



THE POSSIBILITIES ARE INFINITE

**SPC BENCHMARK 2™
FULL DISCLOSURE REPORT**

**FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS
ETERNUS DX8700 S2**

SPC-2™ V1.4

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AUDIT CERTIFICATION



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December 2, 2012

The SPC Benchmark 2™ Reported Data listed below for the **Fujitsu Storage Systems ETERNUS DX8700 S2** was produced in compliance with the SPC Benchmark 2™ V1.4 Remote Audit requirements.

SPC Benchmark 2™ V1.4 Reported Data	
Tested Storage Product (TSP) Name: Fujitsu Storage Systems ETERNUS DX8700 S2	
Metric	Reported Result
SPC-2 MBPS™	16,038.74
SPC-2 Price-Performance	\$79.51/SPC-2 MBPS™
ASU Capacity	71,403.831 GB
Data Protection Level	Protected 2 (<i>Mirroring</i>)
Total Price (including three-year maintenance)	\$1,275,163.74

The following SPC Benchmark 2™ Remote Audit requirements were reviewed and found compliant with V1.4 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 documentation supplied by Fujitsu Limited:
 - ✓ Physical Storage Capacity and related requirements.
 - ✓ Configured Storage Capacity and related requirements.
 - ✓ Addressable Storage Capacity and related requirements.
 - ✓ Capacity of each Logical Volume and related requirements.
 - ✓ Capacity of the Application Storage Unit (ASU) and related requirements.
- The total Application Storage Unit (ASU) Capacity was filled with random data prior to the execution of the SPC-2 Tests.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).

Storage Performance Council
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Redwood City, CA 94062
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AUDIT CERTIFICATION (CONT.)

Fujitsu Storage Systems ETERNUS DX8700 S2
SPC-2 Audit Certification

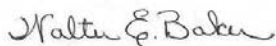
Page 2

- Listings and commands used to create and configure the Benchmark Configuration/Tested Storage Configuration.
- Documentation that no customer tunable parameter or option was changed from its default value.
- The following Host System items were verified by 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 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 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 and 7 of the SPC-2 Benchmark 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 the Priced Storage Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 9 of the SPC-2 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 10 of the SPC-2 Benchmark Specification.
- This successfully audited SPC measurement is not subject to an SPC Confidential Review.

Audit Notes:

There were no audit notes or exceptions.

Respectfully,



Walter E. Baker
SPC Auditor

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LETTER OF GOOD FAITH



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Phone: 044-754-3240

Nov 8, 2012

From: Shigeo Konno, 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.

Contact Information: Carrel A. (Sandy) Wilson

Fujitsu America, Inc.

1250 East Arques Ave. PO Box 3470

Sunnyvale, CA 94088, U.S.A.

Subject: SPC-2 Letter of Good Faith for the ETERNUS DX8700S2

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 V1.3 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:

A handwritten signature in black ink that reads "Shigeo Konno".

Shigeo Konno

General Manager, Storage System Division

A handwritten date in black ink that reads "Nov. 8, 2012".

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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Revision Information and Key Dates

Revision Information and Key Dates	
SPC-2 Specification revision number	V1.4
SPC-2 Workload Generator revision number	V1.2
Date Results were first used publicly	December 3, 2012
Date FDR was submitted to the SPC	December 3, 2012
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	December 2, 2012

Tested Storage Product (TSP) Description

The Fujitsu ETERNUS DX8700 S2 is a flexible, highly reliable storage array, equipped with redundant components to provide uncompromised availability to the enterprise market requirements. A mixture of 300GB, 450GB, 600GB, & 900GB/10krpm, 300GB/15krpm, & 1TB/7.2krpm 2.5" SAS drives, plus 100GB, 200GB, 400GB 2.5" SSD drives are supported. In addition 300GB, 450GB, & 600GB/15krpm 3.5" SAS drives, as well as 1TB, 2TB, & 3TB 7.2krpm 3.5" Nearline SAS drives may be installed. Up to 3072 x 2.5" drives may be included, or up to 1546 x 3.5" drives. Both sized drives can be included in the same storage array. The drives may be arranged in a variety of RAID groups, including RAID1, RAID1+0(10), RAID5, RAID6, and RAID5+0(50). The product is offered with Fibre Channel (4 port as tested or 2 port 2/4/8Gbps versions), iSCSI (1Gbps & 10Gbps 2 port), and FCoE (10Gbps 2 port) host connection Channel Adapters. Up to four Channel Adapters can be attached to each of up to eight Controllers, with multiple types available. In addition, a number of different snapshot and replication facilities, native disk data encryption, and MAID capabilities are available.

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 16.

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.*

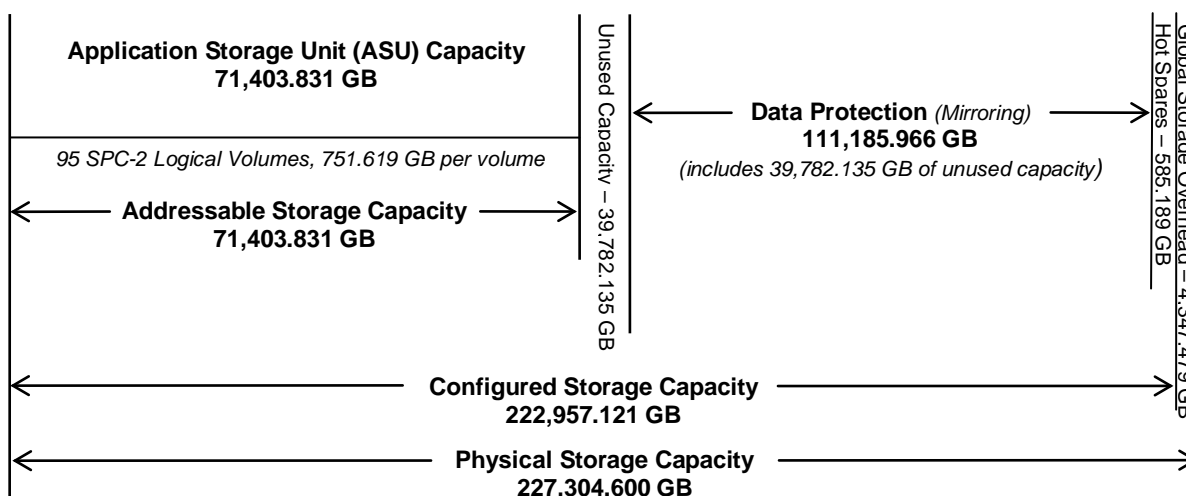
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-2 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country (*non-local currency*).

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				
Fujitsu Storage Systems ETERNUS DX8700 S2				
SPC-2 MBPS™	SPC-2 Price-Performance	ASU Capacity (GB)	Total Price	Data Protection Level
16,038.74	\$79.51	71,403.831	\$1,275,162.74	Protected 2 (<i>Mirroring</i>)
<i>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)</i>				
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LFP Composite	13,516.37			\$94.34
Write Only:				
1024 KiB Transfer	7,030.52	95	74.01	
256 KiB Transfer	6,577.27	95	69.23	
Read-Write:				
1024 KiB Transfer	11,903.88	190	62.65	
256 KiB Transfer	11,638.74	190	61.26	
Read Only:				
1024 KiB Transfer	21,385.81	380	56.28	
256 KiB Transfer	22,562.03	475	47.50	
<i>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).</i>				
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LDQ Composite	22,017.04			\$57.92
1024 KiB Transfer Size				
4 I/Os Outstanding	21,609.03	380	56.87	
1 I/O Outstanding	21,585.18	380	56.80	
64 KiB Transfer Size				
4 I/Os Outstanding	22,808.31	475	48.02	
1 I/O Outstanding	22,065.63	475	46.45	
<i>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).</i>				
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
	12,582.81	16,000	0.79	\$101.34

Storage Capacities and Relationships

The following diagram (*not to scale*) 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.



SPC-2 Storage Capacity Utilization	
Application Utilization	31.41%
Protected Application Utilization	62.83%
Unused Storage Ratio	35.00%

Application Utilization: Total ASU Capacity (71,403.831 GB) divided by Physical Storage Capacity (227,304.600 GB)

Protected Application Utilization: Total ASU Capacity (71,403.831 GB) plus total Data Protection Capacity (111,185.966 GB) minus unused Data Protection Capacity (39,782.135 GB) divided by Physical Storage Capacity (227,304.600 GB).

Unused Storage Ratio: Total Unused Capacity (79,564.269 GB) divided by Physical Storage Capacity (227,304.600 GB) and may not exceed 45%.

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

Priced Storage Configuration Pricing

Product ID	Description	Qty	Unit List Price	Extended LP	Discount %	Discounted Price
ETERD87S_ET872SAU_151990	DX8700 S2 Base System (ET872SAU) Rackmount (AC200V, 19RU) Includes 2xCM & PDU Expansion Controller w/ Battery & PS (ETGECB) Includes 2xCM Expansion Controller (ETGECA) Includes 2xCM FC Host Interface, pair - 8 ports (ETGHF88), with 8 SFP+ modules (2/4/8Gbps, Host/Remote Connect) 12GB Cache Memory for DX8700 S2 (ETGM26) (2GB two sets of 3) Drive Enclosure x4 (2.5" HDD) w/ Backend Router (ETGAB4CU) Rackmount (AC200V, 2RU) Drive Enclosure x4 (2.5" HDD) (ETGAD4CU) Rackmount (AC200V, 2RU) 300GB/10krpm 2.5" Drive x8 (ETGD3SC) (RAID1+0 4+4) 300GB/10krpm 2.5" Drive x1 (ETGD3HC) Base Rack (42RU, 1000x2000mm) (ETGRKA2U) with Front & Rear Doors, side panels without Stabilizers Expansion Rack (42RU, 1000x2000mm) (ETGRKB2U) with Front & Rear Doors, NO side panels without Stabilizers Power Distribution Unit for DX (ETGP16U) (AC240V, 30A - 8 enclosures, 2RU)	1 1 1 1 6 3 4 4 95 2 1 2 4				
<i>Total for above items</i>	ETERNUS DX8700 S2 Storage Array	1	\$1,396,430.00	\$1,396,430.00	30%	\$977,501.00
BR05340-0008	Brocade 5300 SAN Switch 80 ports licensed 68 ports used, with 80 SFP+ modules	1	\$126,600.00	\$126,600.00	10%	\$113,940.00
QLE2562	QLogic Dual port 8Gbps Fibre Channel Host Bus Adapter	16	\$2,597.85	\$41,565.60	10%	\$37,409.04
61-343827-003	Fibre Channel Cable LC-LC 3 m	68	\$132.00	\$8,976.00	20%	\$7,180.80
(Provide 24 hour per day / 7days per week 4 hour response maintenance for 36 months)						
ETD87S-W004240-AHP	24 months, Warranty DX8700 S2	1	\$0.00	\$0.00		\$0.00
ETD87S_P004121-AHP	12 months, Enhanced Plus DX8700 S2	1	\$146,952.00	\$146,952.00	20%	\$117,561.60
FTSPS-ET-QSHIGH	ETERNUS - High End Storage QuickStart Service	1	\$11,160.00	\$11,160.00	20%	\$8,928.00
5300-SVS-4OS3	36 months, Brocade 5300 Switch	1	\$14,047.00	\$14,047.00	10%	\$12,642.30
				Total:		\$1,275,162.74

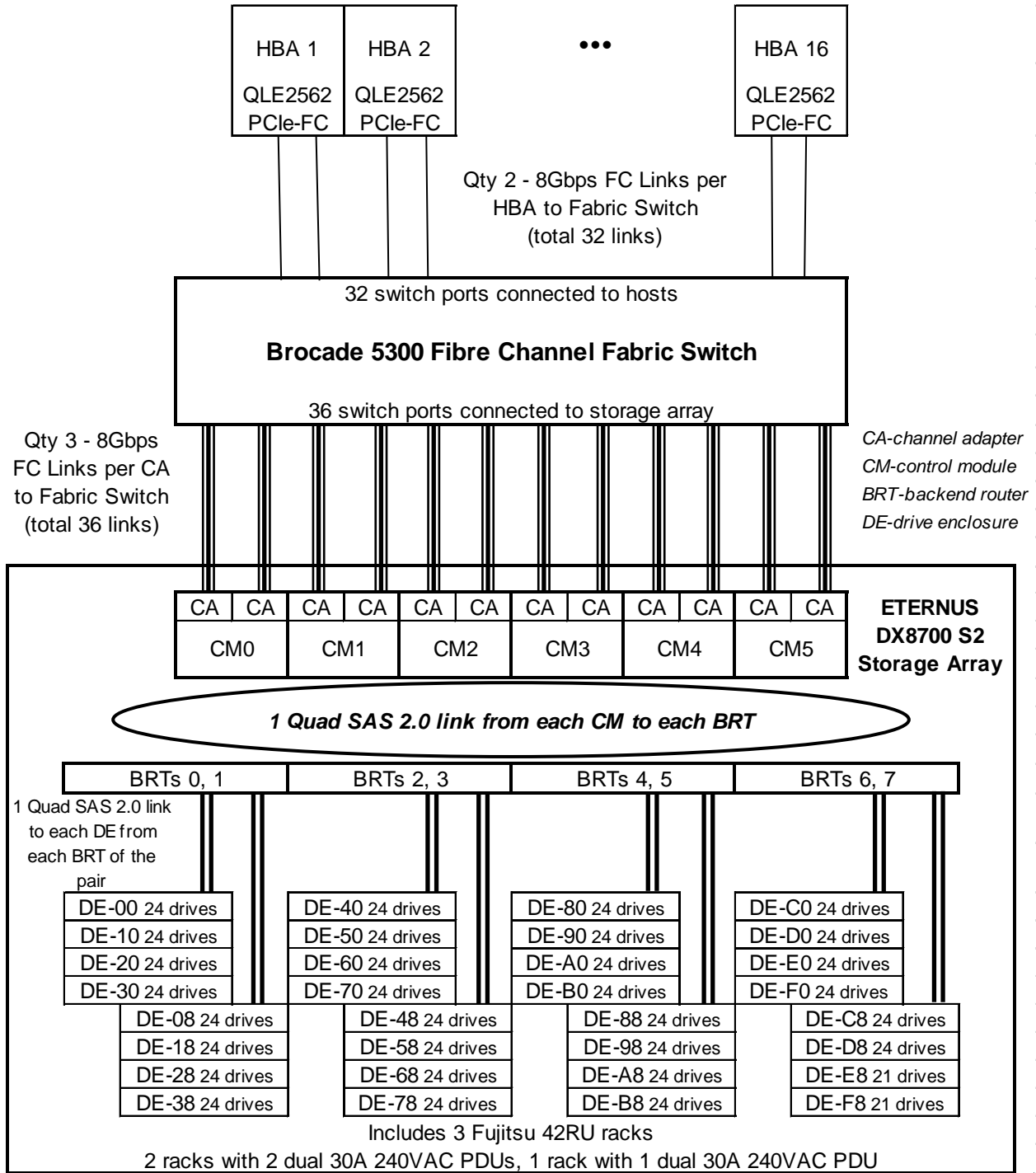
The above pricing includes the following:

- 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 (TSC) and Priced Storage Configuration

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

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration
16 – Qlogic QLE2562 FC dual port FC HBAs (8 Gbps)
Fujitsu Storage Systems ETERNUS DX8700 S2 6 – Controller Modules, each with: 6 GB cache (36 GB total) Flash Memory power fail protection 2 – Channel Adapter Modules (12 total), each with 4 – 8 Gbps Fibre Channel ports (8 total and 3 used per adapter module) 48 – front-end connections available and 36 used 8 – Backend routers (16 Quad SAS 2.0 ports per router, 128 total ports available, 82 used) (3 ports/router used for each CM, 18 total ports used) (1 port/router used for each of 8 DEs, 64 total ports used) Dual power supplies and fan modules
1 – Brocade 5300 Fabric Switch (80 ports available, 68 ports active)
32 –ETERNUS DX8700 S2 Drive Enclosures, each with 2 – I/O Modules, each with Quad SAS 2.0 Expander Drive interface (2 total, 2 used) dual power supplies and fan modules 2 – Quad SAS 2.0 connections (64 total connections available and used)
762 – 300 GB 10K RPM 2.5" SAS Disk Drives: 24 disk drives in each of 30 ETERNUS DX8700 S2 Drive Enclosures 21 disk drives in the remaining 2 drive enclosures
3 – Fujitsu 42RU racks 2 racks with 2 dual 30A 240 VAC PDUs 1 rack with 1 dual 30A 240 VAC PDU

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 21.

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 storage network portion of Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 21 (*Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram*).

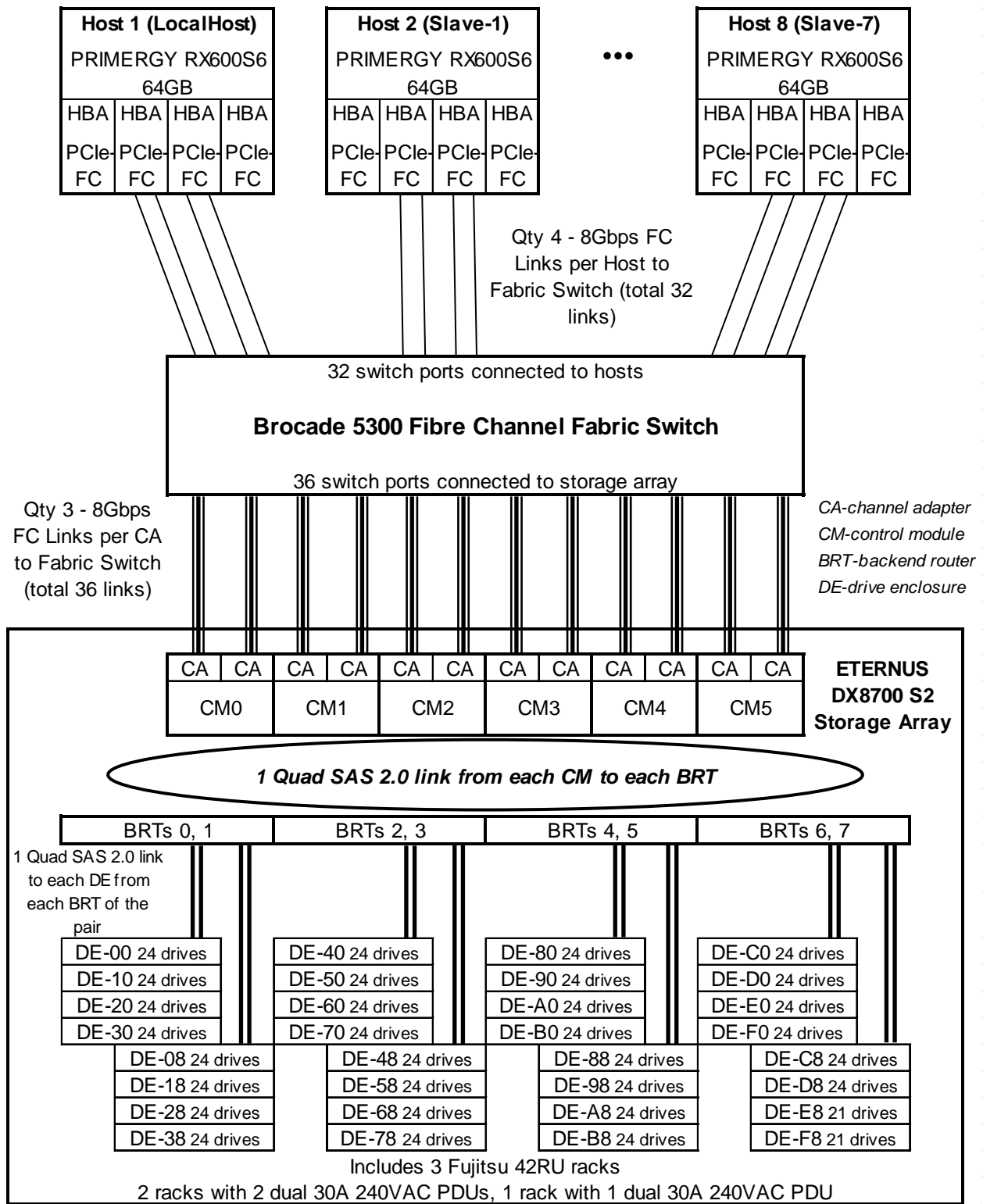
Host System and Tested Storage Configuration Table

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 22.

Benchmark Configuration/Tested Storage Configuration Diagram



Host System and Tested Storage Configuration Components

Host Systems:	Tested Storage Configuration (TSC):
<p>8 –Fujitsu PRIMERGY RX600 S6, each with:</p> <ul style="list-style-type: none"> 4 – Intel Xeon™ 2.27 GHz CPUs, 8 Cores/CPU with 24 MB Intel Smart Cache 64 GB main memory Windows 2008 Enterprise Server R2 PCIe Gen 2 	<p>16 – Qlogic QLE2562 FC dual port FC HBAs (<i>8 Gbps</i>)</p> <p>Fujitsu Storage Systems ETERNUS DX8700 S2</p> <ul style="list-style-type: none"> 6 – Controller Modules, each with: <ul style="list-style-type: none"> 6 GB cache (<i>36 GB total</i>) Flash Memory power fail protection 2 – Channel Adapter Modules (<i>12 total</i>), each with <ul style="list-style-type: none"> 4 – 8 Gbps Fibre Channel ports (<i>8 total and 3 used per adapter module</i>) 48 – front-end connections available and 36 used 8 - Backend Routers <ul style="list-style-type: none"> (<i>16 Quad SAS 2.0 ports/router, 128 total ports</i>) (<i>3 ports/router for each CM, 18 total ports used</i>) (<i>1 port/router for each of 8 DEs, 64 total ports used</i>) Dual power supplies and fan modules <p>1 – Brocade 5300 Fabric Switch (<i>80 ports available, 68 ports active</i>)</p> <p>32 –ETERNUS DX8700 S2 Drive Enclosures, each with <ul style="list-style-type: none"> 2 – I/O Modules, each with <ul style="list-style-type: none"> Quad SAS 2.0 Expander Drive interface (<i>2 total, 2 used</i>) dual power supplies and fan modules 2 – Quad SAS 2.0 connections (<i>64 total connections available and used</i>) </p> <p>762 – 300 GB 10K RPM 2.5" SAS Disk Drives: <i>24 disk drives in each of 30 drive enclosures</i> <i>21 disk drives in the remaining 2 drive enclosures</i></p> <p>3 – Fujitsu 42RU racks <ul style="list-style-type: none"> 2 racks with 2 dual 30A 240 VAC PDUs 1 rack with 1 dual 30A 240 VAC PDU </p>

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 100 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 (Clause 10.6.6.1), 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 101 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 Parameters” on page 109.

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.

The configuration file used to complete the required ASU pre-fill appears in “Appendix D: SPC-2 Workload Generator Storage Commands and Parameters” on page 109.

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 95 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 an illustration documenting the storage capacities and relationships of the SPC-2 Storage Hierarchy (Clause 2.1) shall be included in the FDR.

SPC-2 Storage Capacities

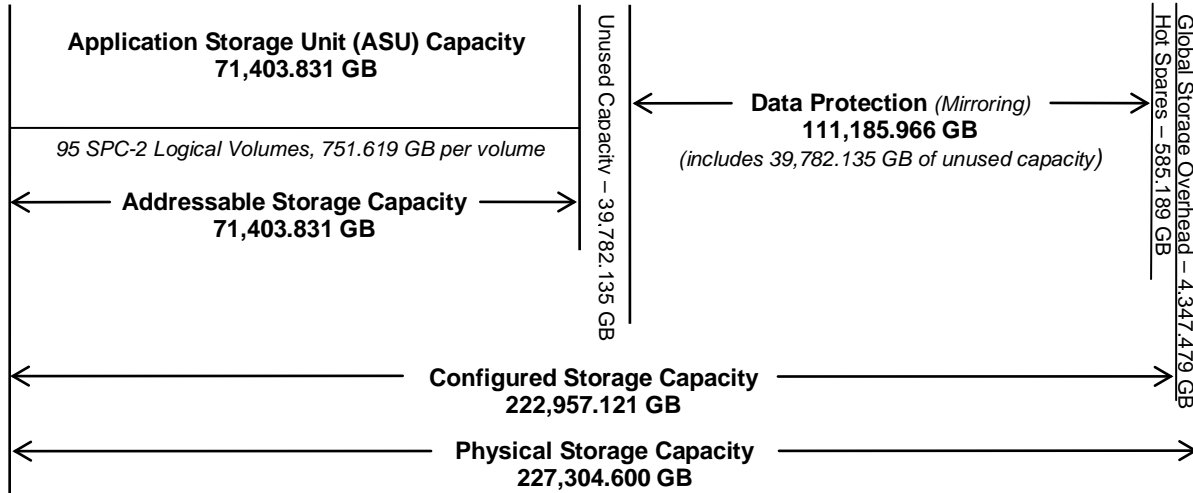
The Physical Storage Capacity consisted of 227,304.600 GB distributed over 762 disk drives each with a formatted capacity of 298.300 GB. There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 4,347.479 GB (1.91%) of the Physical Storage Capacity. There was 79,564.269 GB (35.69%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) of Unused Storage within the Addressable Storage Capacity. The Data Protection (*Mirroring*) capacity was 111,185.966 GB of which 71,403.831 GB was utilized. The total Unused Storage was 79,564.269 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)	71,403.831
Addressable Storage Capacity	Gigabytes (GB)	71,403.831
Configured Storage Capacity	Gigabytes (GB)	222,957.121
Physical Storage Capacity	Gigabytes (GB)	227,304.600
Data Protection (<i>Mirroring</i>)	Gigabytes (GB)	111,185.966
Required Storage (<i>spares/metadata/overhead</i>)	Gigabytes (GB)	585.189
Global Storage Overhead	Gigabytes (GB)	4,347.479
Total Unused Storage	Gigabytes (GB)	79,574.269

SPC-2 Storage Capacities and Relationships Illustration

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



SPC-2 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	32.03%	31.41%
Data Protection (mirroring)		49.87%	48.91%
Addressable Storage Capacity		32.03%	31.41%
Required Storage (spares/metadata/overhead)		0.26%	0.26%
Configured Storage Capacity			98.09%
Global Storage Overhead			1.91%
Unused Storage:			
Addressable	0.00%		
Configured		35.69%	
Physical			0.00%

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	31.41%
Protected Application Utilization	62.83%
Unused Storage Ratio	35.00%

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 (71,403.831 GB)			
	Total Capacity (GB)	Capacity Used (GB)	Capacity Unused (GB)
Logical Volumes 1-95	751.619 per LV	751.619 per LV	0.000 per LV

See the Storage Definition (sd) entries in “Appendix D: SPC-2 Workload Generator Storage Commands and Parameters” on page 109 for more detailed configuration information.

