_doFDR_vod.txt -o
c:\spc\fdr\09_Results\05vod
rem lfp test
call spc2.bat -f c:\spc\fdr\08_Parameters\parm_doFDR_lfp.txt -o
c:\spc\fdr\09_Results\03lfp
rem ldq test
call spc2.bat -f c:\spc\fdr\08_Parameters\parm_doFDR_ldq.txt -o
c:\spc\fdr\09_Results\04ldq
rem pers-w test
call spc2.bat -f c:\spc\fdr\08_Parameters\parm_doFDR_prstw.txt -o
c:\spc\fdr\09_Results\06prstw
```

startPrefillS.sh

The 'master' ASU pre-fill script, started by **dofdr1.bat**, to begin the remote Host System ASU pre-fill operations.

```
#!/bin/bash -x
# Start Prefill_S
for (( i=1; i<8 ; i+=1 ))
do
   ssh  -n -f -o 'StrictHostKeyChecking no' -i /home/Administrator/.ssh/id_rsa
Administrator@slave-${i} "bash -c 'cd /cygdrive/c/spc/fdr/07_Execution;nohup
./doPrefillS.sh &> nohupS.out &'"
done
```

doPrefillS.sh

The ASU pre-fill script, started by **startPrefillS.sh** on each remote Host System, to independently begin the remote Host System's ASU pre-fill operation.

```
#!/usr/bin/bash
rm -rf /cygdrive/c/spc/fdr/09_Results/01prefill[bB]/
./doPrefillS.bat
```

doPrefillS.bat

The ASU pre-fill script, started by **doPrefillS.sh**, to perform the ASU pre-fill operation on each remote Host System.

```
rem run prefill script
chdir c:\spc\work\vdbench
mkdir c:\spc\fdr\09_Results\01prefills
call vdbench.bat -f c:\spc\fdr\08_Parameters\DX8900S3_20160307_prefill_s.txt -o
c:\spc\fdr\09_Results\01prefills
```

rendezvous.sh

A 'coordination' script, started by **dofdr1.bat**, to ensure the ASU pre-fill operations have successfully completed on each remote Host System before start the actual SPC-2 Tests.

```
#!/usr/bin/bash
# Check to see if all slaves  completed the Prefill jobs

function isActiveSlave()
{
   for ((i=1;i<8;i++))
   do
    if (( ${SlaveStatus[$i]} != 0 ))
    then
       echo 1
       return
    fi
   done
   echo 0
   return
}

function Rendezvous()
{
  SCRIPTS=/cygdrive/c/spc/fdr/07_Execution
  jobID=`cat /tmp/spc2/lastjobID`;export jobID
  identity=/home/Administrator/.ssh/id_rsa
  ${SCRIPTS}/recordStatus.sh "Completed Prefill on Master, Waiting for Slaves
Prefill to complete." ${jobID}_message.txt
  # Wait up to 26 minutes for All of slave Prefills to complete
  SlaveStatus=( 0 1 1 1 1 1 1 1 ) #bash array zero orgin use 1 - 7 for slave-n
  export SlaveStatus
  for (( j=1;j<120;j+=1 ))
    do
       if (( `isActiveSlave` ))
       then
```

```
           for (( i=1;i<8;i+=1 ))
           do
              if (( ${SlaveStatus[$i]} != 0 ))
              then
                  status=`ssh -i $identity Administrator@slave-${i} grep \"Vdbench
execution\"  /cygdrive/c/spc/fdr/09_Results/01prefills/summary.html`
                  if [[ $status =~ "completed successfully" ]]
                  then
                      ${SCRIPTS}/recordStatus.sh "Slave ${i} have completed Prefill
Succesfully" ${jobID}_message.txt
                      SlaveStatus[$i]=0
                  fi
              fi
           done
       else
        ${SCRIPTS}/recordStatus.sh "All Slaves Have Completed Prefill Succesfully"
${jobID}_message.txt
        return
       fi
    sleep 10
    done
    ${SCRIPTS}/recordStatus.sh "Waited 20 minutes for Slave Prefill completion,
Something is wrong!" ${jobID}_message.txt
}
Rendezvous
```

dofdr2.bat

The second 'master' execution script started by the Test Sponsor after successful completion of the required TSC power off/power on cycle.

```
chdir c:\spc\spc2
rem pers-r test
call spc2.bat -f c:\spc\fdr\08_Parameters\parm_doFDR_prstr.txt -o
c:\spc\fdr\09_Results\07prstr
rem chdir to home directory
chdir c:\spc\fdr
rem save After Log
c:\cygwin64\bin\bash.exe c:\spc\fdr\07_Execution\saveArrayLog.sh After
```