SPC-2 TEST EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-2 Test, Test Phases, Test Run Sequences, and Test Runs. “**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” on page 96 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 120.

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.

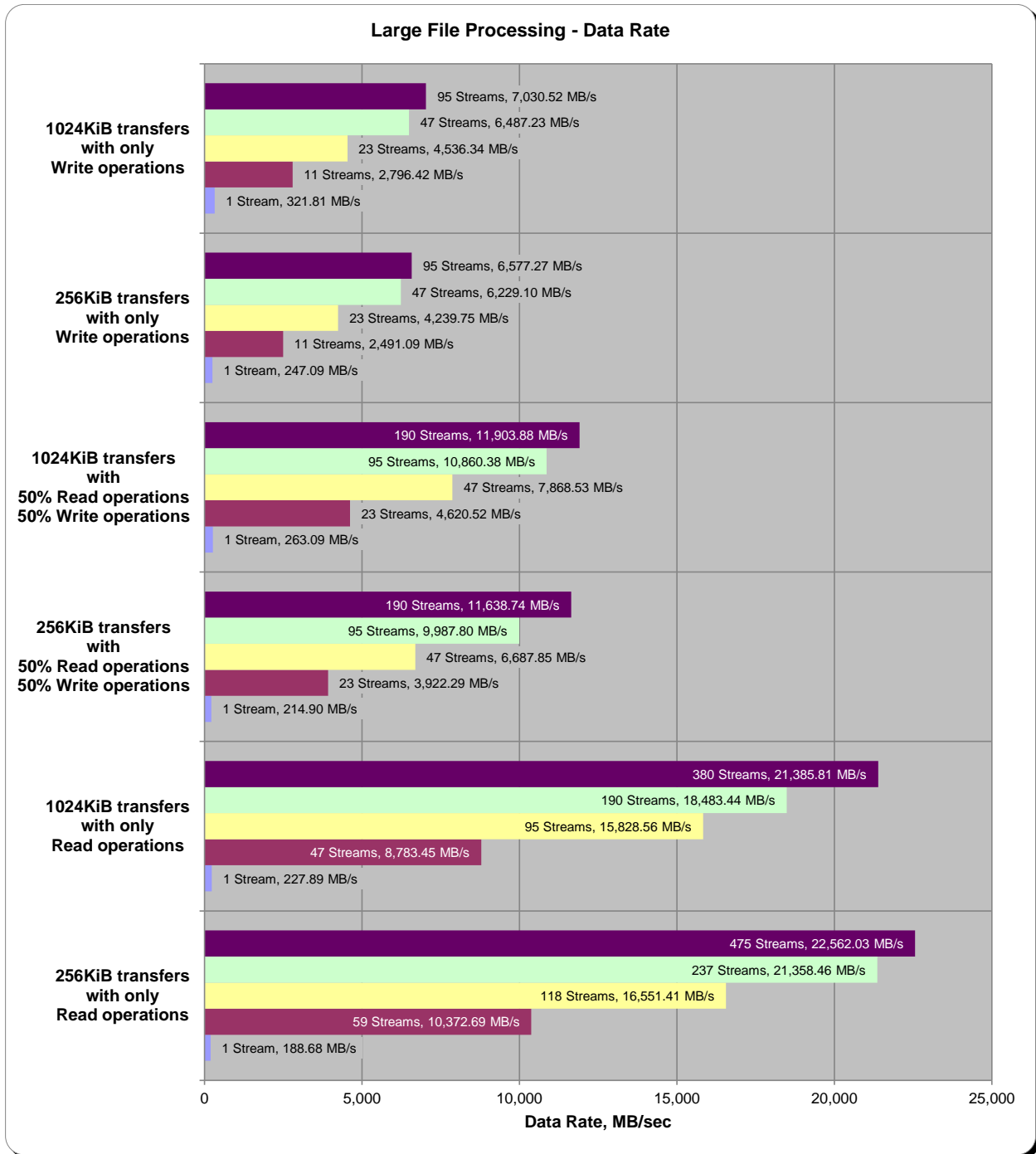
[SPC-2 Large File Processing Test Results File](#)

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	11 Streams	23 Streams	47 Streams	95 Streams
Write 1024KiB	321.81	2,796.42	4,536.34	6,487.23	7,030.52
Test Run Sequence	1 Stream	11 Streams	23 Streams	47 Streams	95 Streams
Write 256KiB	247.09	2,491.09	4,239.75	6,229.10	6,577.27
Test Run Sequence	1 Stream	23 Streams	47 Streams	95 Streams	190 Streams
Read/Write 1024KiB	263.09	4,620.52	7,868.53	10,860.38	11,903.88
Test Run Sequence	1 Stream	23 Streams	47 Streams	95 Streams	190 Streams
Read/Write 256KiB	214.90	3,922.29	6,687.85	9,987.80	11,638.74
Test Run Sequence	1 Stream	47 Streams	95 Streams	190 Streams	380 Streams
Read 1024KiB	227.89	8,783.45	15,828.56	18,483.44	21,385.81
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
Read 256KiB	188.68	10,372.69	16,551.41	21,358.46	22,562.03

SPC-2 Large File Processing Average Data Rates Graph

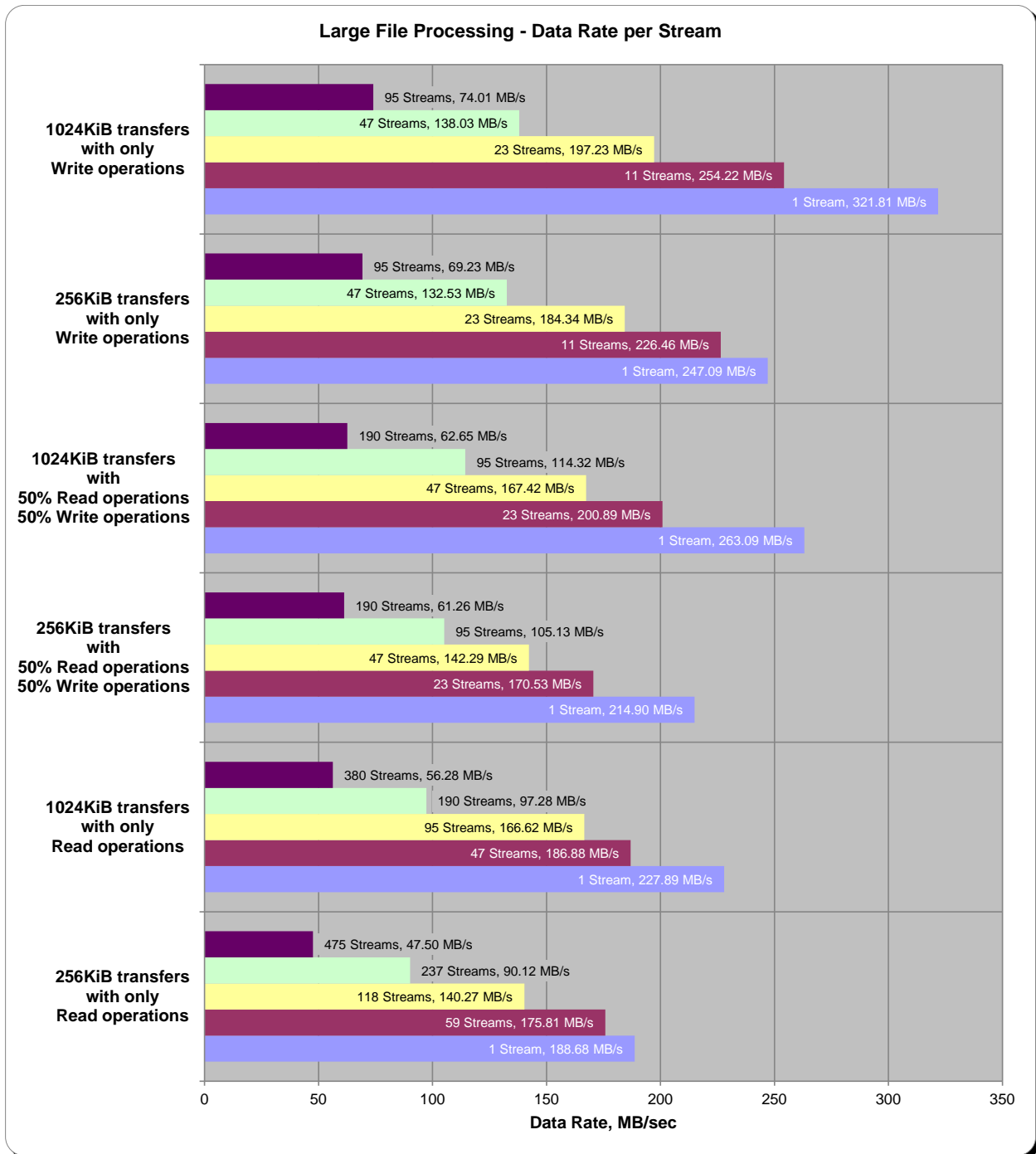


SPC-2 Large File Processing Average Data Rate per Stream

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	11 Streams	23 Streams	47 Streams	95 Streams
Write 1024KiB	321.81	254.22	197.23	138.03	74.01
Test Run Sequence	1 Stream	11 Streams	23 Streams	47 Streams	95 Streams
Write 256KiB	247.09	226.46	184.34	132.53	69.23
Test Run Sequence	1 Stream	23 Streams	47 Streams	95 Streams	190 Streams
Read/Write 1024KiB	263.09	200.89	167.42	114.32	62.65
Test Run Sequence	1 Stream	23 Streams	47 Streams	95 Streams	190 Streams
Read/Write 256KiB	214.90	170.53	142.29	105.13	61.26
Test Run Sequence	1 Stream	47 Streams	95 Streams	190 Streams	380 Streams
Read 1024KiB	227.89	186.88	166.62	97.28	56.28
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
Read 256KiB	188.68	175.81	140.27	90.12	47.50

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

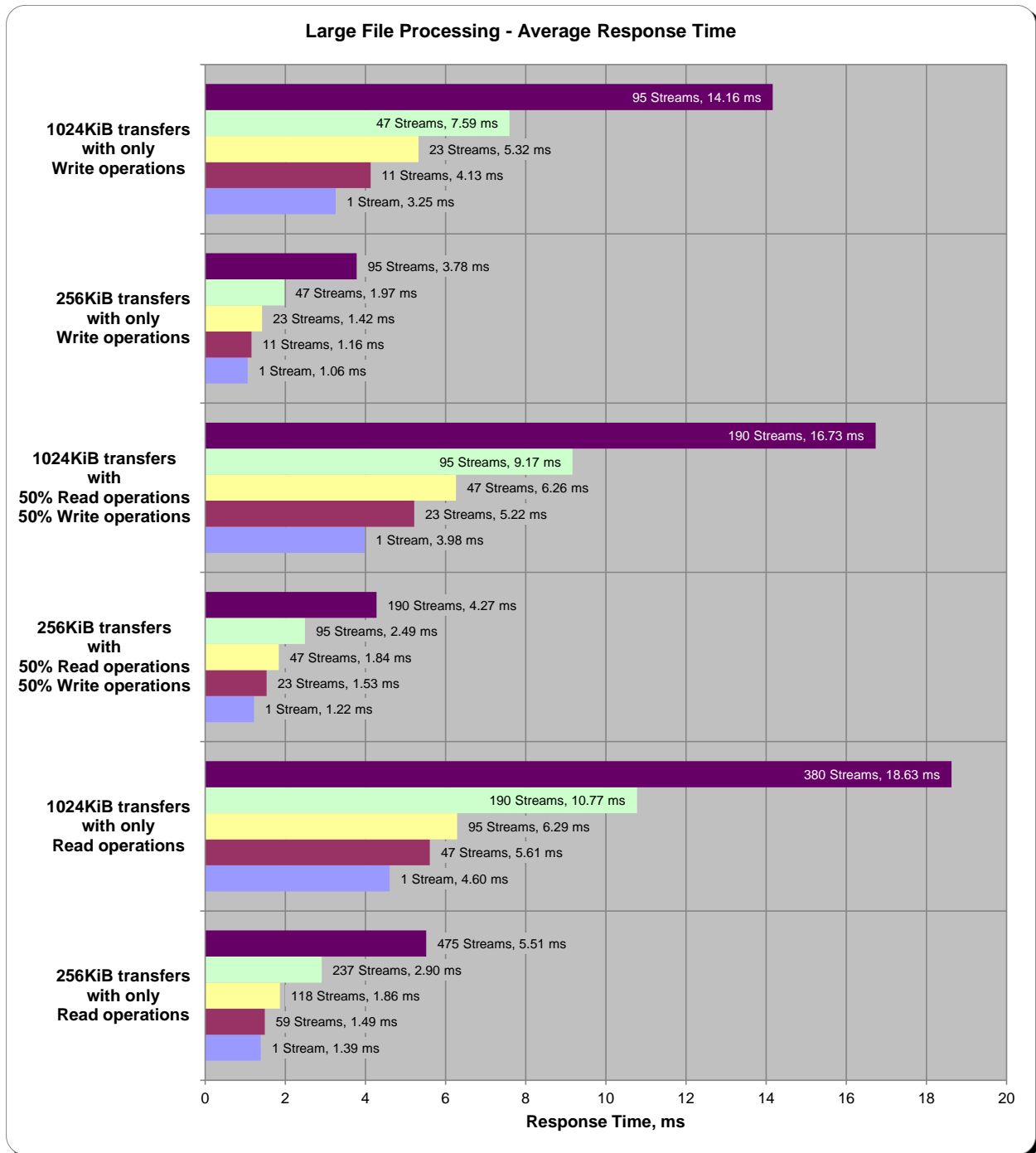


SPC-2 Large File Processing Average Response Time

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	11 Streams	23 Streams	47 Streams	95 Streams
Write 1024KiB	3.25	4.13	5.32	7.59	14.16
Test Run Sequence	1 Stream	11 Streams	23 Streams	47 Streams	95 Streams
Write 256KiB	1.06	1.16	1.42	1.97	3.78
Test Run Sequence	1 Stream	23 Streams	47 Streams	95 Streams	190 Streams
Read/Write 1024KiB	3.98	5.22	6.26	9.17	16.73
Test Run Sequence	1 Stream	23 Streams	47 Streams	95 Streams	190 Streams
Read/Write 256KiB	1.22	1.53	1.84	2.49	4.27
Test Run Sequence	1 Stream	47 Streams	95 Streams	190 Streams	380 Streams
Read 1024KiB	4.60	5.61	6.29	10.77	18.63
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
Read 256KiB	1.39	1.49	1.86	2.90	5.51

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.*

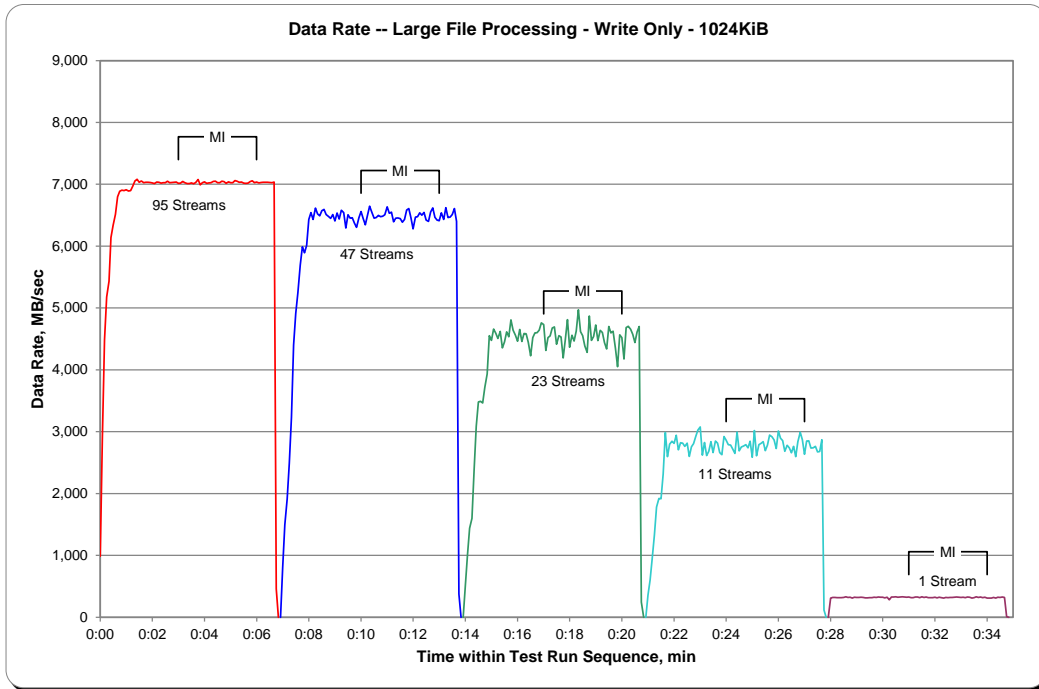
The SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" Test Run data is contained in the table that appears on the next page. That table is followed by graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table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

Immediately following the SPC-2 "Large File Processing/WRITE ONLY/1024 KiB Transfer Size" table and graphs will be the SPC-2 "Large File Processing/WRITE ONLY/64 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.

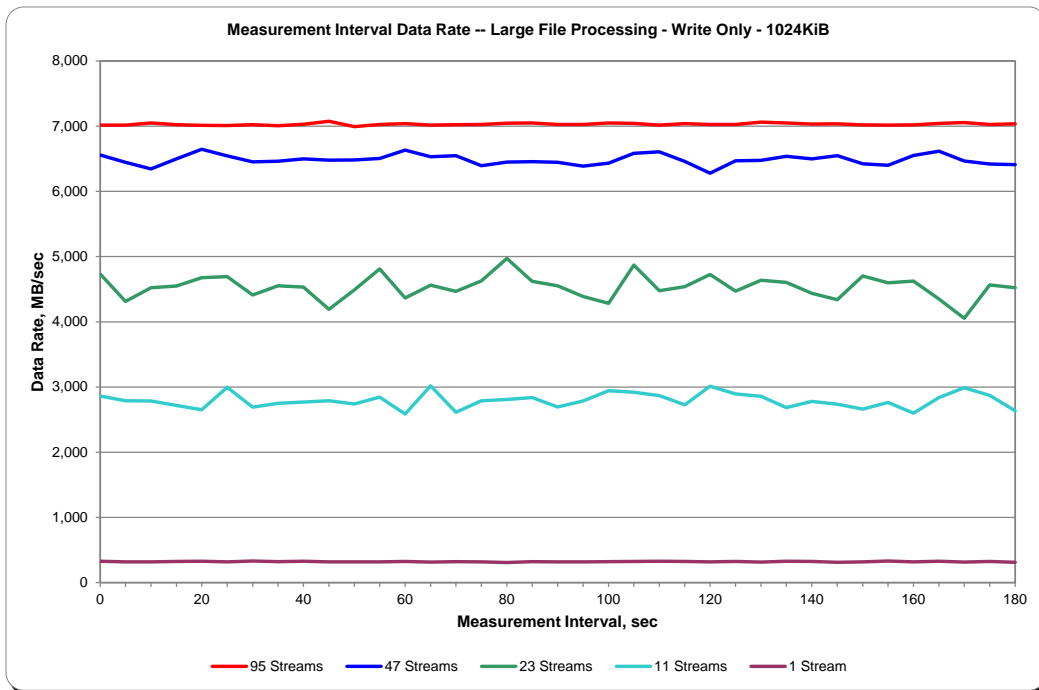
SPC-2 “Large File Processing/WRITE ONLY/1024 KiB Transfer Size” Test Run Data – Ramp-Up Period

TR1 Test Run Sequence Time	95 Streams			TR2 Test Run Sequence Time	47 Streams			TR3 Test Run Sequence Time	23 Streams			TR4 Test Run Sequence Time	11 Streams			TR5 Test Run Sequence Time	1 Stream		
	Data Rate, MB/sec	Data Rate /Stream, MB/sec	Response Time, ms		Data Rate, MB/sec	Data Rate /Stream, MB/sec	Response Time, ms		Data Rate, MB/sec	Data Rate /Stream, MB/sec	Response Time, ms		Data Rate, MB/sec	Data Rate /Stream, MB/sec	Response Time, ms		Data Rate, MB/sec	Data Rate /Stream, MB/sec	Response Time, ms
0:00:00	987.55	89.78	6.03	0:06:55	0.00	0.00	0.00	0:13:55	0.00	0.00	0.00	0:20:55	0.00	0.00	0.00	0:27:55	0.00	0.00	0.00
0:00:05	2,909.17	116.37	6.73	0:07:00	804.26	114.89	5.72	0:14:00	508.14	101.63	4.68	0:21:00	360.29	180.15	3.46	0:28:00	311.43	311.43	3.26
0:00:10	4,488.32	132.01	7.16	0:07:05	1,495.90	135.99	6.58	0:14:05	1,004.96	167.49	5.66	0:21:05	603.35	201.12	4.87	0:28:05	319.61	319.61	3.28
0:00:15	5,177.87	117.68	8.06	0:07:10	1,913.44	136.67	6.75	0:14:10	1,440.74	180.09	5.02	0:21:10	959.03	239.76	4.19	0:28:10	322.12	322.12	3.25
0:00:20	5,434.14	110.90	8.89	0:07:15	2,493.30	146.66	6.41	0:14:15	1,599.29	177.70	5.39	0:21:15	1,328.34	221.39	3.73	0:28:15	316.46	316.46	3.31
0:00:25	6,138.36	107.69	9.25	0:07:20	3,232.76	134.70	6.57	0:14:20	2,380.48	198.37	4.59	0:21:20	1,783.42	254.77	3.69	0:28:20	317.93	317.93	3.30
0:00:30	6,335.29	105.59	9.61	0:07:25	4,399.62	151.71	6.35	0:14:25	3,087.64	237.51	4.40	0:21:25	1,920.36	274.34	3.82	0:28:25	316.46	316.46	3.31
0:00:35	6,513.33	95.78	10.24	0:07:30	4,912.37	148.86	6.70	0:14:30	3,481.06	217.57	4.37	0:21:30	1,918.26	213.14	4.34	0:28:30	322.12	322.12	3.25
0:00:40	6,797.92	94.42	10.81	0:07:35	5,245.40	154.28	6.73	0:14:35	3,491.76	218.23	4.80	0:21:35	2,316.93	231.69	4.07	0:28:35	330.72	330.72	3.15
0:00:45	6,889.14	93.10	11.15	0:07:40	5,693.56	153.88	6.55	0:14:40	3,463.03	203.71	5.13	0:21:40	2,986.13	271.47	3.81	0:28:40	322.33	322.33	3.25
0:00:50	6,905.71	92.08	11.37	0:07:45	5,989.47	157.62	6.54	0:14:45	3,717.62	206.53	4.96	0:21:45	2,597.53	236.14	4.44	0:28:45	325.48	325.48	3.22
0:00:55	6,897.53	88.43	11.59	0:07:50	5,891.74	147.29	6.92	0:14:50	3,932.79	206.99	4.92	0:21:50	2,797.81	254.35	4.11	0:28:50	310.80	310.80	3.37
0:01:00	6,912.42	84.30	12.16	0:07:55	6,015.26	146.71	6.98	0:14:55	4,552.08	206.91	4.75	0:21:55	2,845.00	258.64	4.05	0:28:55	324.01	324.01	3.23
0:01:05	6,892.50	84.05	12.45	0:08:00	6,430.29	149.54	6.71	0:15:00	4,476.58	203.48	5.14	0:22:00	2,811.65	255.60	4.10	0:29:00	322.54	322.54	3.25
0:01:10	6,899.42	81.17	12.78	0:08:05	6,541.23	152.12	6.89	0:15:05	4,658.40	211.75	4.95	0:22:05	2,942.93	267.54	3.92	0:29:05	321.91	321.91	3.25
0:01:15	6,970.30	78.32	13.07	0:08:10	6,432.80	149.60	7.00	0:15:10	4,595.70	208.90	5.01	0:22:10	2,706.79	246.07	4.25	0:29:10	325.27	325.27	3.22
0:01:20	7,052.72	75.03	13.55	0:08:15	6,615.89	147.02	7.00	0:15:15	4,509.09	196.05	5.19	0:22:15	2,821.30	256.48	4.08	0:29:15	320.86	320.86	3.26
0:01:25	7,082.08	74.55	13.94	0:08:20	6,520.67	141.75	7.34	0:15:20	4,622.12	200.96	5.21	0:22:20	2,815.43	255.95	4.09	0:29:20	314.57	314.57	3.33
0:01:30	7,031.96	74.02	14.13	0:08:25	6,488.80	138.06	7.56	0:15:25	4,355.16	189.35	5.54	0:22:25	2,764.47	251.32	4.17	0:29:25	314.57	314.57	3.33
0:01:35	7,053.98	74.25	14.14	0:08:30	6,573.94	139.87	7.49	0:15:30	4,452.67	193.59	5.41	0:22:30	2,814.38	255.85	4.09	0:29:30	318.77	318.77	3.29
0:01:40	7,026.51	73.96	14.15	0:08:35	6,593.03	140.28	7.47	0:15:35	4,613.11	200.57	5.23	0:22:35	2,601.31	236.48	4.43	0:29:35	317.72	317.72	3.30
0:01:45	7,031.12	74.01	14.17	0:08:40	6,509.77	138.51	7.56	0:15:40	4,535.09	197.18	5.31	0:22:40	2,757.34	250.67	4.18	0:29:40	324.01	324.01	3.23
0:01:50	7,033.85	74.04	14.15	0:08:45	6,479.15	137.85	7.61	0:15:45	4,809.61	209.11	5.01	0:22:45	2,807.88	255.26	4.10	0:29:45	322.75	322.75	3.24
0:01:55	7,029.86	74.00	14.17	0:08:50	6,447.48	137.18	7.63	0:15:50	4,642.05	201.83	5.19	0:22:50	2,920.91	265.54	3.94	0:29:50	329.25	329.25	3.18
0:02:00	7,023.99	73.94	14.18	0:08:55	6,510.40	138.52	7.57	0:15:55	4,558.37	198.19	5.28	0:22:55	3,025.56	275.05	3.81	0:29:55	325.48	325.48	3.22
0:02:05	7,011.62	73.81	14.18	0:09:00	6,405.96	136.30	7.69	0:16:00	4,463.79	194.08	5.40	0:23:00	3,078.83	279.89	3.74	0:30:00	325.27	325.27	3.22
0:02:10	7,035.32	74.06	14.15	0:09:05	6,535.56	139.05	7.54	0:16:05	4,653.79	202.34	5.18	0:23:05	2,619.97	238.18	4.40	0:30:05	315.83	315.83	3.31
0:02:15	7,033.43	74.04	14.17	0:09:10	6,438.89	137.00	7.65	0:16:10	4,460.22	193.92	5.40	0:23:10	2,826.33	256.94	4.08	0:30:10	326.11	326.11	3.21
0:02:20	7,019.17	73.89	14.20	0:09:15	6,581.07	140.02	7.48	0:16:15	4,586.68	199.42	5.26	0:23:15	2,615.78	237.80	4.40	0:30:15	282.70	282.70	3.70
0:02:25	7,024.83	73.95	14.18	0:09:20	6,543.11	139.22	7.53	0:16:20	4,585.21	199.36	5.25	0:23:20	2,684.98	244.09	4.30	0:30:20	327.58	327.58	3.20
0:02:30	7,024.20	73.94	14.16	0:09:25	6,293.76	133.91	7.82	0:16:25	4,444.91	193.26	5.43	0:23:25	2,837.87	257.99	4.05	0:30:25	328.62	328.62	3.19
0:02:35	7,048.95	74.20	14.14	0:09:30	6,508.93	138.49	7.57	0:16:30	4,229.54	183.89	5.69	0:23:30	2,663.17	242.11	4.33	0:30:30	330.72	330.72	3.17
0:02:40	7,025.67	73.95	14.16	0:09:35	6,453.78	137.31	7.63	0:16:35	4,519.99	196.52	5.33	0:23:35	2,848.14	258.92	4.04	0:30:35	323.17	323.17	3.24
0:02:45	7,029.02	73.99	14.18	0:09:40	6,459.86	137.44	7.62	0:16:40	4,597.17	199.88	5.24	0:23:40	2,814.80	255.89	4.10	0:30:40	326.95	326.95	3.20
0:02:50	7,032.80	74.03	14.14	0:09:45	6,373.87	135.61	7.72	0:16:45	4,601.36	200.06	5.24	0:23:45	2,661.71	241.97	4.32	0:30:45	330.93	330.93	3.16
0:02:55	7,036.15	74.06	14.16	0:09:50	6,303.83	134.12	7.82	0:16:50	4,642.05	201.83	5.19	0:23:50	2,628.99	239.00	4.39	0:30:50	329.25	329.25	3.18
				0:09:55	6,460.49	137.46	7.63	0:16:55	4,760.95	207.00	5.05	0:23:55	2,922.38	265.67	3.93	0:30:55	324.85	324.85	3.22

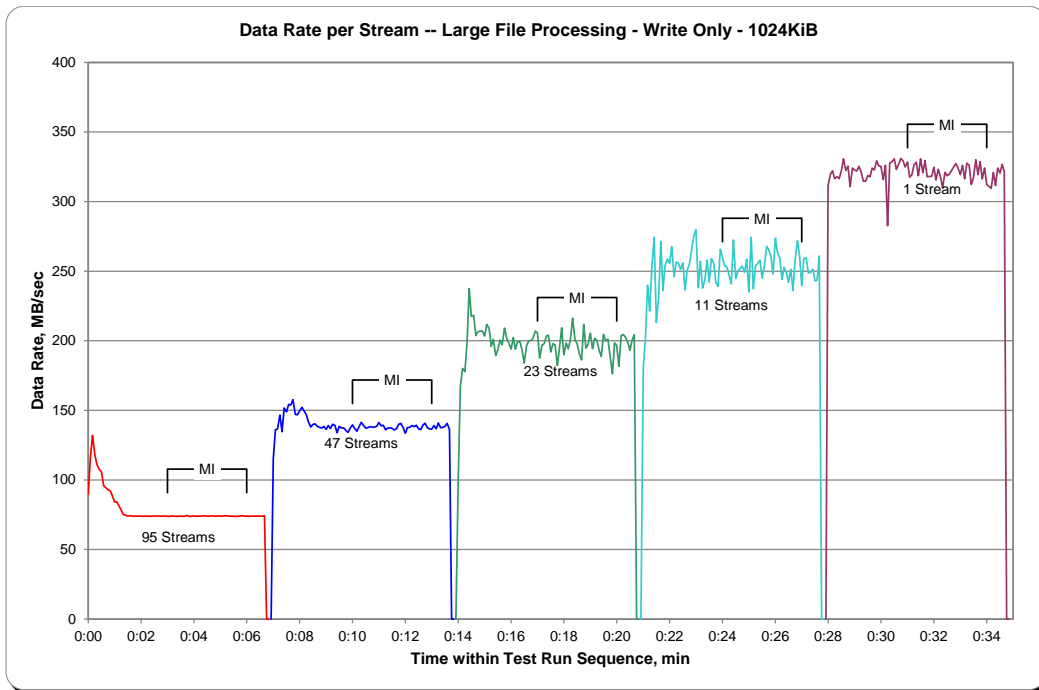
SPC-2 “Large File Processing/WRITE ONLY/1024 KiB Transfer Size” Average Data Rate Graph – Complete Test Run



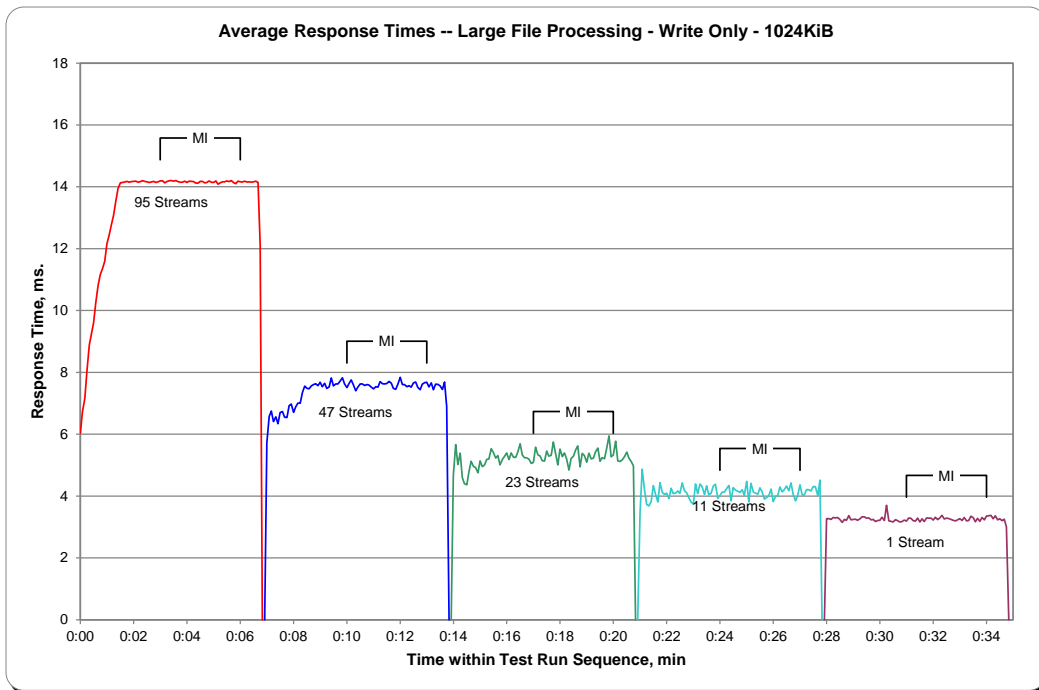
SPC-2 “Large File Processing/ WRITE ONLY /1024 KiB Transfer Size” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large File Processing/ WRITE ONLY /1024 KiB Transfer Size” Average Data Rate per Stream Graph



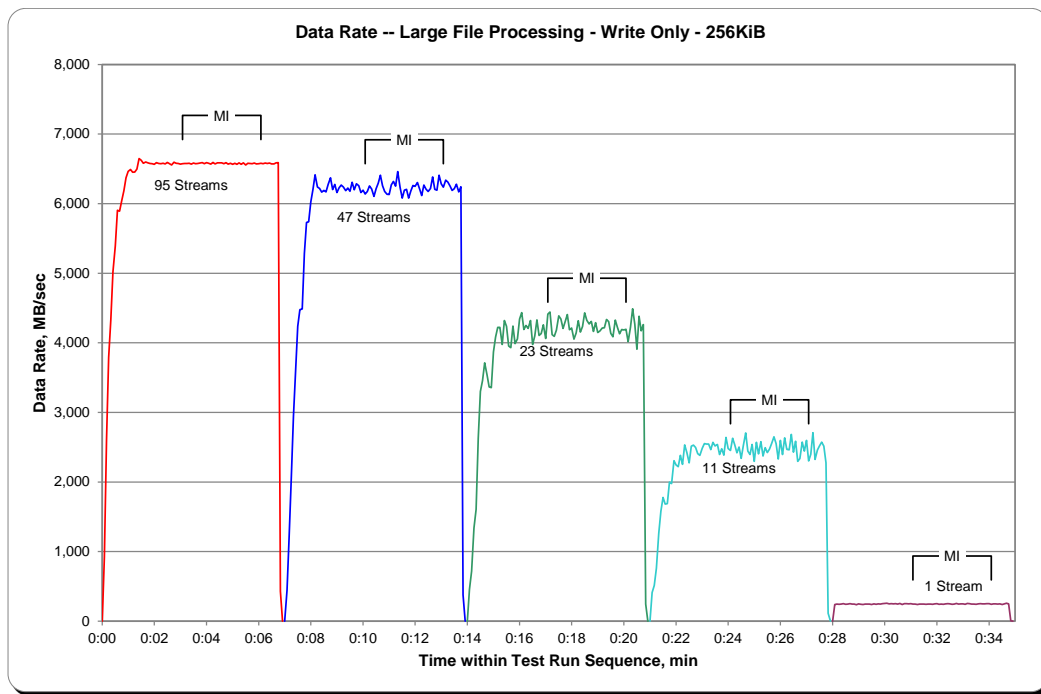
SPC-2 “Large File Processing/ WRITE ONLY /1024 KiB Transfer Size” Average Response Time Graph



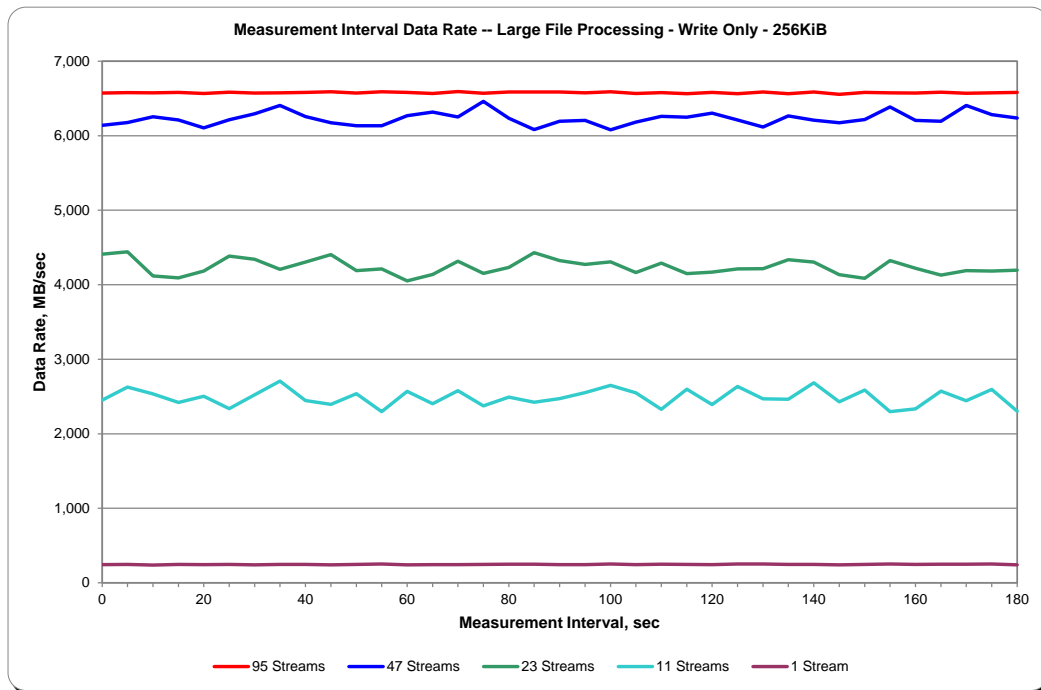
SPC-2 “Large File Processing/ WRITE ONLY /256 KiB Transfer Size” Test Run Data – Ramp-Up Period

TR6				TR7				TR8				TR9				TR10			
Test Run Sequence Time	95 Streams		Response Time, ms	Test Run Sequence Time	47 Streams		Response Time, ms	Test Run Sequence Time	23 Streams		Response Time, ms	Test Run Sequence Time	11 Streams		Response Time, ms	Test Run Sequence Time	1 Stream		Response Time, ms
	Data Rate, MB/sec	Data Rate /Stream, MB/sec			Data Rate, MB/sec	Data Rate /Stream, MB/sec			Data Rate, MB/sec	Data Rate /Stream, MB/sec			Data Rate, MB/sec	Data Rate /Stream, MB/sec			Data Rate, MB/sec	Data Rate /Stream, MB/sec	
0:00:00	0.00	0.00	0.00	0:07:00	0.00	0.00	0.00	0:14:00	0.00	0.00	0.00	0:21:00	0.00	0.00	0.00	0:28:00	0.00	0.00	0.00
0:00:05	920.49	83.68	1.69	0:07:05	446.22	111.56	1.34	0:14:05	458.23	152.74	1.26	0:21:05	411.67	205.84	1.04	0:28:05	239.65	239.65	1.06
0:00:10	2,602.51	123.93	1.75	0:07:10	1,228.41	102.37	1.67	0:14:10	718.12	119.69	1.61	0:21:10	511.81	255.90	1.02	0:28:10	244.48	244.48	1.07
0:00:15	3,791.70	140.43	1.74	0:07:15	2,067.11	129.19	1.73	0:14:15	1,339.45	167.43	1.36	0:21:15	762.11	190.53	1.23	0:28:15	241.07	241.07	1.08
0:00:20	4,325.69	116.91	1.92	0:07:20	2,945.19	133.87	1.73	0:14:20	1,606.79	178.53	1.40	0:21:20	1,262.01	210.34	1.12	0:28:20	244.84	244.84	1.07
0:00:25	5,018.69	106.78	2.23	0:07:25	3,596.20	138.32	1.69	0:14:25	2,628.20	164.26	1.31	0:21:25	1,580.26	225.75	1.06	0:28:25	250.92	250.92	1.04
0:00:30	5,391.10	99.84	2.47	0:07:30	4,237.09	146.11	1.71	0:14:30	3,301.76	194.22	1.31	0:21:30	1,776.29	253.76	1.03	0:28:30	241.80	241.80	1.08
0:00:35	5,904.37	98.41	2.51	0:07:35	4,477.52	144.44	1.73	0:14:35	3,455.84	191.99	1.34	0:21:35	1,683.07	240.44	1.09	0:28:35	245.16	245.16	1.07
0:00:40	5,891.37	92.05	2.72	0:07:40	4,484.71	135.90	1.87	0:14:40	3,711.12	206.17	1.27	0:21:40	1,689.20	241.31	1.08	0:28:40	251.08	251.08	1.04
0:00:45	6,042.89	91.56	2.81	0:07:45	5,283.98	142.81	1.76	0:14:45	3,538.84	196.60	1.33	0:21:45	1,997.38	221.93	1.12	0:28:45	244.95	244.95	1.07
0:00:50	6,182.46	87.08	2.85	0:07:50	5,730.68	146.94	1.75	0:14:50	3,366.56	187.03	1.40	0:21:50	1,977.14	197.71	1.19	0:28:50	245.73	245.73	1.06
0:00:55	6,369.57	86.08	2.99	0:07:55	5,739.01	139.98	1.84	0:14:55	3,356.54	186.47	1.40	0:21:55	2,306.92	230.69	1.13	0:28:55	237.08	237.08	1.10
0:01:00	6,463.06	85.04	3.01	0:08:00	6,023.13	143.41	1.79	0:15:00	3,868.56	193.43	1.31	0:22:00	2,245.42	224.54	1.16	0:29:00	247.88	247.88	1.05
0:01:05	6,491.00	82.16	3.11	0:08:05	6,203.59	140.99	1.79	0:15:05	4,084.68	194.51	1.29	0:22:05	2,221.20	222.12	1.18	0:29:05	241.96	241.96	1.08
0:01:10	6,451.68	80.65	3.22	0:08:10	6,415.61	145.81	1.79	0:15:10	4,221.20	191.87	1.33	0:22:10	2,383.41	238.34	1.10	0:29:10	239.60	239.60	1.09
0:01:15	6,453.15	76.82	3.34	0:08:15	6,238.14	138.63	1.85	0:15:15	4,223.03	183.61	1.41	0:22:15	2,253.65	204.88	1.16	0:29:15	246.05	246.05	1.06
0:01:20	6,496.19	71.39	3.54	0:08:20	6,219.05	135.20	1.92	0:15:20	3,977.04	172.91	1.51	0:22:20	2,532.36	230.21	1.13	0:29:20	244.53	244.53	1.07
0:01:25	6,647.19	72.25	3.61	0:08:25	6,166.57	134.06	1.95	0:15:25	4,318.61	187.77	1.39	0:22:25	2,426.30	220.57	1.18	0:29:25	245.68	245.68	1.06
0:01:30	6,622.07	69.71	3.71	0:08:30	6,190.37	131.71	1.96	0:15:30	4,238.03	184.26	1.42	0:22:30	2,274.78	206.80	1.26	0:29:30	240.12	240.12	1.09
0:01:35	6,580.29	69.27	3.78	0:08:35	6,167.41	131.22	1.99	0:15:35	3,954.18	171.92	1.52	0:22:35	2,514.12	228.56	1.14	0:29:35	249.98	249.98	1.04
0:01:40	6,598.27	69.46	3.77	0:08:40	6,277.41	133.56	1.96	0:15:40	3,931.43	170.93	1.53	0:22:40	2,531.37	230.12	1.14	0:29:40	243.90	243.90	1.07
0:01:45	6,587.47	69.34	3.77	0:08:45	6,370.10	135.53	1.93	0:15:45	4,241.07	184.39	1.42	0:22:45	2,497.08	227.01	1.15	0:29:45	247.36	247.36	1.06
0:01:50	6,576.77	69.23	3.78	0:08:50	6,201.54	131.95	1.98	0:15:50	3,989.57	173.46	1.51	0:22:50	2,405.70	218.70	1.19	0:29:50	245.10	245.10	1.07
0:01:55	6,573.42	69.19	3.78	0:08:55	6,274.68	133.50	1.96	0:15:55	4,056.63	176.38	1.48	0:22:55	2,382.63	216.60	1.21	0:29:55	252.60	252.60	1.03
0:02:00	6,564.92	69.10	3.79	0:09:00	6,157.87	131.02	2.00	0:16:00	4,342.83	188.82	1.38	0:23:00	2,484.23	225.84	1.16	0:30:00	254.80	254.80	1.03
0:02:05	6,588.15	69.35	3.77	0:09:05	6,226.97	132.49	1.97	0:16:05	4,433.38	192.76	1.36	0:23:05	2,552.39	232.04	1.13	0:30:05	256.22	256.22	1.02
0:02:10	6,575.99	69.22	3.78	0:09:10	6,265.50	133.31	1.96	0:16:10	4,190.79	182.21	1.43	0:23:10	2,545.47	231.41	1.13	0:30:10	249.88	249.88	1.05
0:02:15	6,573.10	69.19	3.78	0:09:15	6,238.19	132.73	1.97	0:16:15	4,249.04	184.74	1.41	0:23:15	2,543.79	231.25	1.13	0:30:15	250.45	250.45	1.04
0:02:20	6,581.23	69.28	3.78	0:09:20	6,185.86	131.61	1.99	0:16:20	4,206.47	182.89	1.43	0:23:20	2,466.67	224.24	1.17	0:30:20	247.46	247.46	1.06
0:02:25	6,571.06	69.17	3.78	0:09:25	6,223.51	132.42	1.97	0:16:25	4,318.67	187.77	1.39	0:23:25	2,571.06	233.73	1.12	0:30:25	250.19	250.19	1.04
0:02:30	6,592.08	69.39	3.77	0:09:30	6,179.10	131.47	1.99	0:16:30	3,975.41	172.84	1.51	0:23:30	2,517.37	228.85	1.14	0:30:30	244.89	244.89	1.07
0:02:35	6,573.05	69.19	3.79	0:09:35	6,305.98	134.17	1.95	0:16:35	4,099.20	178.23	1.47	0:23:35	2,540.59	230.96	1.13	0:30:35	253.86	253.86	1.03
0:02:40	6,556.64	69.02	3.79	0:09:40	6,198.29	131.88	1.98	0:16:40	4,330.72	188.29	1.39	0:23:40	2,394.90	217.72	1.21	0:30:40	239.76	239.76	1.09
0:02:45	6,594.44	69.42	3.77	0:09:45	6,284.64	133.72	1.96	0:16:45	4,103.81	178.43	1.46	0:23:45	2,476.63	225.15	1.16	0:30:45	251.03	251.03	1.04
0:02:50	6,579.24	69.26	3.78	0:09:50	6,257.38	133.14	1.96	0:16:50	4,132.28	179.66	1.46	0:23:50	2,385.67	216.88	1.21	0:30:50	250.56	250.56	1.04
0:02:55	6,578.19	69.24	3.78	0:09:55	6,159.07	131.04	2.00	0:16:55	4,259.37	185.19	1.41	0:23:55	2,640.31	240.03	1.09	0:30:55	247.25	247.25	1.06
0:03:00	6,567.76	69.13	3.79	0:10:00	6,191.53	131.73	1.98	0:17:00	4,061.03	176.57	1.48	0:24:00	2,480.56	225.51	1.16	0:31:00	252.65	252.65	1.03

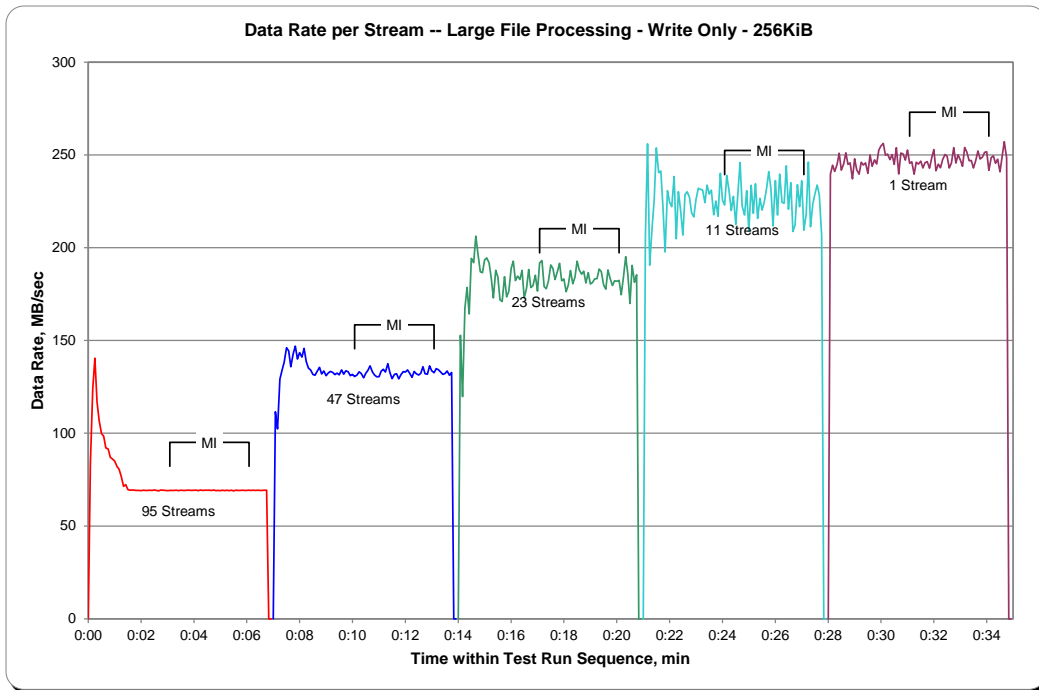
SPC-2 “Large File Processing/ WRITE ONLY /256 KiB Transfer Size” Average Data Rate Graph – Complete Test Run



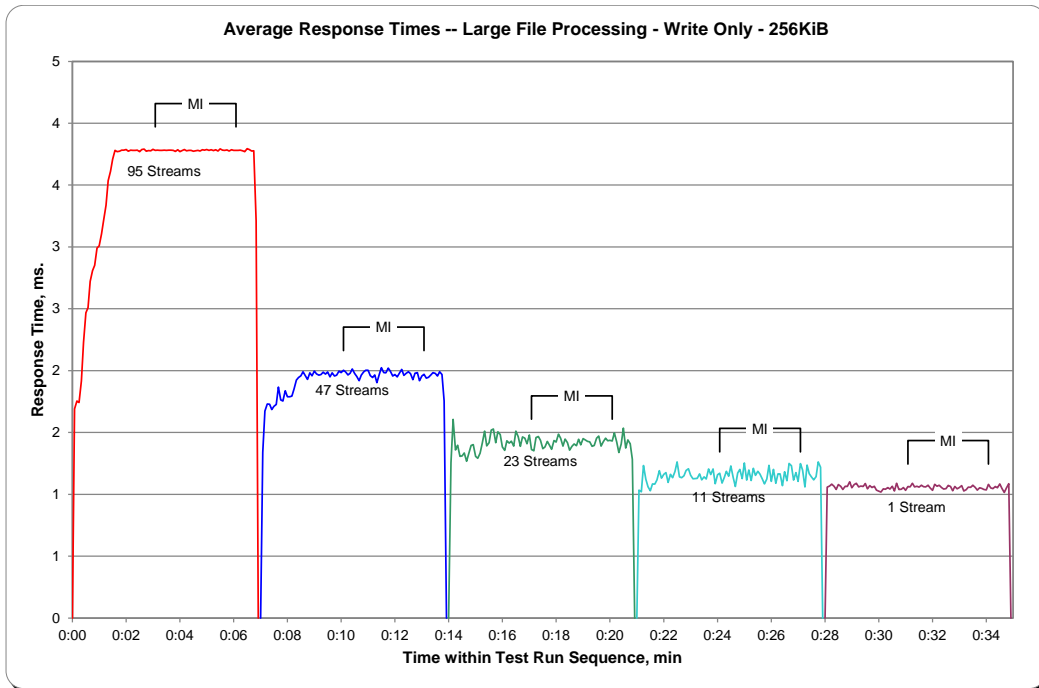
SPC-2 “Large File Processing/ WRITE ONLY /256 KiB Transfer Size” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large File Processing/ WRITE ONLY /256 KiB Transfer Size” Average Data Rate per Stream Graph



SPC-2 “Large File Processing/ WRITE ONLY /256 KiB Transfer Size” Average Response Time Graph



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.*

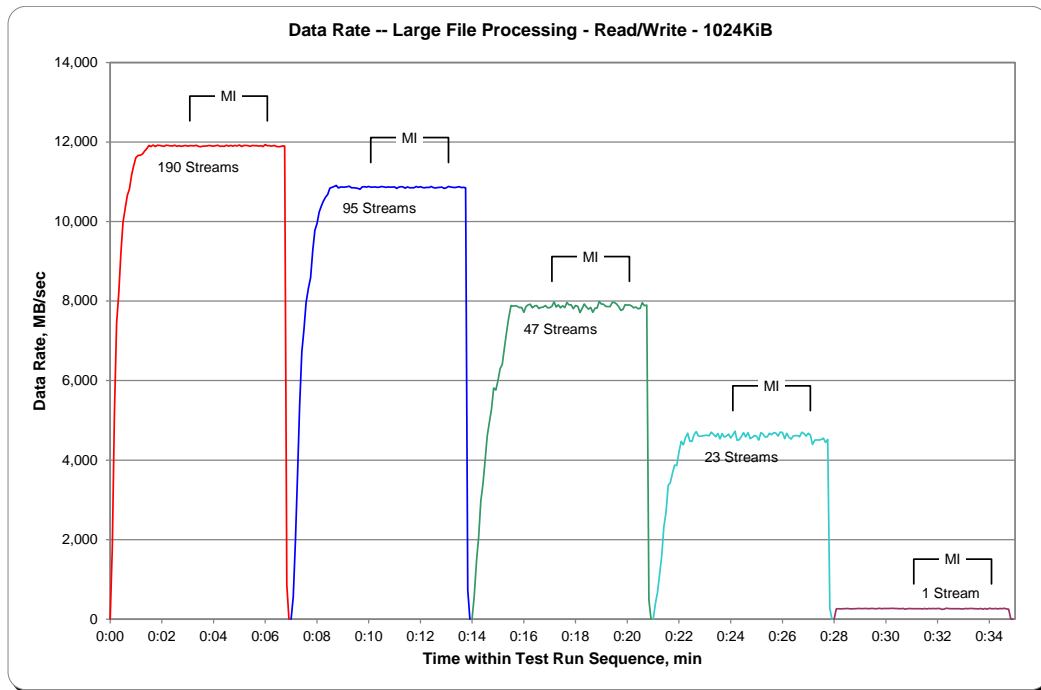
The SPC-2 "Large File Processing/READ-WRITE/1024 KiB Transfer Size" Test Run data is contained in the table that appears on the next page. That table is followed by graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table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

Immediately following the SPC-2 "Large File Processing/ READ-WRITE /1024 KiB Transfer Size" table and graphs will be the SPC-2 "Large File Processing/ READ-WRITE /64 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.

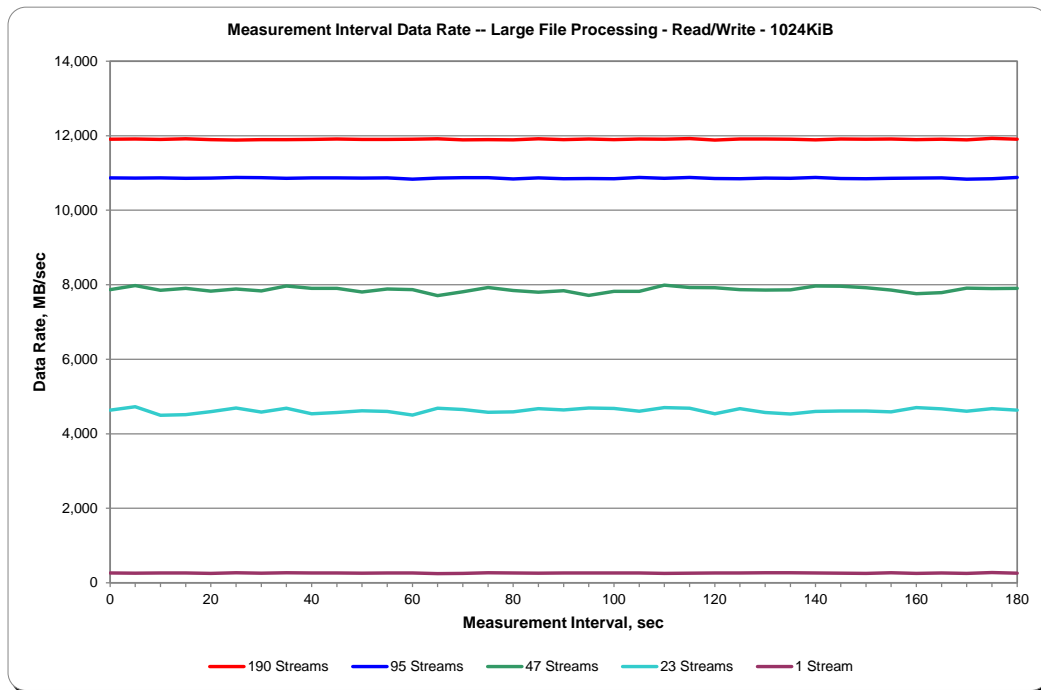
SPC-2 “Large File Processing/READ-WRITE/1024 KiB Transfer Size” Test Run Data – Ramp-Up Period

TR11	190 Streams			TR12	95 Streams			TR13	47 Streams			TR14	23 Streams			TR15	1 Stream		
Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms
0:00:00	0.00	0.00	0.00	0:07:00	0.00	0.00	0.00	0:14:00	0.00	0.00	0.00	0:21:00	0.00	0.00	0.00	0:28:00	0.00	0.00	0.00
0:00:05	1,801.87	78.34	6.43	0:07:05	560.78	93.46	5.48	0:14:05	568.54	94.76	5.87	0:21:05	380.21	126.74	5.06	0:28:05	258.16	258.16	3.94
0:00:10	5,199.26	115.54	6.97	0:07:10	1,932.53	120.78	5.98	0:14:10	1,464.23	162.69	5.69	0:21:10	673.19	168.30	5.25	0:28:10	261.31	261.31	4.01
0:00:15	7,435.87	121.90	7.54	0:07:15	3,617.59	139.14	6.01	0:14:15	2,074.29	138.29	5.75	0:21:15	1,129.74	188.29	5.46	0:28:15	259.21	259.21	4.04
0:00:20	8,177.22	102.22	9.18	0:07:20	5,387.58	138.14	6.24	0:14:20	2,970.41	165.02	5.85	0:21:20	1,600.55	160.05	5.48	0:28:20	264.66	264.66	3.96
0:00:25	9,193.08	94.77	10.06	0:07:25	6,716.34	142.90	6.66	0:14:25	3,397.39	154.43	5.89	0:21:25	2,329.52	194.13	5.14	0:28:25	261.10	261.10	4.01
0:00:30	9,984.96	97.89	10.45	0:07:30	7,282.36	145.65	7.05	0:14:30	3,992.35	159.69	5.98	0:21:30	2,688.34	179.22	5.11	0:28:30	267.18	267.18	3.92
0:00:35	10,319.88	92.97	10.82	0:07:35	7,962.47	139.69	7.12	0:14:35	4,610.38	170.75	5.87	0:21:35	3,365.51	197.97	5.02	0:28:35	265.08	265.08	3.95
0:00:40	10,653.95	86.62	11.48	0:07:40	8,330.94	143.64	7.20	0:14:40	4,956.41	177.01	5.91	0:21:40	3,434.30	202.02	5.19	0:28:40	259.00	259.00	4.05
0:00:45	10,815.43	83.84	12.26	0:07:45	8,585.95	134.16	7.40	0:14:45	5,287.97	165.25	6.01	0:21:45	3,667.92	203.77	5.05	0:28:45	264.66	264.66	3.96
0:00:50	11,165.24	82.10	12.42	0:07:50	9,262.91	134.25	7.62	0:14:50	5,814.35	176.19	5.89	0:21:50	3,875.96	204.00	5.05	0:28:50	262.35	262.35	3.99
0:00:55	11,405.15	77.59	13.00	0:07:55	9,780.07	132.16	7.73	0:14:55	5,758.99	174.51	6.00	0:21:55	3,863.79	193.19	5.35	0:28:55	268.44	268.44	3.90
0:01:00	11,604.59	72.53	13.85	0:08:00	9,947.00	129.18	7.89	0:15:00	5,995.13	171.29	5.95	0:22:00	4,221.99	191.91	5.09	0:29:00	266.76	266.76	3.93
0:01:05	11,664.15	71.56	14.55	0:08:05	10,236.62	127.96	8.05	0:15:05	6,299.43	174.98	5.97	0:22:05	4,470.92	203.22	5.15	0:29:05	263.61	263.61	3.97
0:01:10	11,665.20	68.22	14.88	0:08:10	10,384.47	125.11	8.27	0:15:10	6,405.96	168.58	5.98	0:22:10	4,385.14	199.32	5.26	0:29:10	270.74	270.74	3.87
0:01:15	11,694.98	66.45	15.52	0:08:15	10,514.49	120.86	8.54	0:15:15	6,814.49	170.36	5.96	0:22:15	4,565.08	198.48	5.11	0:29:15	267.39	267.39	3.92
0:01:20	11,773.83	65.05	15.85	0:08:20	10,611.17	120.58	8.66	0:15:20	7,204.35	171.53	6.01	0:22:20	4,676.44	203.32	5.16	0:29:20	263.40	263.40	3.98
0:01:25	11,832.13	64.66	16.05	0:08:25	10,679.96	117.36	8.72	0:15:25	7,568.41	168.19	6.05	0:22:25	4,473.43	194.50	5.38	0:29:25	266.55	266.55	3.93
0:01:30	11,914.55	63.04	16.38	0:08:30	10,839.34	114.10	9.07	0:15:30	7,885.29	167.77	6.17	0:22:30	4,468.19	194.27	5.37	0:29:30	266.34	266.34	3.92
0:01:35	11,884.35	62.55	16.76	0:08:35	10,861.57	114.33	9.17	0:15:35	7,871.24	167.47	6.25	0:22:35	4,634.71	201.51	5.21	0:29:35	265.29	265.29	3.95
0:01:40	11,923.36	62.75	16.70	0:08:40	10,883.17	114.56	9.14	0:15:40	7,880.47	167.67	6.25	0:22:40	4,716.29	205.06	5.12	0:29:40	261.93	261.93	4.00
0:01:45	11,886.66	62.56	16.70	0:08:45	10,907.08	114.81	9.13	0:15:45	7,867.05	167.38	6.26	0:22:45	4,605.35	200.23	5.23	0:29:45	273.05	273.05	3.84
0:01:50	11,916.23	62.72	16.77	0:08:50	10,841.44	114.12	9.18	0:15:50	7,832.23	166.64	6.28	0:22:50	4,599.89	200.00	5.24	0:29:50	262.14	262.14	4.00
0:01:55	11,913.50	62.70	16.71	0:08:55	10,870.80	114.43	9.17	0:15:55	7,841.04	166.83	6.28	0:22:55	4,611.22	200.49	5.22	0:29:55	268.65	268.65	3.90
0:02:00	11,900.71	62.64	16.75	0:09:00	10,862.62	114.34	9.16	0:16:00	7,716.26	164.18	6.38	0:23:00	4,618.56	200.81	5.22	0:30:00	265.92	265.92	3.94
0:02:05	11,893.16	62.60	16.75	0:09:05	10,867.02	114.39	9.17	0:16:05	7,859.92	167.23	6.27	0:23:05	4,623.59	201.03	5.21	0:30:05	267.18	267.18	3.92
0:02:10	11,920.42	62.74	16.70	0:09:10	10,873.73	114.46	9.15	0:16:10	7,903.75	168.16	6.23	0:23:10	4,612.27	200.53	5.22	0:30:10	265.71	265.71	3.94
0:02:15	11,911.40	62.69	16.73	0:09:15	10,884.64	114.58	9.15	0:16:15	7,918.64	168.48	6.22	0:23:15	4,699.51	204.33	5.13	0:30:15	271.37	271.37	3.86
0:02:20	11,899.03	62.63	16.75	0:09:20	10,849.20	114.20	9.17	0:16:20	7,827.62	166.55	6.28	0:23:20	4,650.22	202.18	5.18	0:30:20	269.90	269.90	3.88
0:02:25	11,901.55	62.64	16.74	0:09:25	10,847.94	114.19	9.18	0:16:25	7,874.39	167.54	6.26	0:23:25	4,588.36	199.49	5.25	0:30:25	267.39	267.39	3.92
0:02:30	11,916.23	62.72	16.72	0:09:30	10,845.21	114.16	9.17	0:16:30	7,885.71	167.78	6.24	0:23:30	4,666.79	202.90	5.16	0:30:30	264.87	264.87	3.95
0:02:35	11,892.74	62.59	16.72	0:09:35	10,832.63	114.03	9.19	0:16:35	7,814.20	166.26	6.31	0:23:35	4,536.56	197.24	5.31	0:30:35	264.45	264.45	3.96
0:02:40	11,909.73	62.68	16.74	0:09:40	10,810.61	113.80	9.22	0:16:40	7,839.57	166.80	6.28	0:23:40	4,670.78	203.08	5.16	0:30:40	266.55	266.55	3.93
0:02:45	11,890.43	62.58	16.74	0:09:45	10,869.33	114.41	9.16	0:16:45	7,848.59	166.99	6.28	0:23:45	4,575.99	198.96	5.27	0:30:45	251.45	251.45	4.16
0:02:50	11,901.55	62.64	16.73	0:09:50	10,877.93	114.50	9.15	0:16:50	7,889.70	167.87	6.24	0:23:50	4,604.51	200.20	5.23	0:30:50	263.61	263.61	3.98
0:02:55	11,913.50	62.70	16.72	0:09:55	10,867.23	114.39	9.16	0:16:55	7,827.41	166.54	6.30	0:23:55	4,652.53	202.28	5.18	0:30:55	267.18	267.18	3.92
0:03:00	11,895.68	62.61	16.74	0:10:00	10,878.98	114.52	9.15	0:17:00	7,831.39	166.63	6.28	0:24:00	4,554.18	198.01	5.29	0:31:00	264.45	264.45	3.96

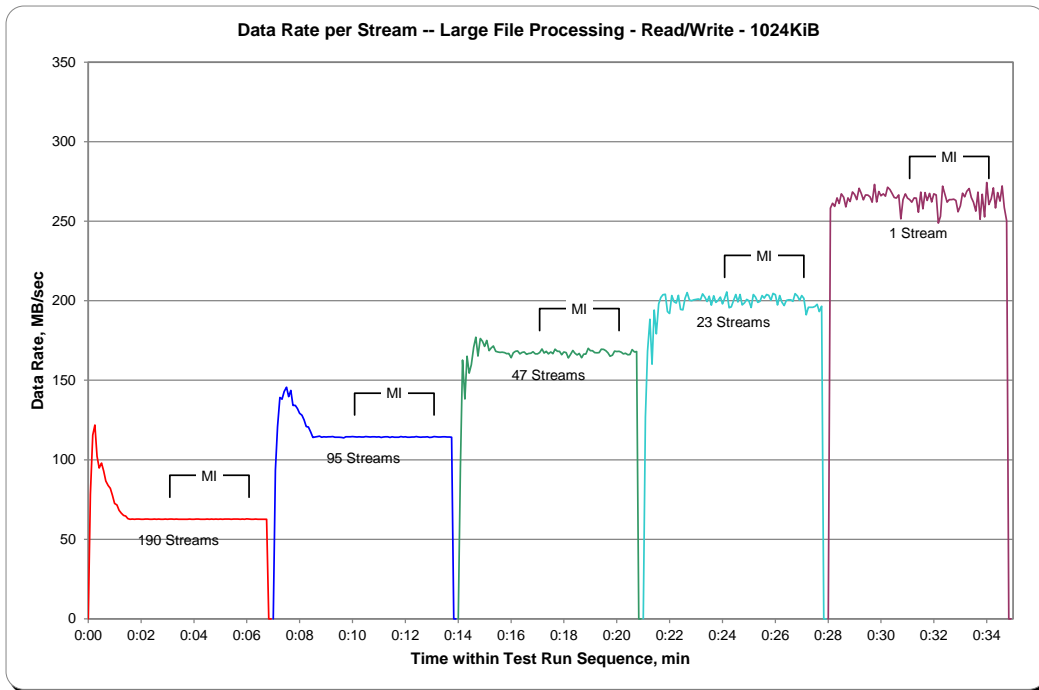
SPC-2 “Large File Processing/ READ-WRITE/1024 KiB Transfer Size” Average Data Rate Graph – Complete Test Run



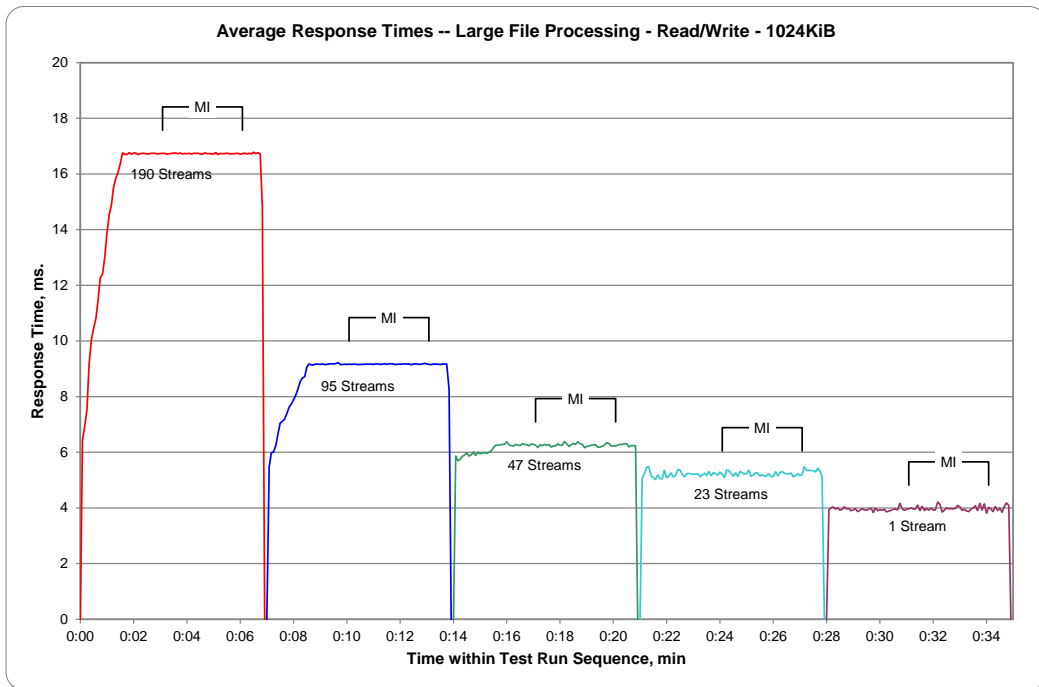
SPC-2 “Large File Processing/ READ-WRITE/1024 KiB Transfer Size” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large File Processing/READ-WRITE/1024 KiB Transfer Size” Average Data Rate per Stream Graph



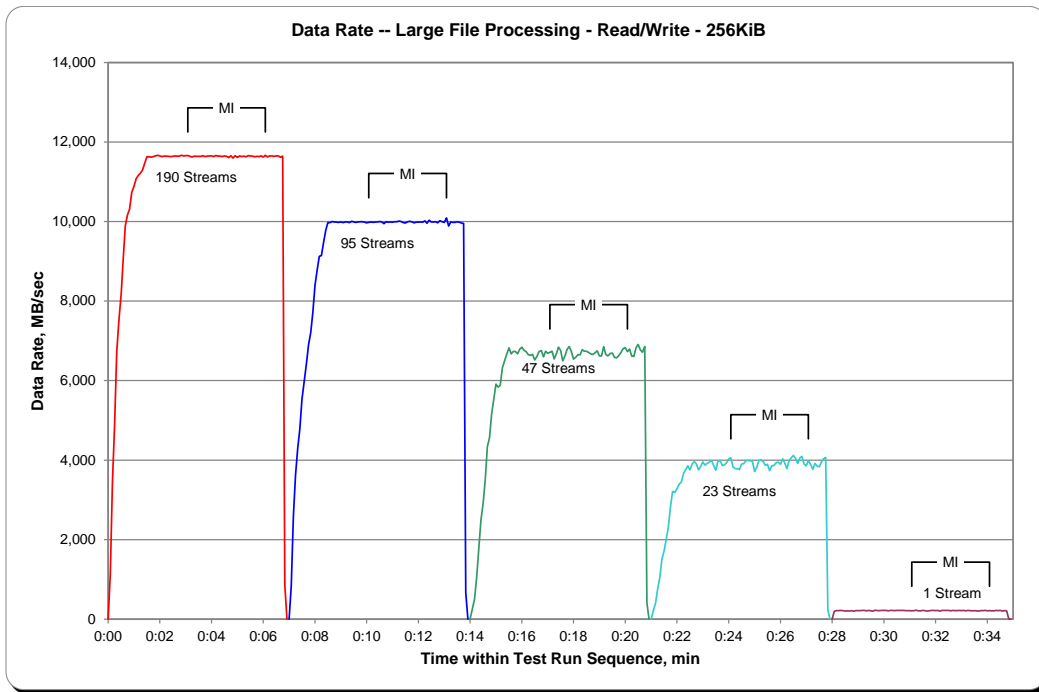
SPC-2 “Large File Processing/READ-WRITE/1024 KiB Transfer Size” Average Response Time Graph



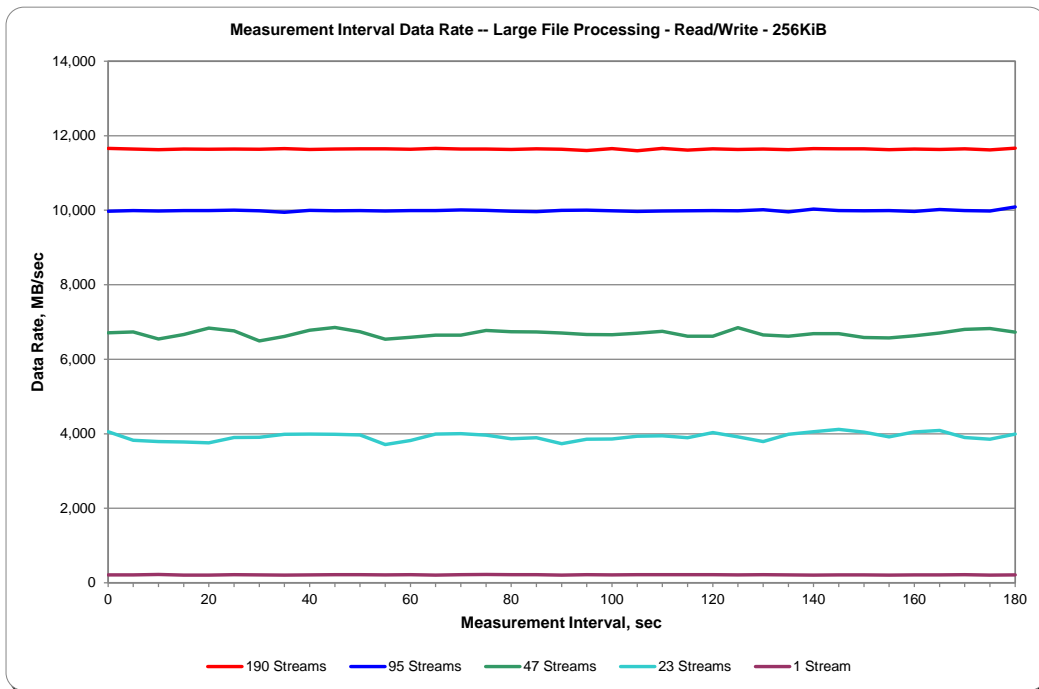
SPC-2 “Large File Processing/READ-WRITE/256 KiB Transfer Size” Test Run Data
Measurement Interval, Run-Out, and Ramp-Down Periods

Table with columns for Test Run Sequence Time, Data Rate, and Response Time for 190 Streams, 95 Streams, 47 Streams, 23 Streams, and 1 Stream. Rows contain detailed timing and performance data for each stream configuration.

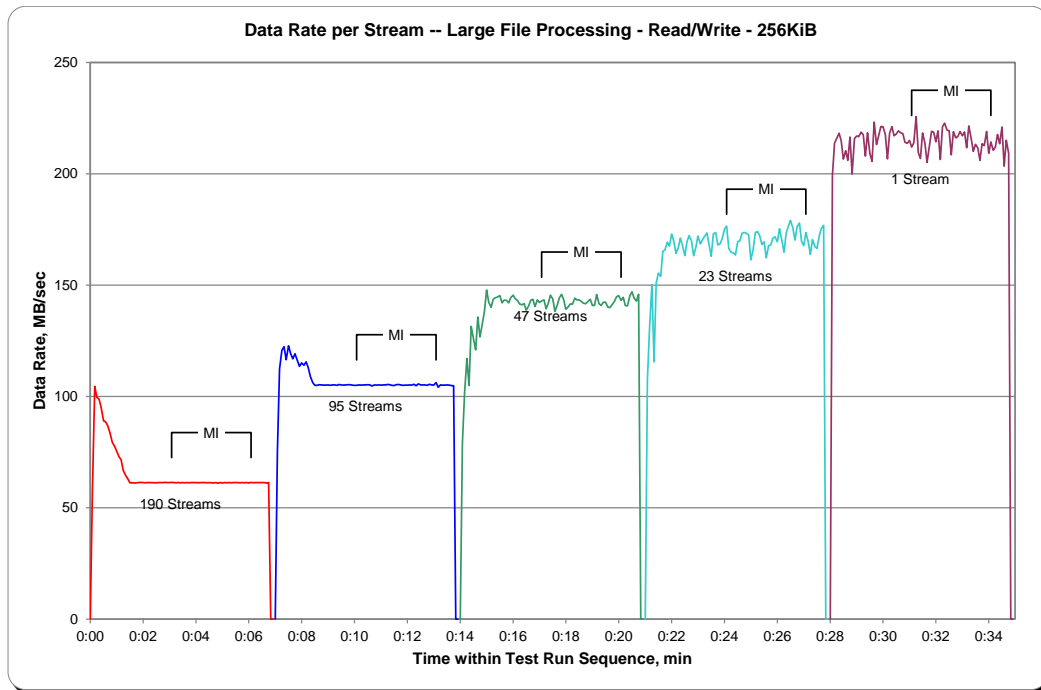
SPC-2 “Large File Processing/READ-WRITE/256 KiB Transfer Size” Average Data Rate Graph – Complete Test Run



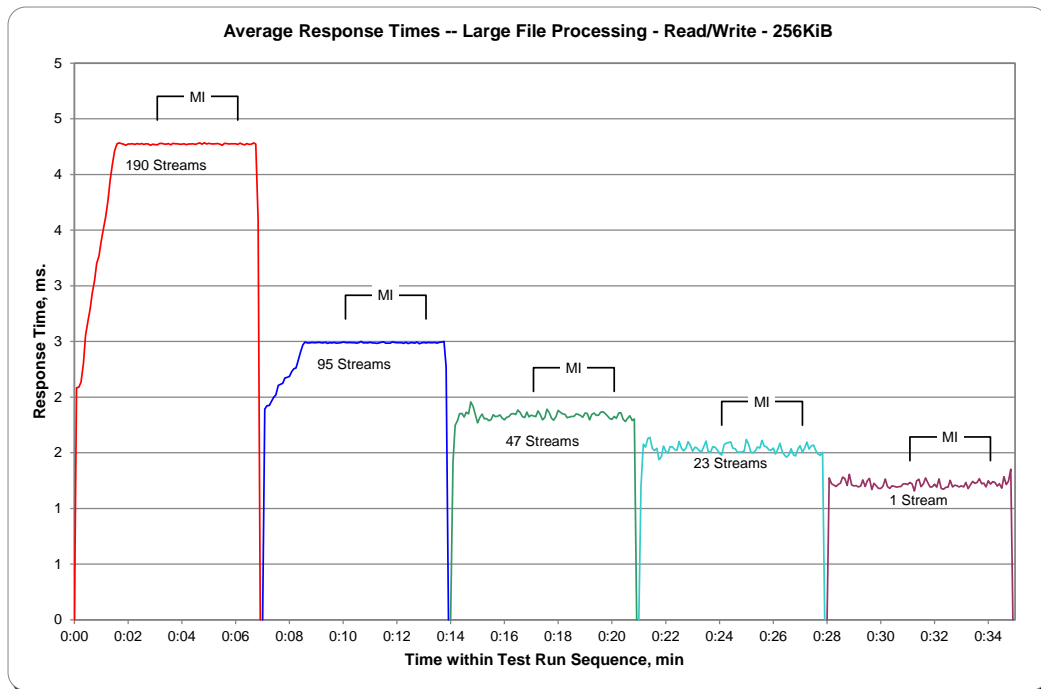
SPC-2 “Large File Processing/READ-WRITE/256 KiB Transfer Size” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large File Processing/READ-WRITE/256 KiB Transfer Size” Average Data Rate per Stream Graph



SPC-2 “Large File Processing/READ-WRITE/256 KiB Transfer Size” Average Response Time Graph



Large File Processing Test – READ ONLY Test Phase

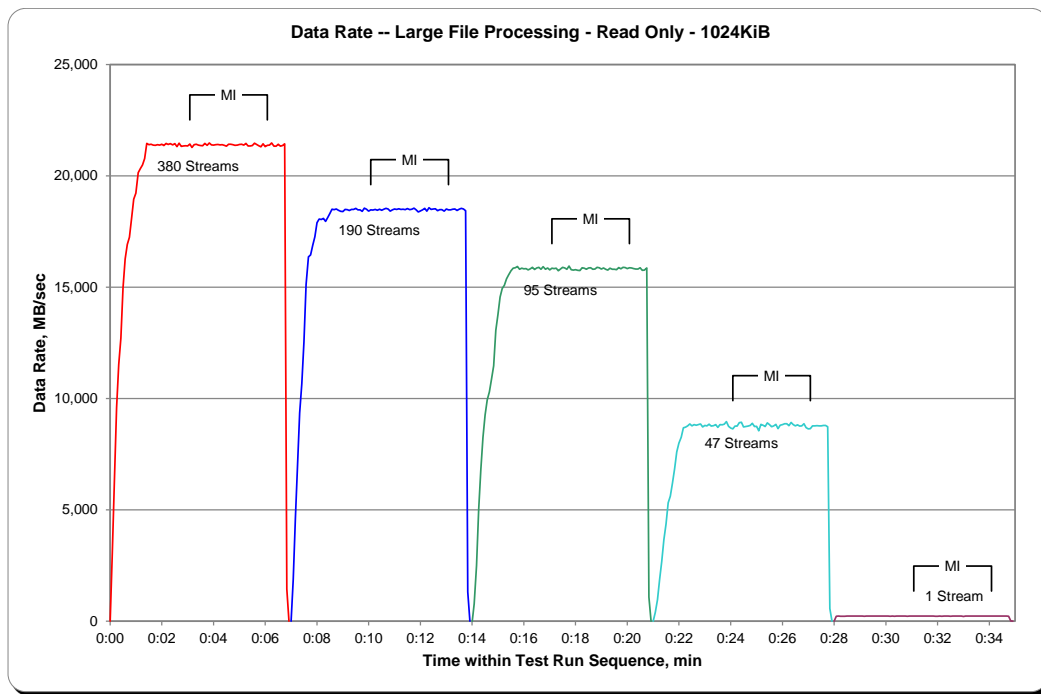
Clause 10.6.9.1.3

1. 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.
2. 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.
3. 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.
4. 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.

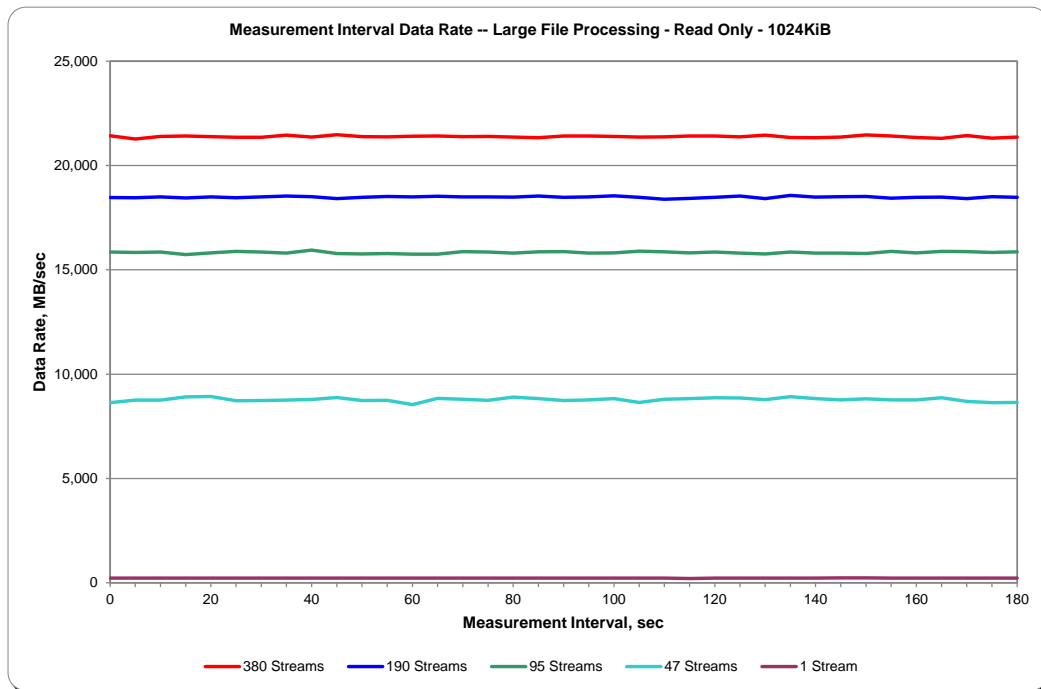
The SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" Test Run data is contained in the table that appears on the next page. That table is followed by graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs. The table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

Immediately following the SPC-2 "Large File Processing/READ ONLY/1024 KiB Transfer Size" table and graphs will be the SPC-2 "Large File Processing/READ ONLY/64 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.

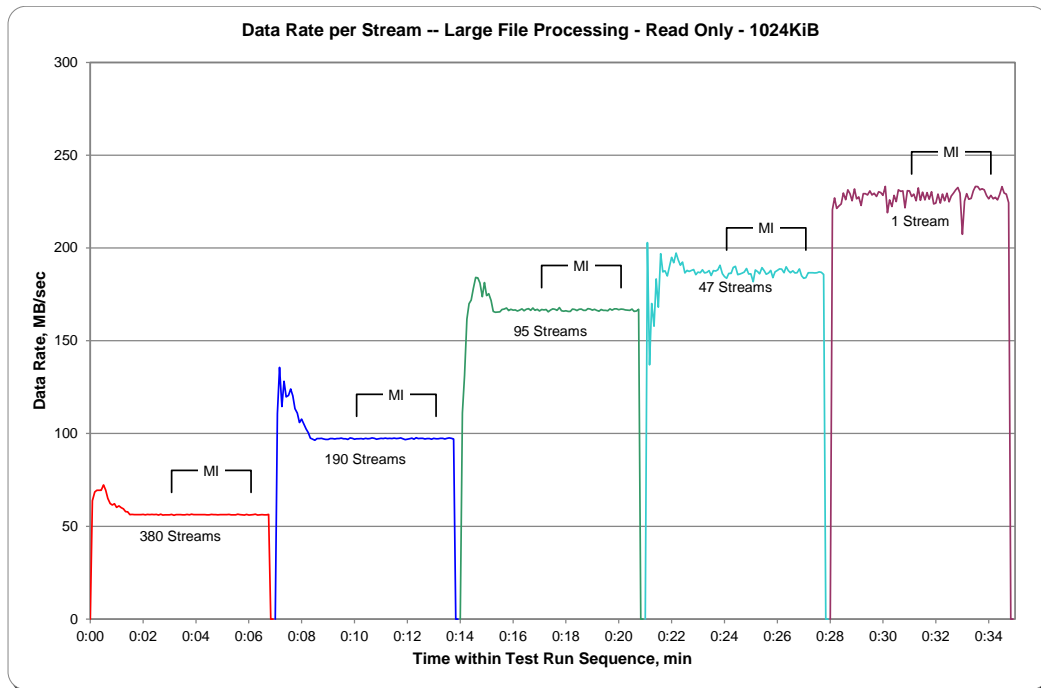
SPC-2 “Large File Processing/READ ONLY/1024 KiB Transfer Size” Average Data Rate Graph – Complete Test Run



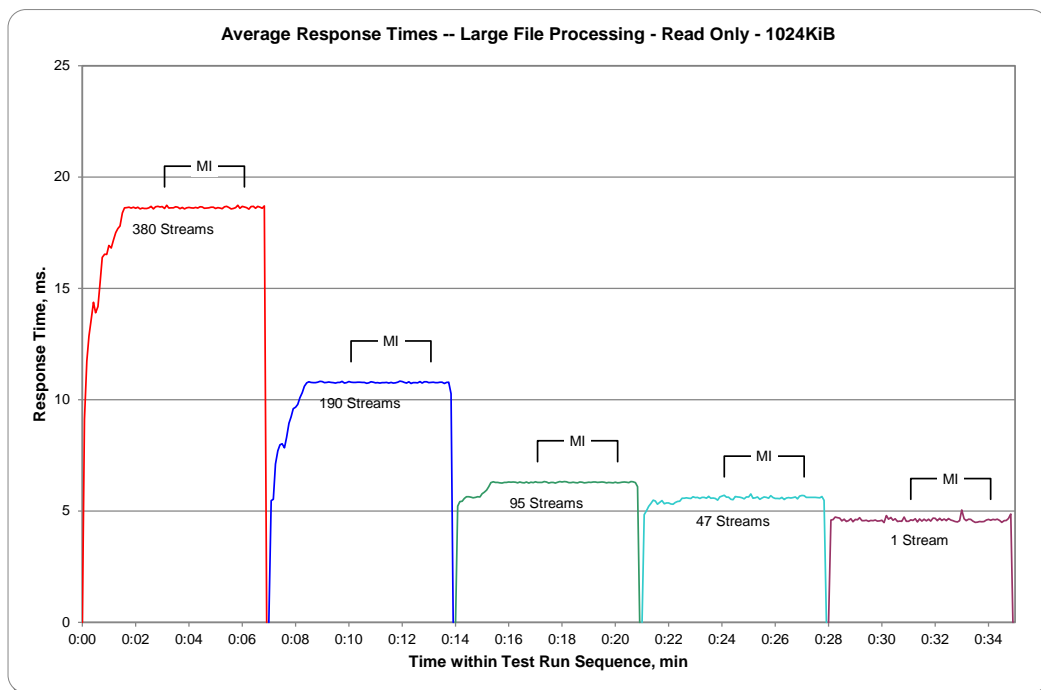
SPC-2 “Large File Processing/READ ONLY/1024 KiB Transfer Size” Average Data Rate Graph – Measurement Interval (MI) Only



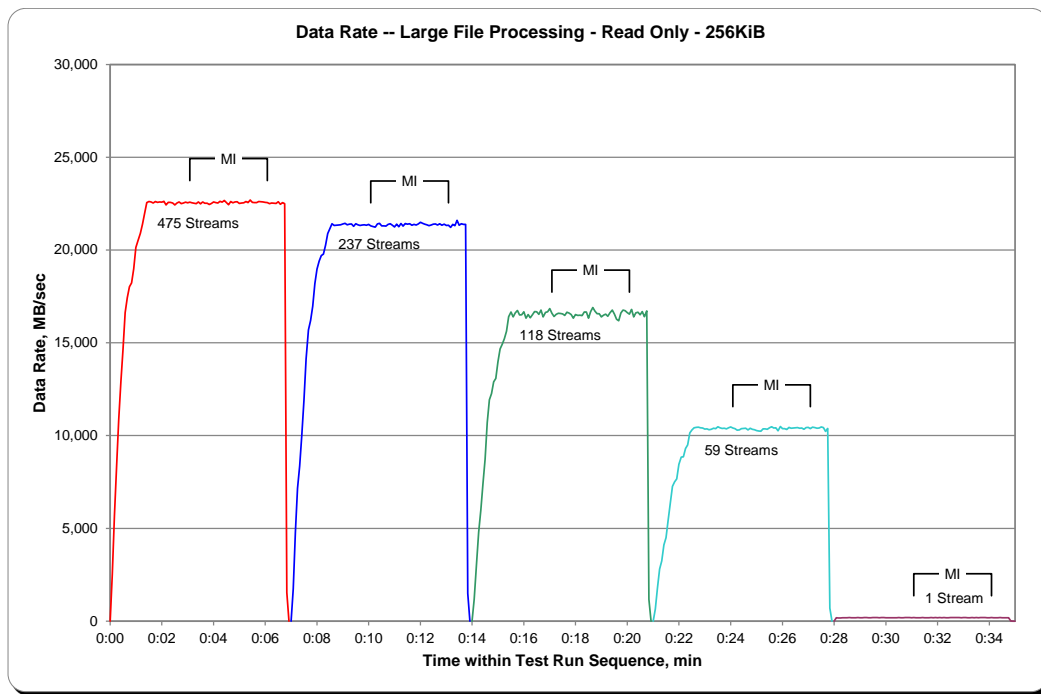
SPC-2 “Large File Processing/READ ONLY/1024 KiB Transfer Size” Average Data Rate per Stream Graph



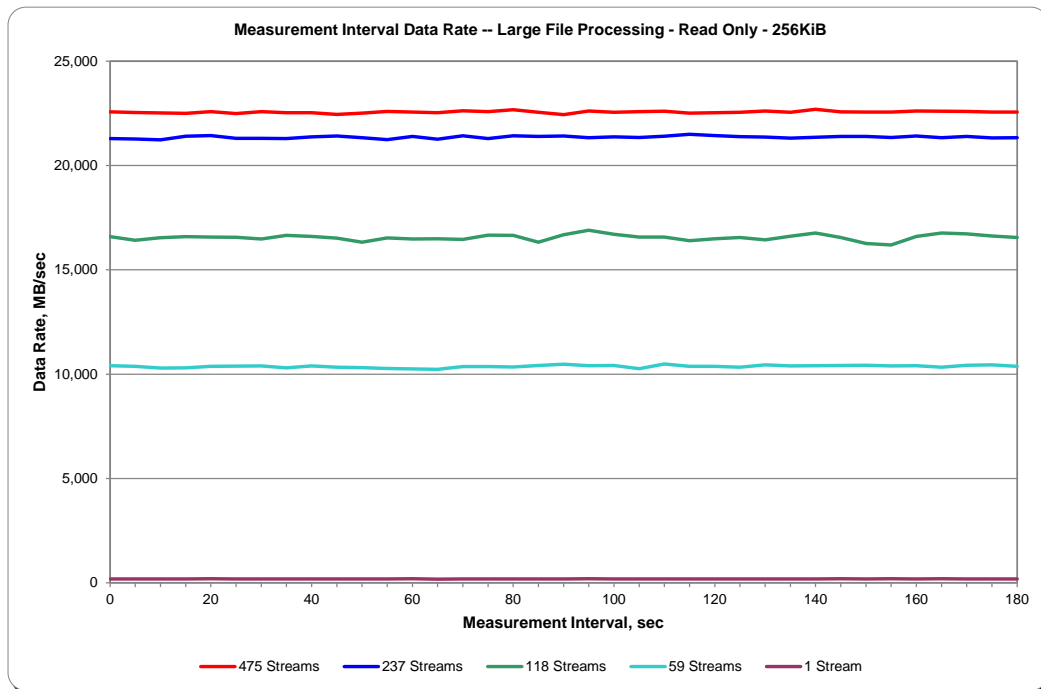
SPC-2 “Large File Processing/READ ONLY/1024 KiB Transfer Size” Average Response Time Graph



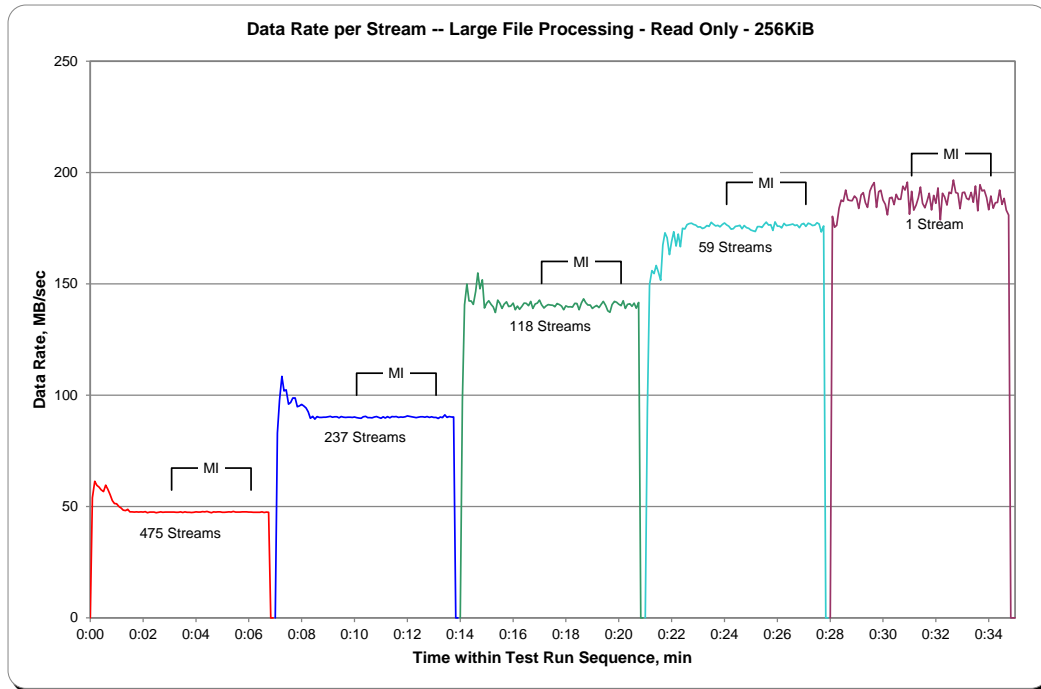
SPC-2 “Large File Processing/READ ONLY/256 KiB Transfer Size” Average Data Rate Graph – Complete Test Run



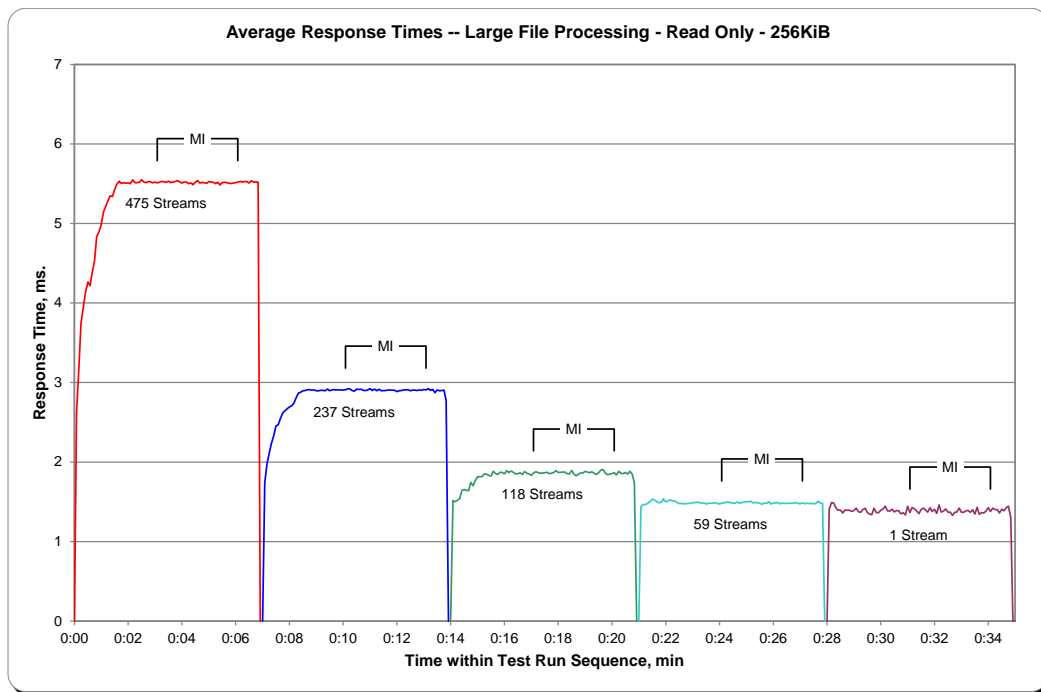
SPC-2 “Large File Processing/READ ONLY/256 KiB Transfer Size” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large File Processing/READ ONLY/256 KiB Transfer Size” Average Data Rate per Stream Graph



SPC-2 “Large File Processing/READ ONLY/256 KiB Transfer Size” Average Response Time Graph



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 120.

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.

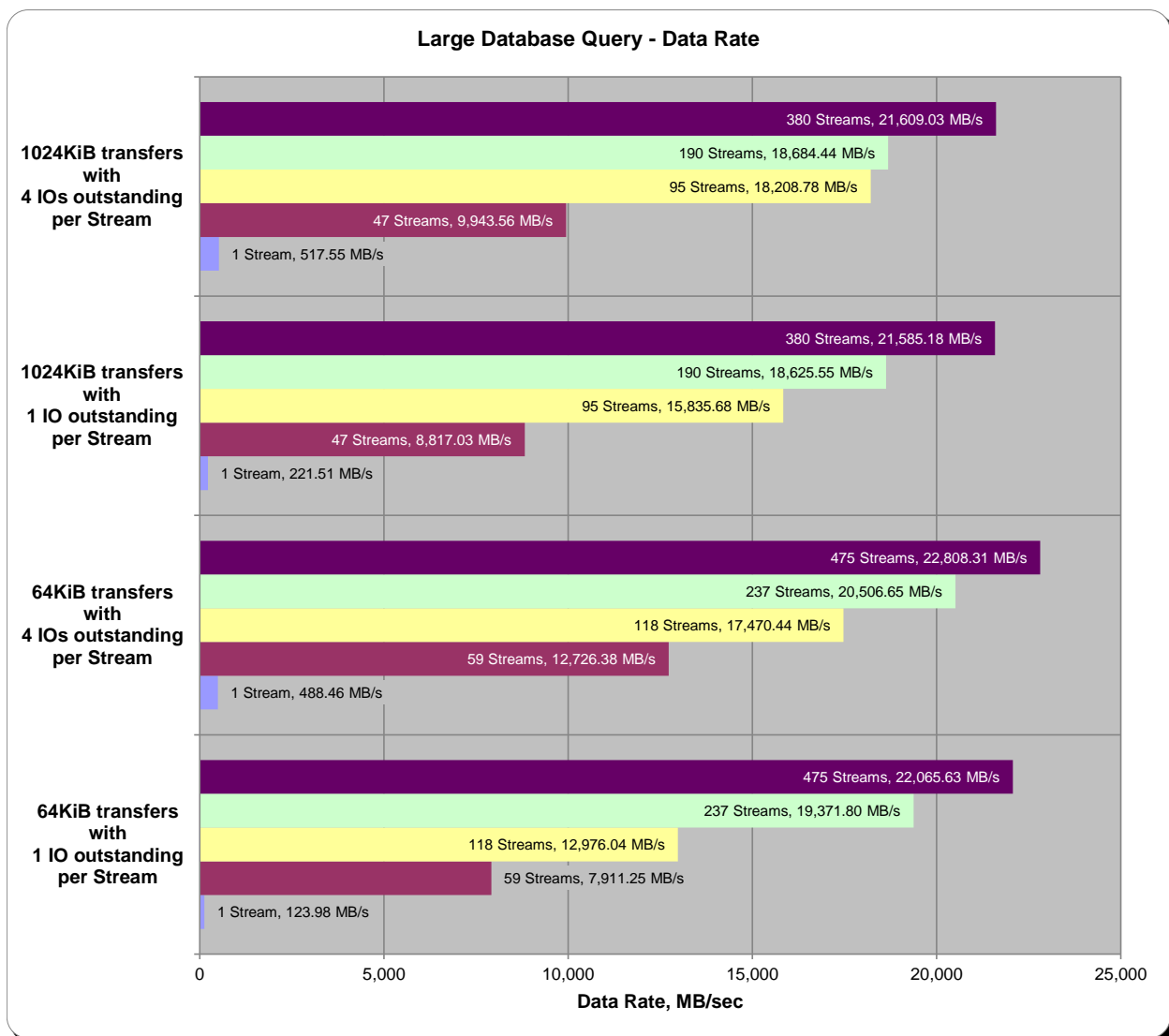
[SPC-2 Large Database Query Test Results File](#)

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	47 Streams	95 Streams	190 Streams	380 Streams
1024KiB w/ 4 IOs/Stream	517.55	9,943.56	18,208.78	18,684.44	21,609.03
Test Run Sequence	1 Stream	47 Streams	95 Streams	190 Streams	380 Streams
1024KiB w/ 1 IO/Stream	221.51	8,817.03	15,835.68	18,625.55	21,585.18
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
64KiB w/ 4 IOs/Stream	488.46	12,726.38	17,470.44	20,506.65	22,808.31
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
64KiB w/ 1 IO/Stream	123.98	7,911.25	12,976.04	19,371.80	22,065.63

SPC-2 Large Database Query Average Data Rates Graph

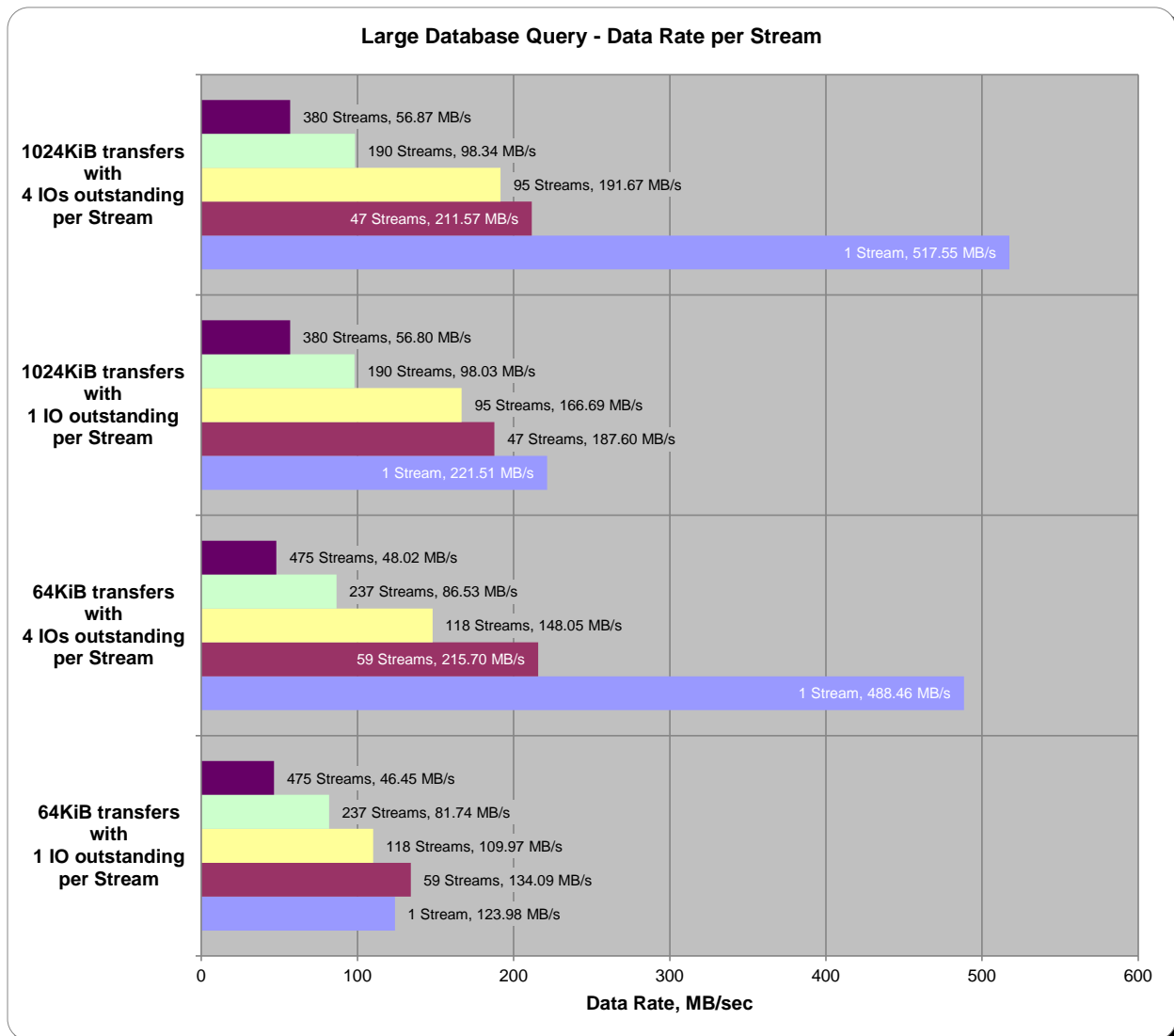


SPC-2 Large Database Query Average Data Rate per Stream

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	47 Streams	95 Streams	190 Streams	380 Streams
1024KiB w/ 4 IOs/Stream	517.55	211.57	191.67	98.34	56.87
Test Run Sequence	1 Stream	47 Streams	95 Streams	190 Streams	380 Streams
1024KiB w/ 1 IO/Stream	221.51	187.60	166.69	98.03	56.80
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
64KiB w/ 4 IOs/Stream	488.46	215.70	148.05	86.53	48.02
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
64KiB w/ 1 IO/Stream	123.98	134.09	109.97	81.74	46.45

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

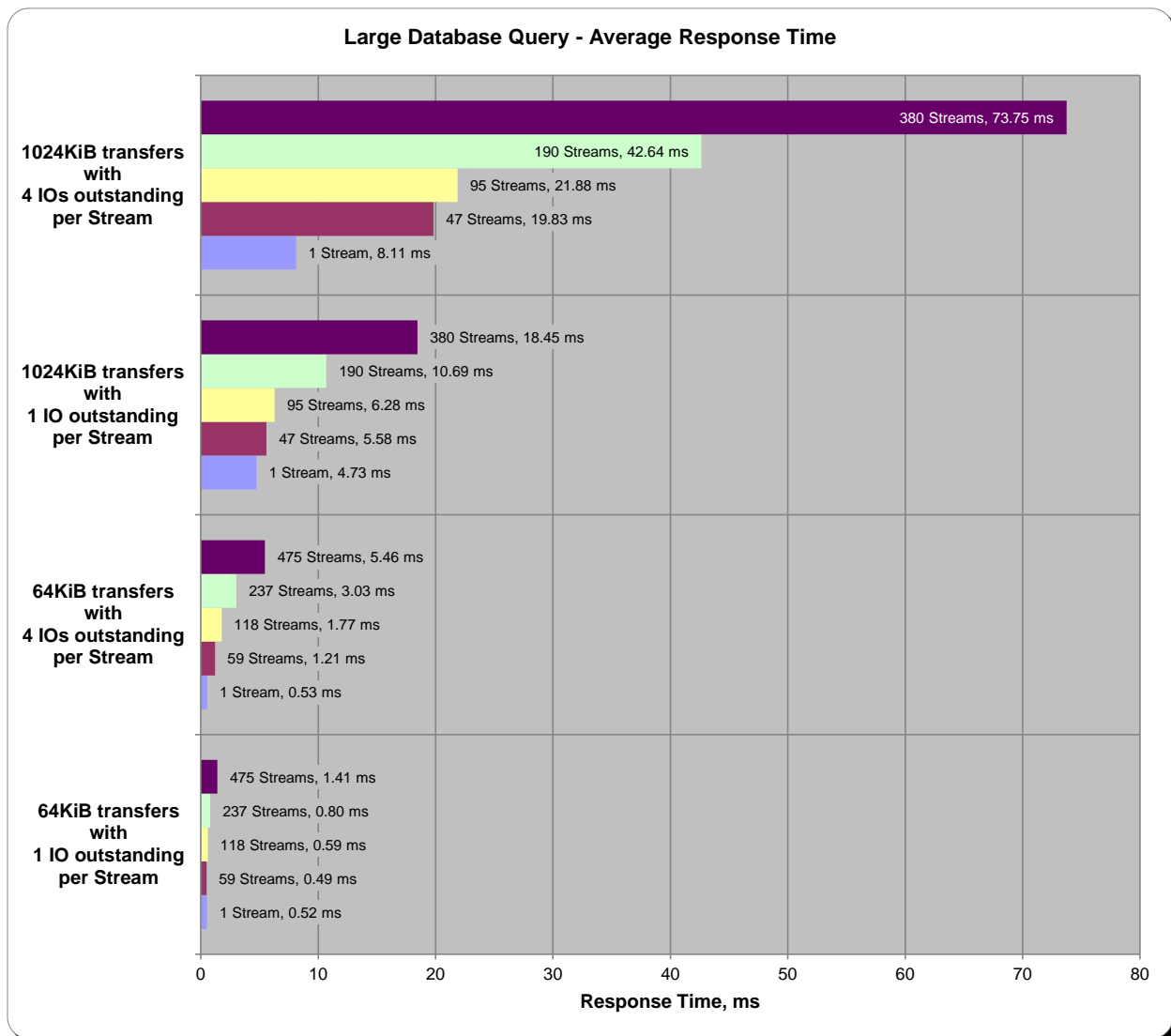


SPC-2 Large Database Query Average Response Time

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	47 Streams	95 Streams	190 Streams	380 Streams
1024KiB w/ 4 IOs/Stream	8.11	19.83	21.88	42.64	73.75
Test Run Sequence	1 Stream	47 Streams	95 Streams	190 Streams	380 Streams
1024KiB w/ 1 IO/Stream	4.73	5.58	6.28	10.69	18.45
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
64KiB w/ 4 IOs/Stream	0.53	1.21	1.77	3.03	5.46
Test Run Sequence	1 Stream	59 Streams	118 Streams	237 Streams	475 Streams
64KiB w/ 1 IO/Stream	0.52	0.49	0.59	0.80	1.41

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.*

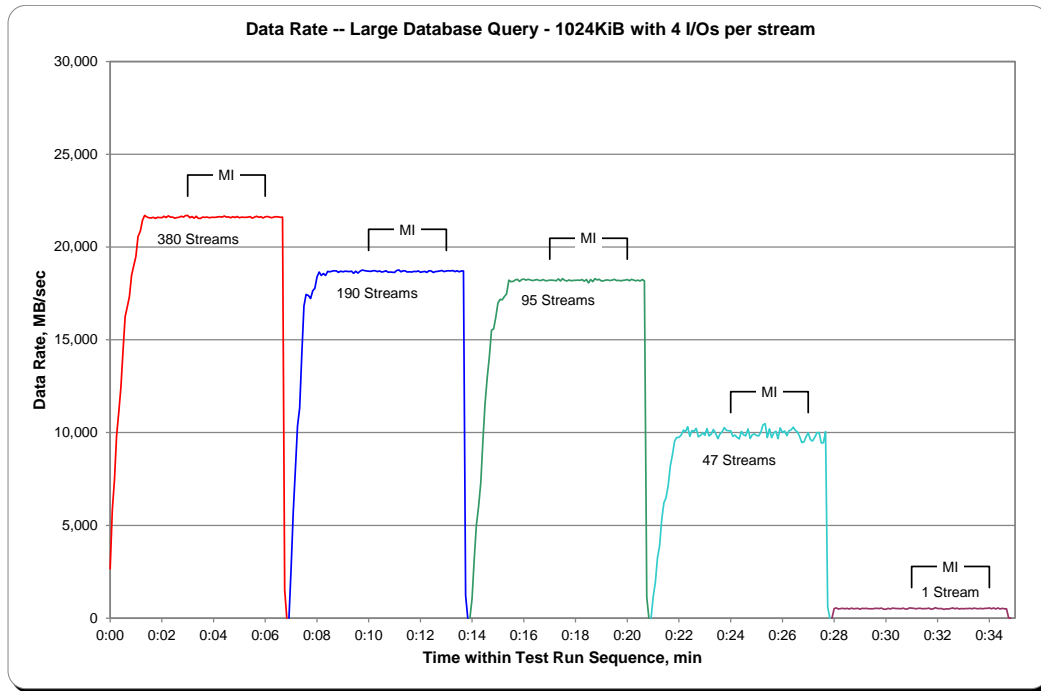
The SPC-2 "Large Database Query/1024 KiB TRANSFER SIZE/4 Outstanding I/Os" Test Run data is contained in the table that appears on the next page. That table is followed by graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs.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

Immediately following the SPC-2 "Large Database Query/1024 KiB TRANSFER SIZE/4 Outstanding I/Os" table and graphs will be the 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.

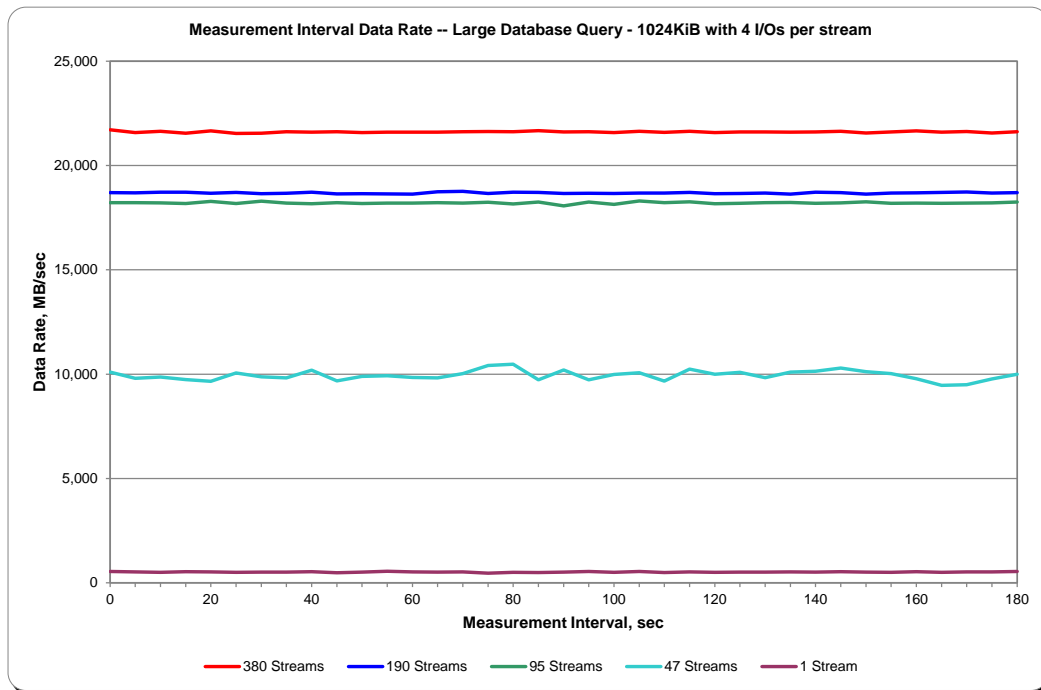
SPC-2 “Large Database Query/1024 KiB Transfer Size/4 Outstanding I/Os” Test Run Data Measurement Interval, Run-Out, and Ramp-Down Periods

Table with 16 columns and multiple rows. Columns are grouped by test runs: TR1 (380 Streams), TR2 (190 Streams), TR3 (95 Streams), TR4 (47 Streams), and TR5 (1 Stream). Each group contains columns for Test Run Sequence Time, Data Rate, /Stream, /MB/sec, and Response Time, ms.

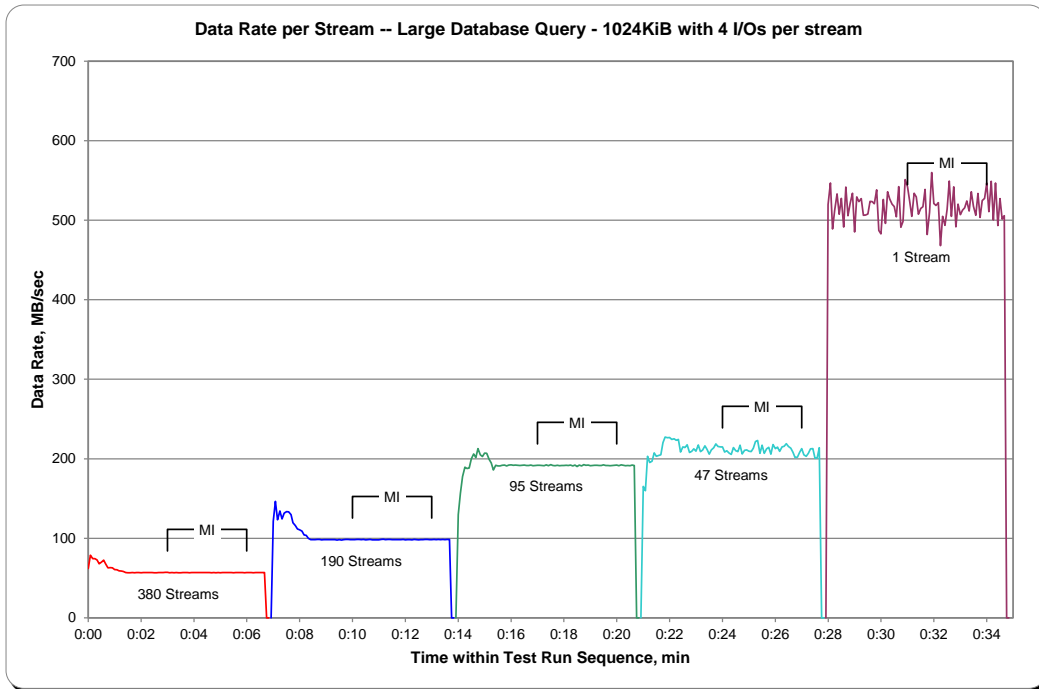
SPC-2 “Large Database Query/1024 KiB Transfer Size/4 Outstanding I/Os” Average Data Rate Graph – Complete Test Run



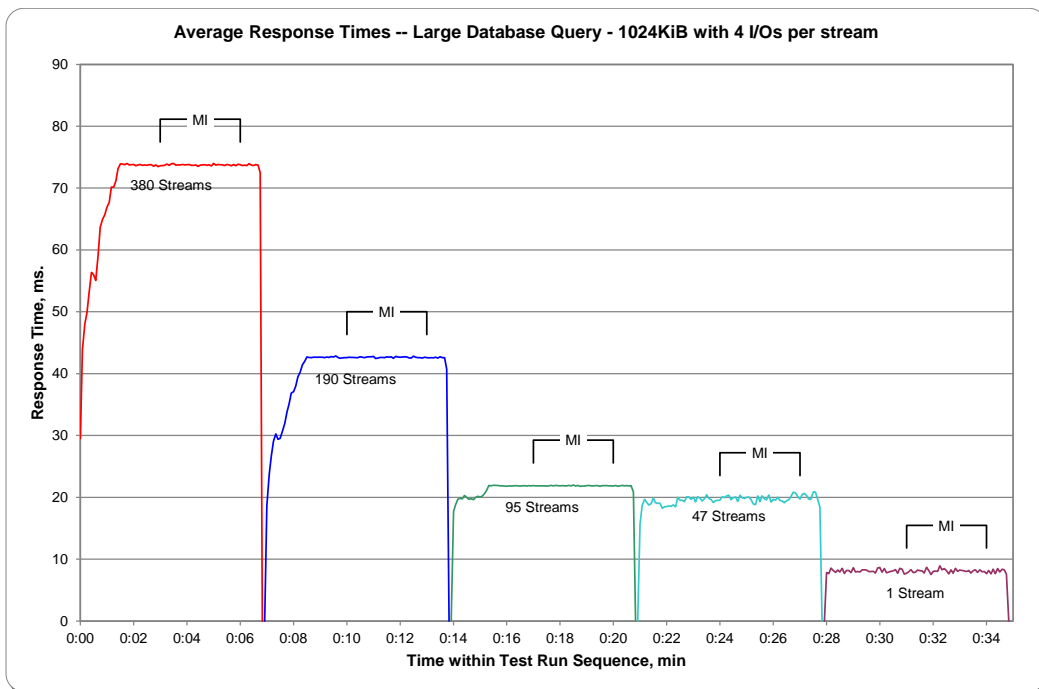
SPC-2 “Large Database Query/1024 KiB Transfer Size/4 Outstanding I/Os” Average Data Rate Graph – Measurement Interval (MI) Only



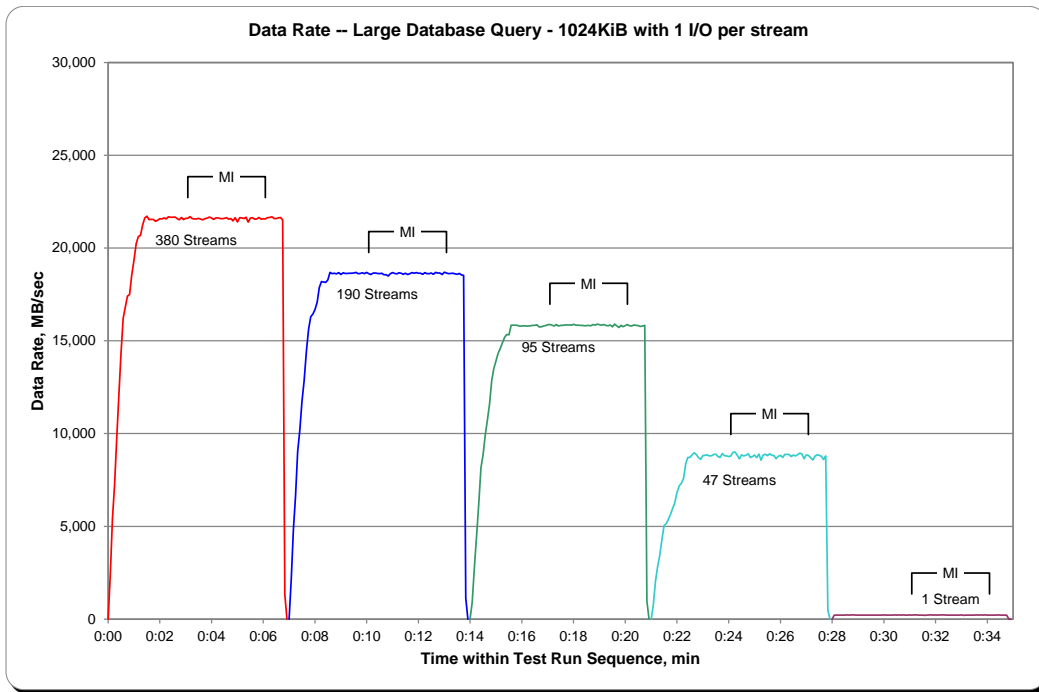
SPC-2 “Large Database Query/1024 KiB Transfer Size/4 Outstanding I/Os” Average Data Rate per Stream Graph



SPC-2 “Large Database Query/1024 KiB Transfer Size/4 Outstanding I/Os” Average Response Time Graph



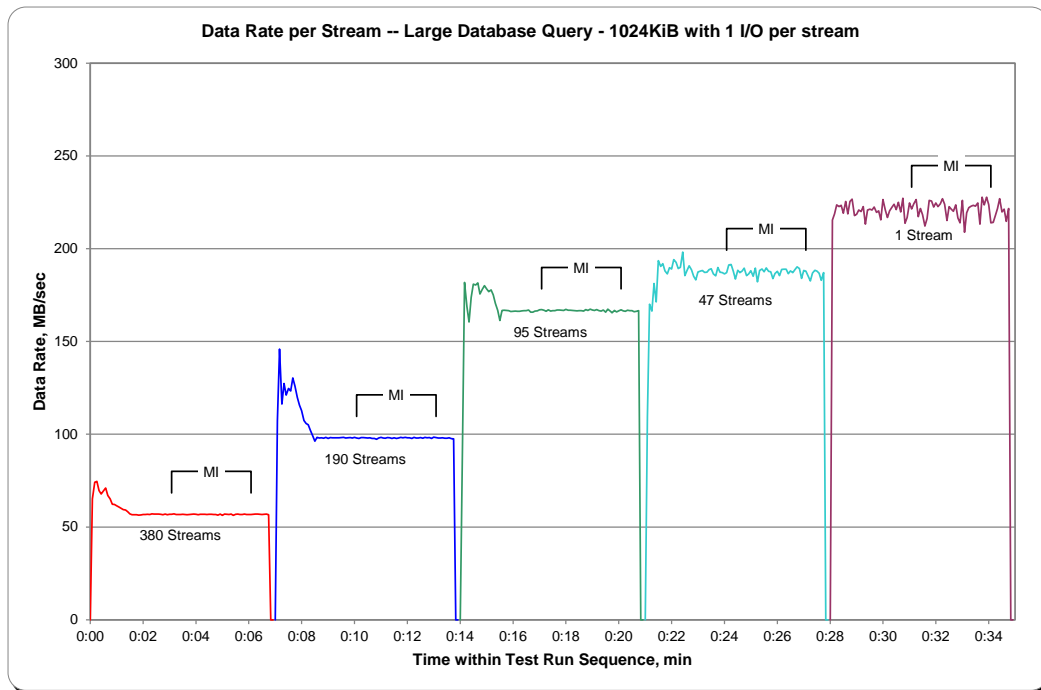
SPC-2 “Large Database Query/1024 KiB Transfer Size/1 Outstanding I/O” Average Data Rate Graph – Complete Test Run



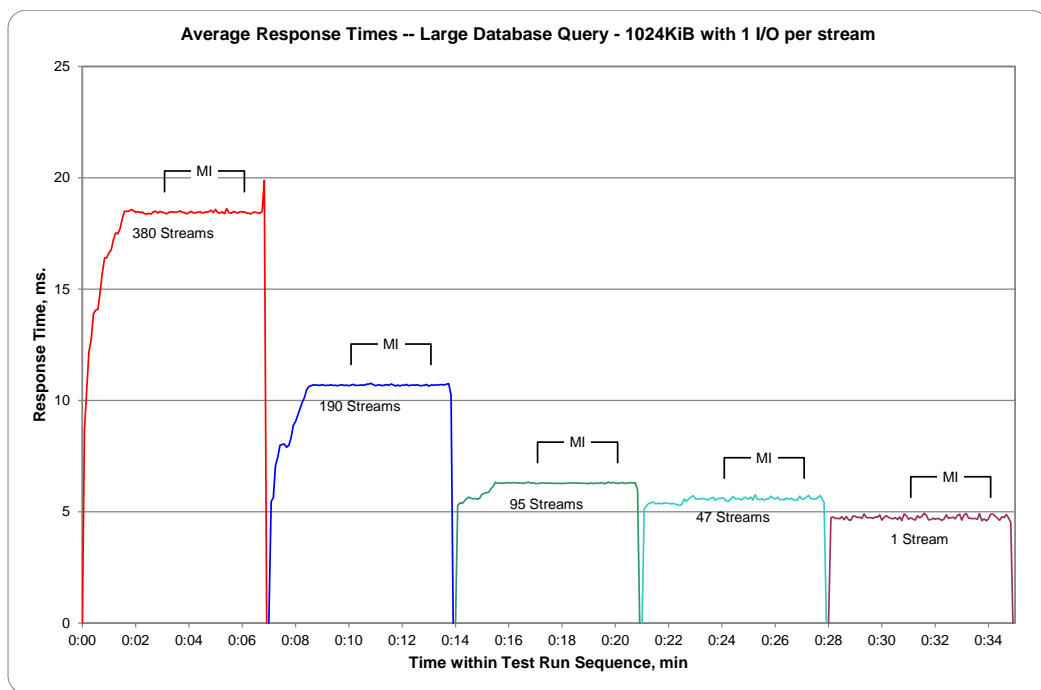
SPC-2 “Large Database Query/1024 KiB Transfer Size/1 Outstanding I/O” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large Database Query/1024 KiB Transfer Size/1 Outstanding I/O” Average Data Rate per Stream Graph



SPC-2 “Large Database Query/1024 KiB Transfer Size/1 Outstanding I/O” Average Response Time Graph



Large Database Query Test – 64 KiB TRANSFER SIZE Test Phase

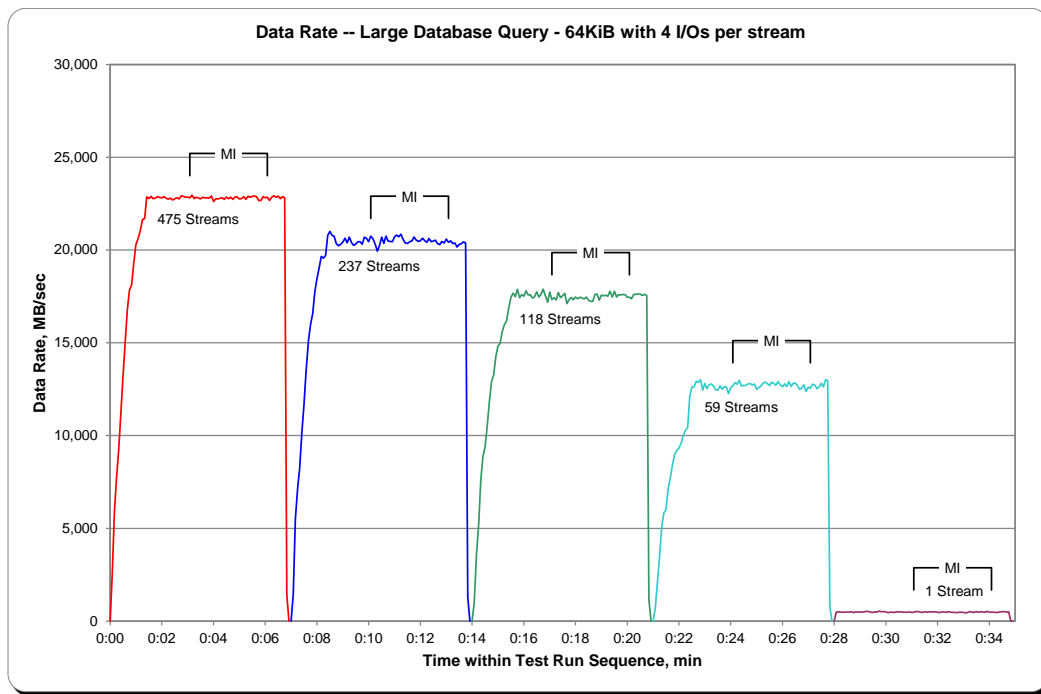
Clause 10.6.9.2.2

5. *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.*
6. *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.*
7. *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.*
8. *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.*

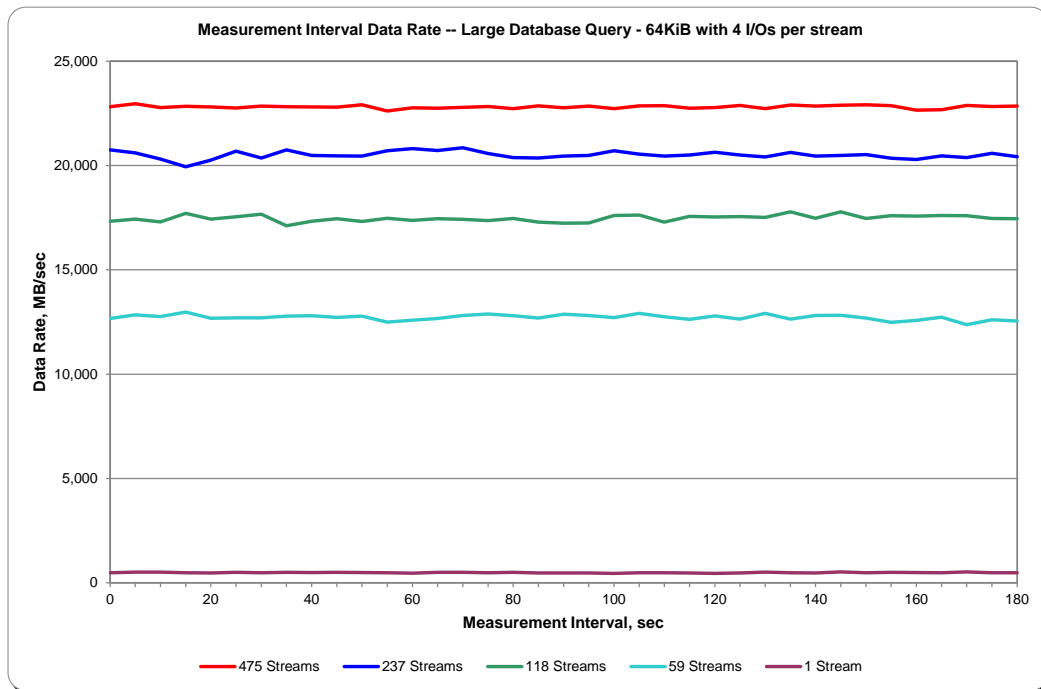
The SPC-2 "Large Database Query/64 KiB TRANSFER SIZE/4 Outstanding I/Os" Test Run data is contained in the table that appears on the next page. That table is followed by graphs illustrating the average Data Rate, average Data Rate per Stream, and average Response Time produced by the same Test Runs.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

Immediately following the SPC-2 "Large Database Query/64 KiB TRANSFER SIZE/4 Outstanding I/Os" table and graphs will be the 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.

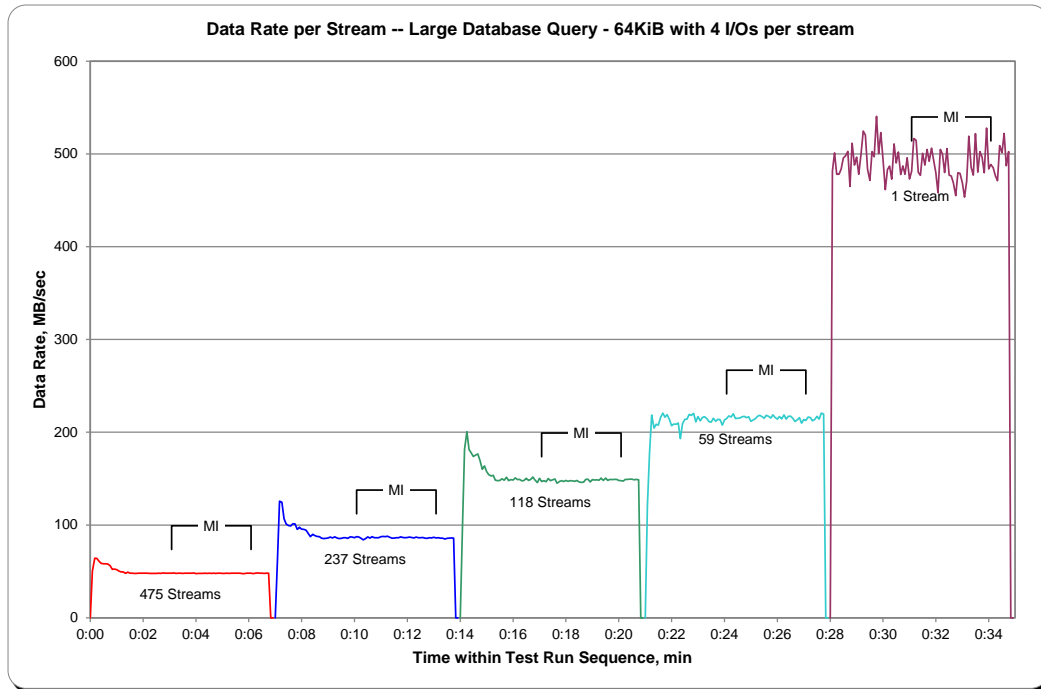
SPC-2 “Large Database Query/64 KiB Transfer Size/4 Outstanding I/Os” Average Data Rate Graph – Complete Test Run



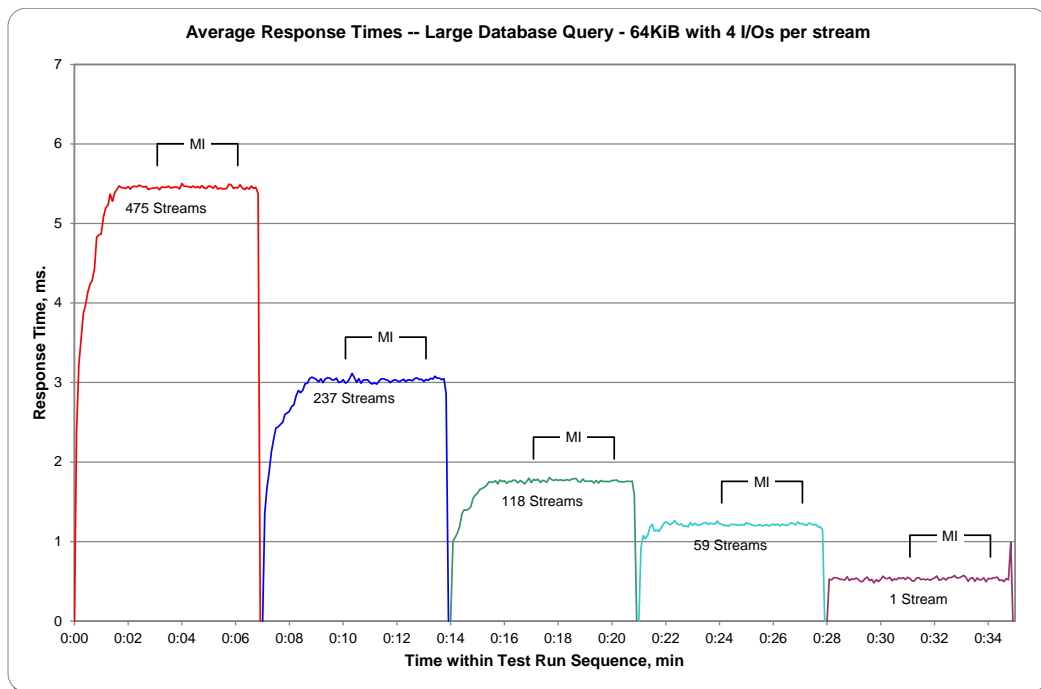
SPC-2 “Large Database Query/64 KiB Transfer Size/4 Outstanding I/Os” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large Database Query/64 KiB Transfer Size/4 Outstanding I/Os” Average Data Rate per Stream Graph



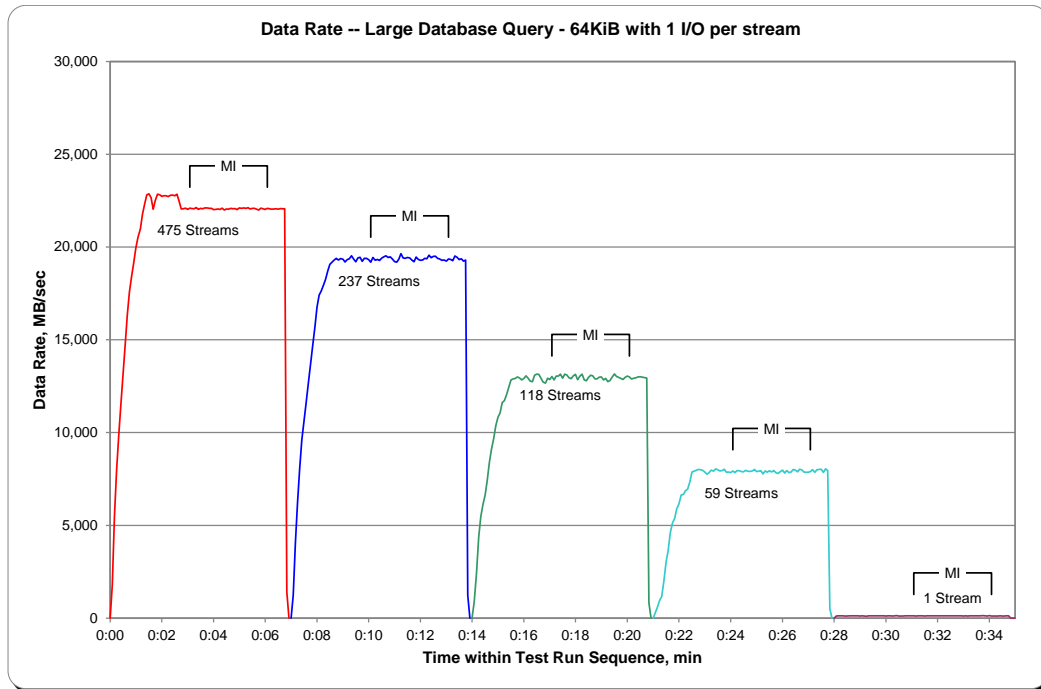
SPC-2 “Large Database Query/64 KiB Transfer Size/4 Outstanding I/Os” Average Response Time Graph



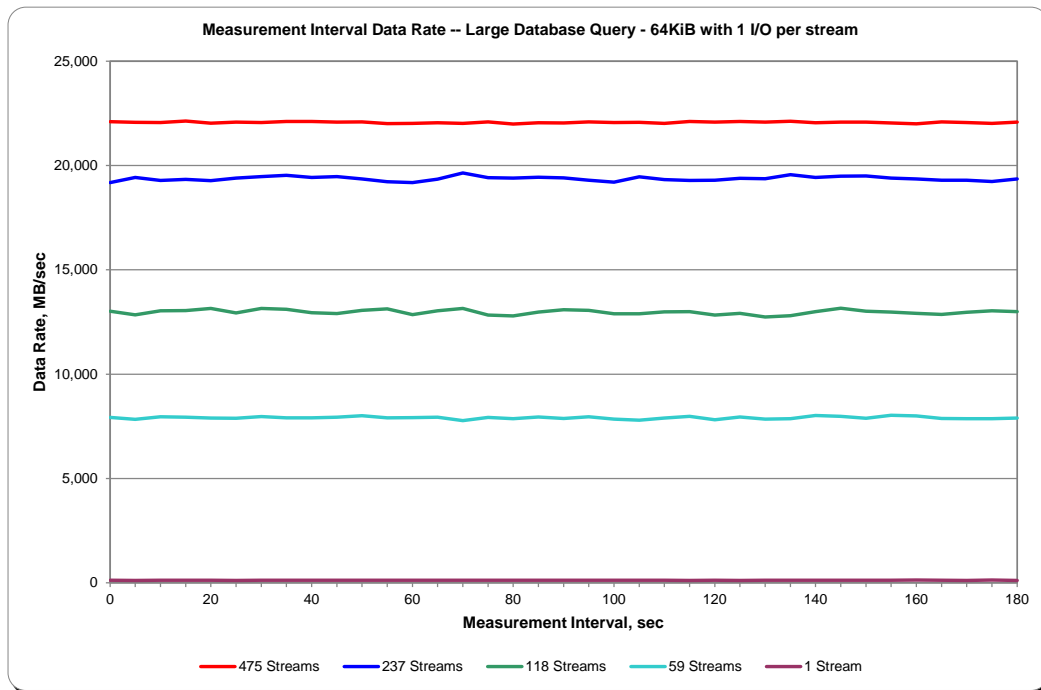
SPC-2 “Large Database Query/64 KiB Transfer Size/1 Outstanding I/O” Test Run Data
Measurement Interval, Run-Out, and Ramp-Down Period

Table with columns for TR16 (475 Streams), TR17 (237 Streams), TR18 (118 Streams), TR19 (59 Streams), TR20 (1 Stream). Each TR column contains sub-columns for Test Run Sequence Time, Data Rate, Data Rate / Stream, and Response Time, with corresponding values for various sequence times.

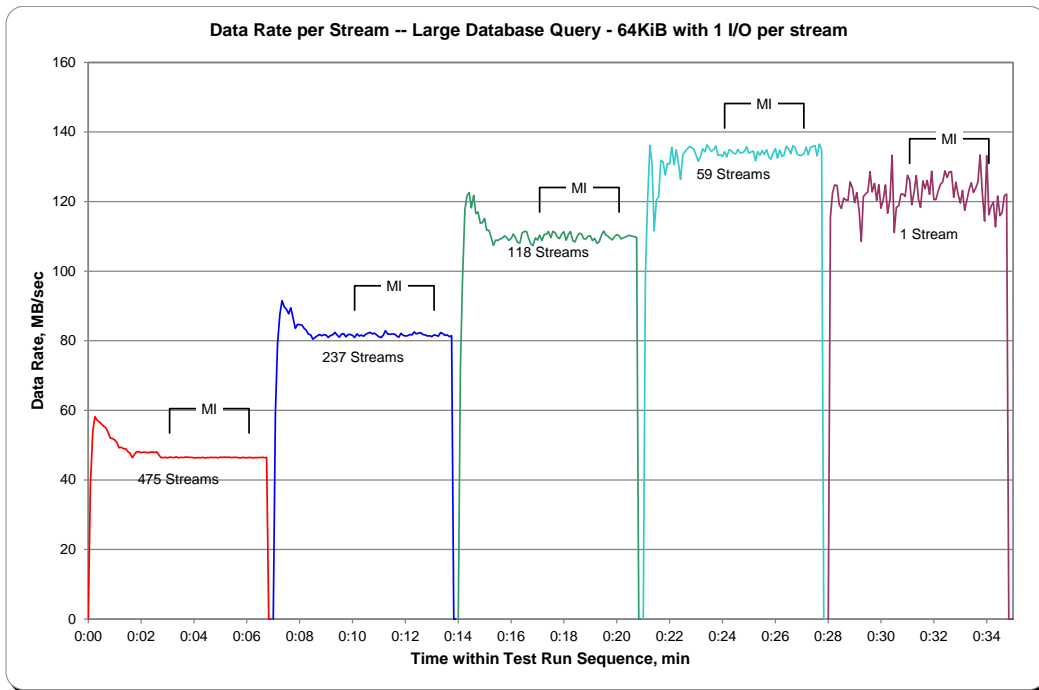
SPC-2 “Large Database Query/64 KiB Transfer Size/1 Outstanding I/O” Average Data Rate Graph – Complete Test Run



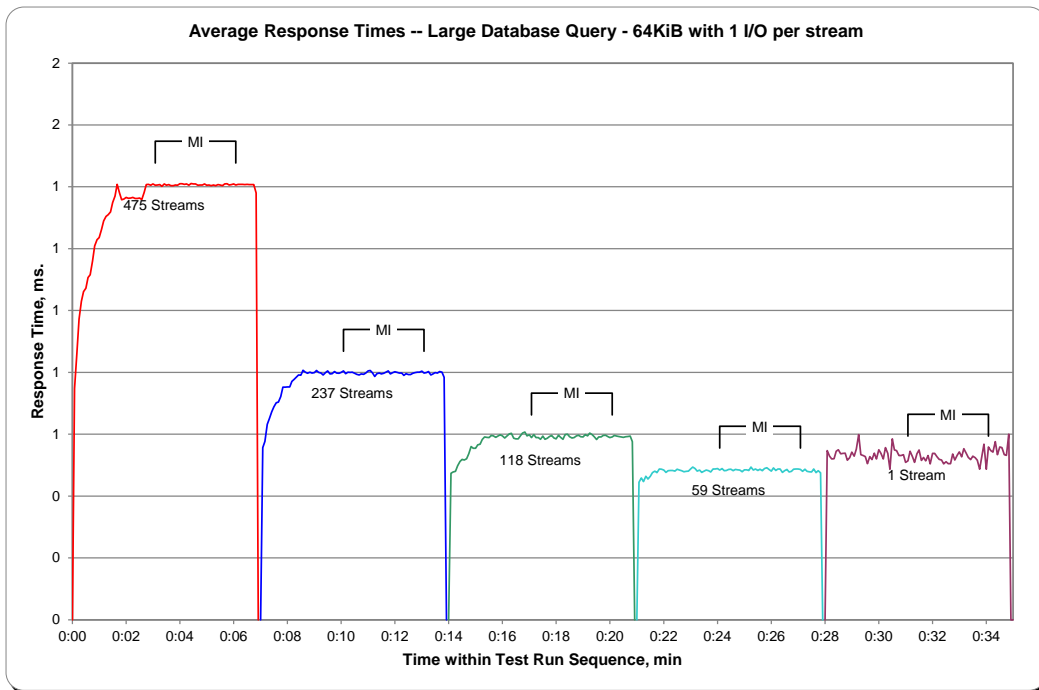
SPC-2 “Large Database Query/64 KiB Transfer Size/1 Outstanding I/O” Average Data Rate Graph – Measurement Interval (MI) Only



SPC-2 “Large Database Query/64 KiB Transfer Size/1 Outstanding I/O” Average Data Rate per Stream Graph



SPC-2 “Large Database Query/64 KiB Transfer Size/1 Outstanding I/O” Average Response Time Graph



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 120.

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.

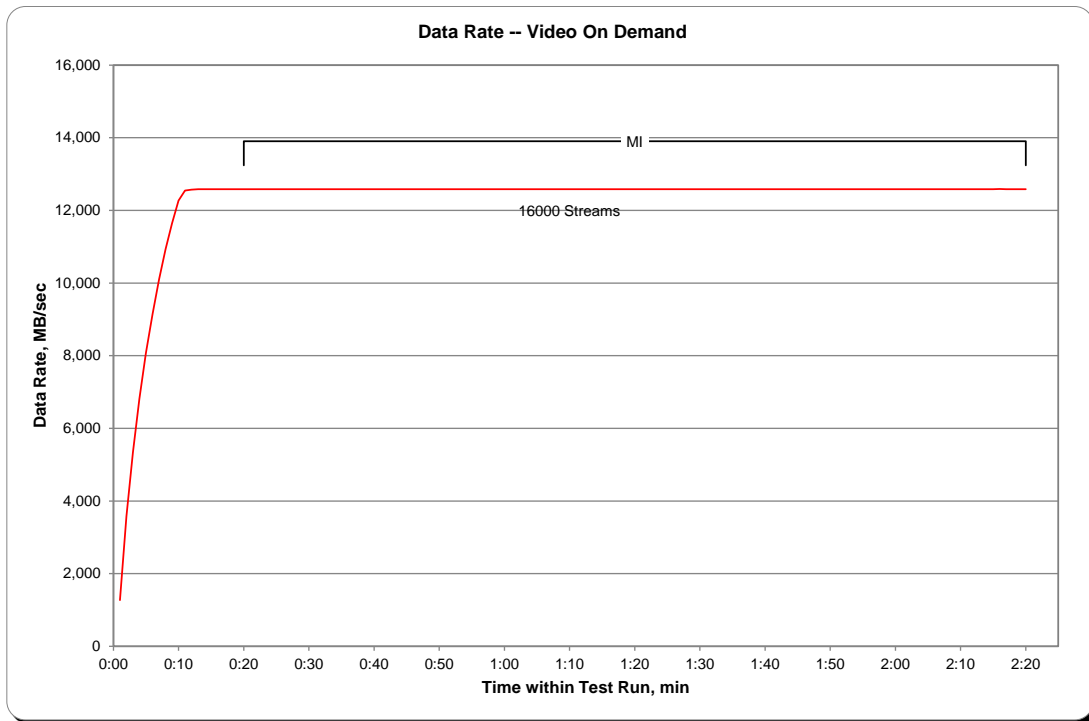
[SPC-2 Video on Demand Delivery Test Results File](#)

SPC-2 Video on Demand Delivery Test Run Data

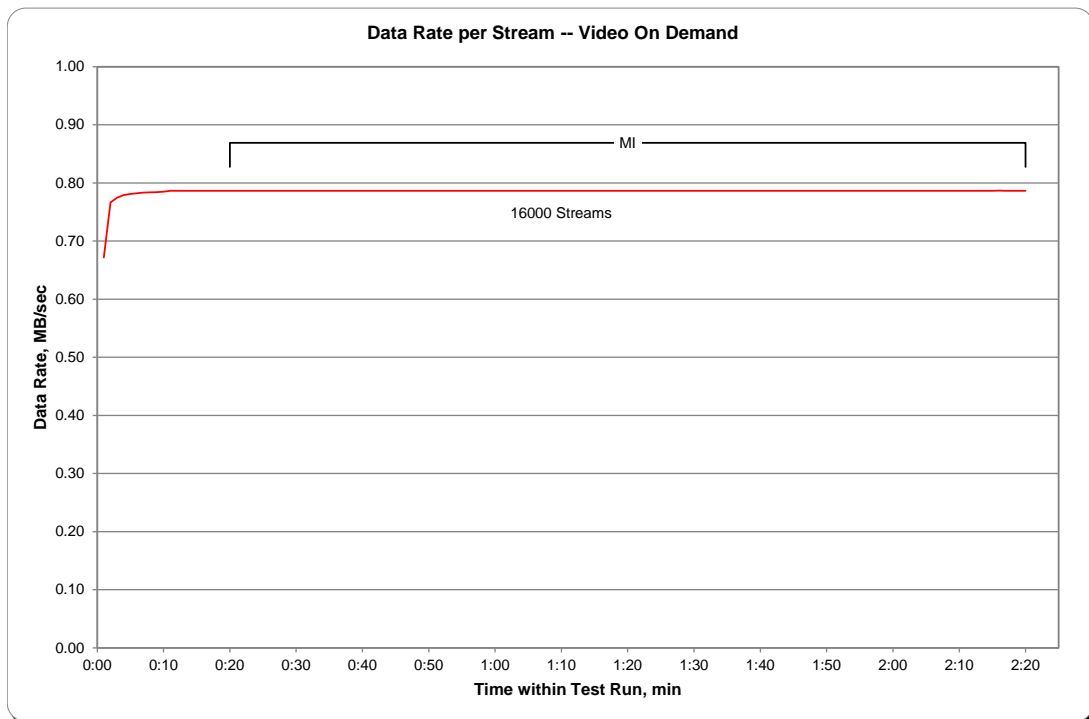
The number of Streams specified, Ramp-Up duration in seconds, Measurement Interval duration in seconds, average Data Rate for the Measurement Interval, and average Data Rate per Stream for the Measurement Interval are listed in the following table.

SPC-2-VOD	TR1
Number of Streams	16000
Ramp-up Time, sec	1200
Measurement Interval, sec	7200
Average Data Rate, MB/sec	12,582.81
Per Stream Data Rate, MB/sec	0.79
Average Response Time, ms	30.98
Average Max Response Time, ms	706.42

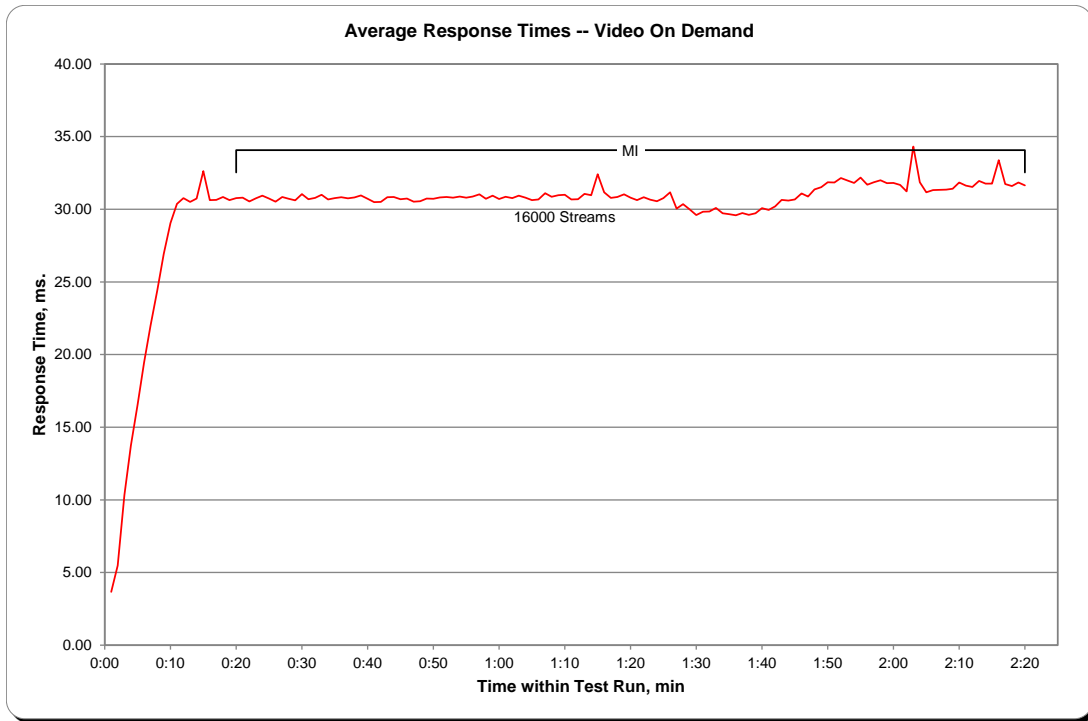
SPC-2 Video on Demand Delivery Average Data Rate Graph



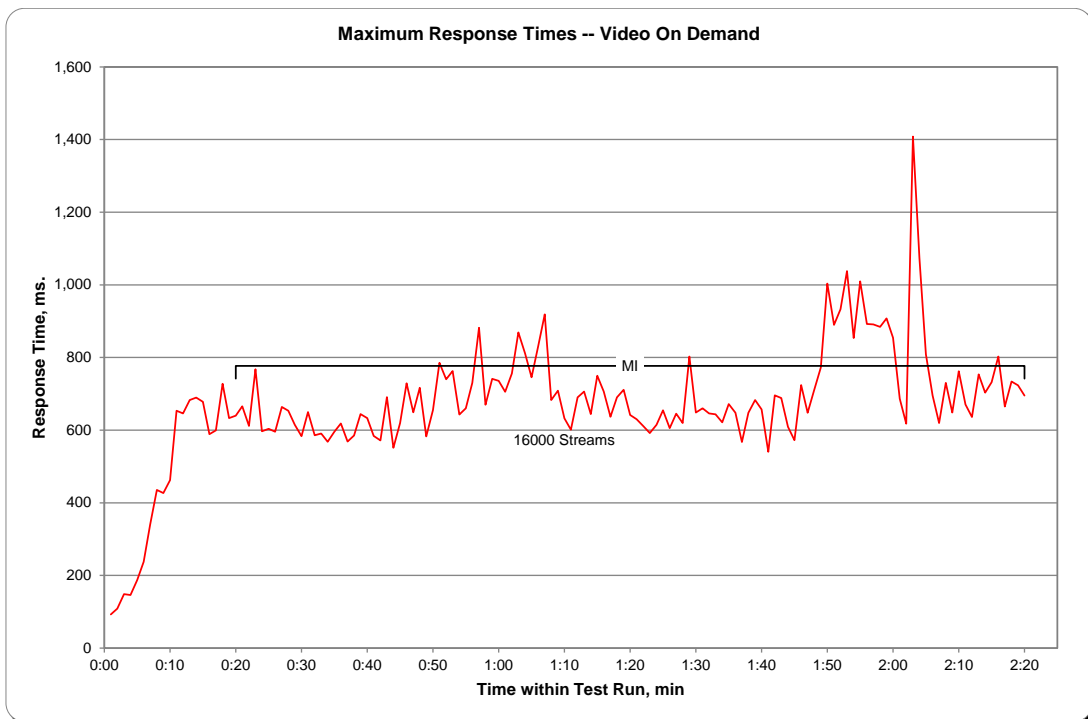
SPC-2 Video on Demand Delivery Average Data Rate per Stream Graph



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 120.

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 Results File](#)

[Persistence 2 Test Run Results File](#)

Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Number: 1	
Total Number of Logical Blocks Written	916,968
Total Number of Logical Blocks Re-referenced	6,137
Total Number of Logical Blocks Verified	910,831
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 DX8700 S2, 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 Remote Audit of the Fujitsu Storage Systems ETERNUS DX8700 S2.

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 gibibyte (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:

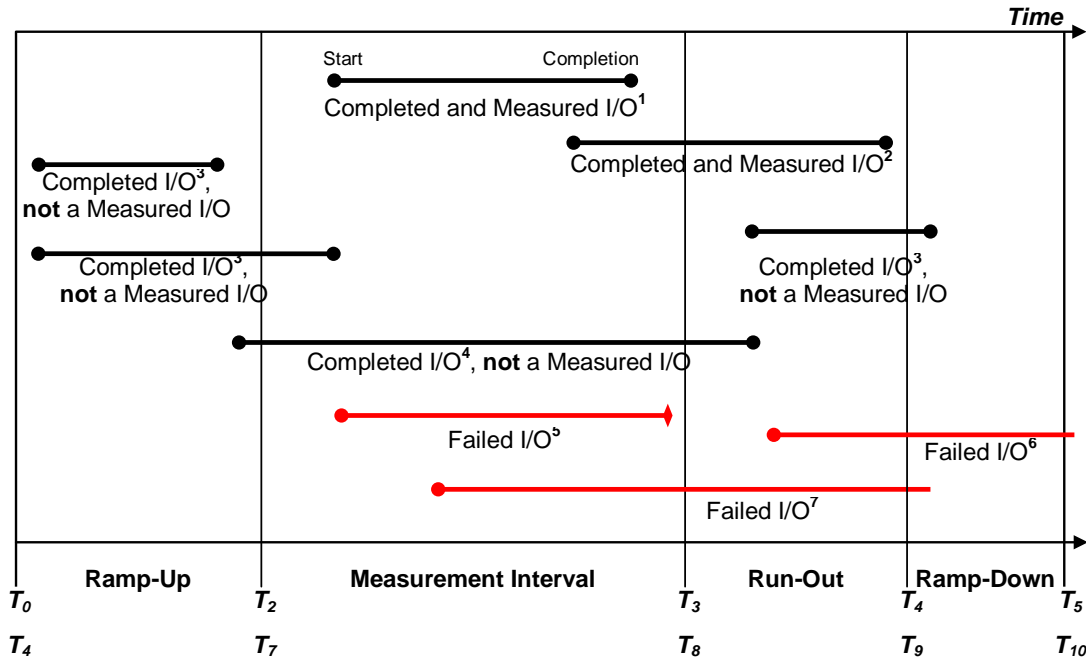
- Test Run 1: Maximum number of Streams, which is selected by the Test Sponsor
- Test Run 2: 50% of the maximum number of Streams used in Test Run 1.
- Test Run 3: 25% of the maximum number of Streams used in Test Run 1.
- Test Run 4: 12.5% of the maximum number of Streams used in Test Run 1.
- Test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

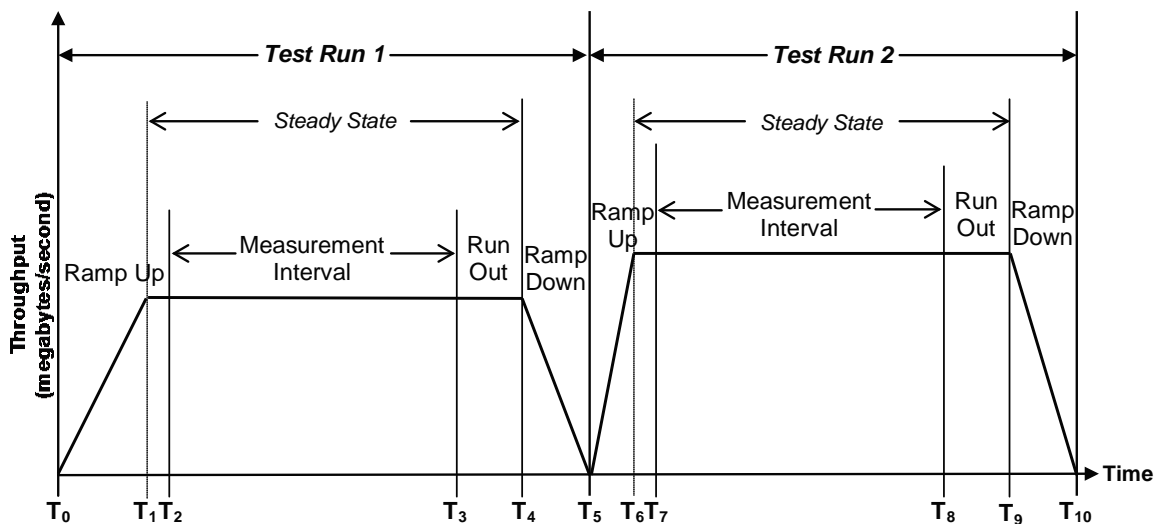
Transfer Size: The Transfer Size parameter specifies the number of bytes in KiB to transfer. (*Clause 3.4.7 of the SPC-2 Benchmark Specification*)

I/O Completion Types



- Completed and Measured I/O¹:** I/O started and completed within the Measurement Interval.
- Completed and Measured I/O²:** I/O started within the Measurement Interval and completed within Ramp Down.
- Completed I/O³:** I/O started before or after the Measurement Interval – not measured.
- Completed I/O⁴:** I/O started before and completed after the Measurement Interval – not measured.
- Failed I/O⁵:** Signaled as failed by System Software.
- Failed I/O⁶:** I/O did not complete prior to the end of Ramp-Down.
- Failed I/O⁷:** I/O did not complete prior to the end of Run-Out.

SPC-2 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

There were no customer tunable parameters or options changed from their default values for the SPC-2 benchmark measurements.

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

In preparation for the benchmark a planning workbook was prepared [DX8700s2 Conf Plan.xlsx](#). There is a README within the workbook that provides additional details on the planning sections. In the plan for the SPC-2 benchmark, there were 95 RAID10 (4+4) groups identified as groups of 8 drives, with each group assigned a name. A single Logical Volume was defined within each group for use in the benchmark. A portion of a worksheet was used to define the mapping of the Logical Volumes to Host Interface Channel Adapter ports on each of the six Control Modules used in the storage array.

From this planning information, a standard Fujitsu Command Line tool (CLI) script was defined, using the [cygwin](#) packages **expect** and **openssh**. That script, [DX8700s2 Configuration.exp](#), was executed on the Master Host System.

The script included the **docli** procedure, which 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 following documents the steps to create the SPC-2 Tested Storage Configuration. Steps 1-4 document the details of the script. Step 5 documents the switch configuration details.

Step 1 – Creation of RAID Groups

A total of 95 RAID Groups were created, per the plan. Each RAID Group was made up of 8 disk drives in a RAID10 (4+4) configuration, and assigned to a specific Controller Module (CM) and CPU within the CM for operational control. The RAID Groups were named RG10-0 through RG10-94.

Step 2 – Creation of the Logical Volumes

Within each of the RAID Groups, one Logical Volume was created with a size of 700 GiB, per the plan. The names, RG10-V#0 through RG10-#V94, were assigned to the volumes as part of their creation.

Step 3 – Creation of the Global Hot Spares

Two drives were designated as Global Hot Spare drives in slot 20 of DE-E8 and DE-F8, per the configuration plan.

Step 4 – Assignment of LUN Mapping for Host Access

First, any existing port LUN mapping was released to start from a clean unmapped configuration. Then port LUN mapping was assigned, using the configuration plan – three ports for each set of LUNs. Eleven of the twelve sets of LUNs have LUNs0-7, and one set has LUNs0-6, defined. There are three of four ports used on each of two Channel Adapters (CAs) on each of the six Control Modules (CMs) within the ETERNUS DX8700 S2 storage array, for a total of 36 ports on the array. Each of the CA ports is attached to a port on the Brocade 5300 Fabric Switch to enable connection from the Host Server HBA ports.

Step 5 – Assignment of Zoning with the Fabric Switch

The configuration plan includes specific definitions for 36 zones providing specific connections within the fabric switch between the Host HBA ports and the Storage CA ports. Each Host HBA port is provided connection to three different CA ports on different CMs. Each of the Host HBA ports has connection through the Fabric Switch to 24 Logical Volumes (LVs), except for one that only accesses 23 LVs, providing connection to all of the 95 LVs defined in the array. $(3 \times 24 = 72) + 23 = 95$

The standard GUI was used to set up the zoning within the Brocade 5300 Fabric Switch, and the **zoneshow.txt** report confirms the implemented zones match up with the plan.

There is a second crosscheck on the zoning and LV addressing within each host, using the QLogic **scli** command to show the assigned LUN details for each port on the HBAs. This tool provides the size and LV number for each of the LUNs seen by each of the HBA ports. These map back to the details on the configuration plan, and are detailed on worksheet **Host-Links** in the [DX8700s2 Conf Plan.xlsx](#) workbook.

DX8700s2_Configuration.exp

```
#!/usr/bin/expect
# script to setup initial configuration for dx8700s2
# for SPC-2 benchmark
set timeout 600
set user root
set password root
spawn ssh 10.21.151.180 -l $user
expect "password:"
send "$password\r"
expect "CLI>"
# procedure to execute dx8700s2 cli command
proc docli { cmd args } {
send "$cmd $args\r"
expect "CLI>"
}
# procedure to exit
proc doexit {} {
send "exit \r"
}

#DX8700 S2 R10(4+4) SPC-2 Plan

#Create raid-groups
docli create raid-group -name R10-0 -disks 0000-0003,1000-1003 -level 10 -assigned-
cm cm0cpul
docli create raid-group -name R10-1 -disks 0004-0007,1004-1007 -level 10 -assigned-
cm cm1cpul
docli create raid-group -name R10-2 -disks 0008-0011,1008-1011 -level 10 -assigned-
cm cm2cpul
docli create raid-group -name R10-3 -disks 0012-0015,1012-1015 -level 10 -assigned-
cm cm3cpul
docli create raid-group -name R10-4 -disks 0016-0019,1016-1019 -level 10 -assigned-
cm cm4cpul
docli create raid-group -name R10-5 -disks 0020-0023,1020-1023 -level 10 -assigned-
cm cm5cpul
docli create raid-group -name R10-6 -disks 2000-2003,3000-3003 -level 10 -assigned-
cm cm0cpu0
docli create raid-group -name R10-7 -disks 2004-2007,3004-3007 -level 10 -assigned-
cm cm1cpu0
```

```
docli create raid-group -name R10-8 -disks 2008-2011,3008-3011 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-9 -disks 2012-2015,3012-3015 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-10 -disks 2016-2019,3016-3019 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-11 -disks 2020-2023,3020-3023 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-12 -disks 4000-4003,5000-5003 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-13 -disks 4004-4007,5004-5007 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-14 -disks 4008-4011,5008-5011 -level 10 -assigned-  
cm cm2cpul  
docli create raid-group -name R10-15 -disks 4012-4015,5012-5015 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-16 -disks 4016-4019,5016-5019 -level 10 -assigned-  
cm cm4cpul  
docli create raid-group -name R10-17 -disks 4020-4023,5020-5023 -level 10 -assigned-  
cm cm5cpul  
docli create raid-group -name R10-18 -disks 6000-6003,7000-7003 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-19 -disks 6004-6007,7004-7007 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-20 -disks 6008-6011,7008-7011 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-21 -disks 6012-6015,7012-7015 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-22 -disks 6016-6019,7016-7019 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-23 -disks 6020-6023,7020-7023 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-24 -disks 8000-8003,9000-9003 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-25 -disks 8004-8007,9004-9007 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-26 -disks 8008-8011,9008-9011 -level 10 -assigned-  
cm cm2cpul  
docli create raid-group -name R10-27 -disks 8012-8015,9012-9015 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-28 -disks 8016-8019,9016-9019 -level 10 -assigned-  
cm cm4cpul  
docli create raid-group -name R10-29 -disks 8020-8023,9020-9023 -level 10 -assigned-  
cm cm5cpul  
docli create raid-group -name R10-30 -disks A000-A003,B000-B003 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-31 -disks A004-A007,B004-B007 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-32 -disks A008-A011,B008-B011 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-33 -disks A012-A015,B012-B015 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-34 -disks A016-A019,B016-B019 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-35 -disks A020-A023,B020-B023 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-36 -disks C000-C003,D000-D003 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-37 -disks C004-C007,D004-D007 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-38 -disks C008-C011,D008-D011 -level 10 -assigned-  
cm cm2cpul
```

```
docli create raid-group -name R10-39 -disks C012-C015,D012-D015 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-40 -disks C016-C019,D016-D019 -level 10 -assigned-  
cm cm4cpul  
docli create raid-group -name R10-41 -disks C020-C023,D020-D023 -level 10 -assigned-  
cm cm5cpul  
docli create raid-group -name R10-42 -disks E000-E003,F000-F003 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-43 -disks E004-E007,F004-F007 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-44 -disks E008-E011,F008-F011 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-45 -disks E012-E015,F012-F015 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-46 -disks E016-E019,F016-F019 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-47 -disks E020-E023,F020-F023 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-48 -disks 0800-0803,1800-1803 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-49 -disks 0804-0807,1804-1807 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-50 -disks 0808-0811,1808-1811 -level 10 -assigned-  
cm cm2cpul  
docli create raid-group -name R10-51 -disks 0812-0815,1812-1815 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-52 -disks 0816-0819,1816-1819 -level 10 -assigned-  
cm cm4cpul  
docli create raid-group -name R10-53 -disks 0820-0823,1820-1823 -level 10 -assigned-  
cm cm5cpul  
docli create raid-group -name R10-54 -disks 2800-2803,3800-3803 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-55 -disks 2804-2807,3804-3807 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-56 -disks 2808-2811,3808-3811 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-57 -disks 2812-2815,3812-3815 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-58 -disks 2816-2819,3816-3819 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-59 -disks 2820-2823,3820-3823 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-60 -disks 4800-4803,5800-5803 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-61 -disks 4804-4807,5804-5807 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-62 -disks 4808-4811,5808-5811 -level 10 -assigned-  
cm cm2cpul  
docli create raid-group -name R10-63 -disks 4812-4815,5812-5815 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-64 -disks 4816-4819,5816-5819 -level 10 -assigned-  
cm cm4cpul  
docli create raid-group -name R10-65 -disks 4820-4823,5820-5823 -level 10 -assigned-  
cm cm5cpul  
docli create raid-group -name R10-66 -disks 6800-6803,7800-7803 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-67 -disks 6804-6807,7804-7807 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-68 -disks 6808-6811,7808-7811 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-69 -disks 6812-6815,7812-7815 -level 10 -assigned-  
cm cm3cpu0
```



```
docli create raid-group -name R10-70 -disks 6816-6819,7816-7819 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-71 -disks 6820-6823,7820-7823 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-72 -disks 8800-8803,9800-9803 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-73 -disks 8804-8807,9804-9807 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-74 -disks 8808-8811,9808-9811 -level 10 -assigned-  
cm cm2cpul  
docli create raid-group -name R10-75 -disks 8812-8815,9812-9815 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-76 -disks 8816-8819,9816-9819 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-77 -disks 8820-8823,9820-9823 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-78 -disks A800-A803,B800-B803 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-79 -disks A804-A807,B804-B807 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-80 -disks A808-A811,B808-B811 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-81 -disks A812-A815,B812-B815 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-82 -disks A816-A819,B816-B819 -level 10 -assigned-  
cm cm4cpu0  
docli create raid-group -name R10-83 -disks A820-A823,B820-B823 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-84 -disks C800-C803,D800-D803 -level 10 -assigned-  
cm cm0cpul  
docli create raid-group -name R10-85 -disks C804-C807,D804-D807 -level 10 -assigned-  
cm cmlcpul  
docli create raid-group -name R10-86 -disks C808-C811,D808-D811 -level 10 -assigned-  
cm cm2cpul  
docli create raid-group -name R10-87 -disks C812-C815,D812-D815 -level 10 -assigned-  
cm cm3cpul  
docli create raid-group -name R10-88 -disks C816-C819,D816-D819 -level 10 -assigned-  
cm cm4cpul  
docli create raid-group -name R10-89 -disks C820-C823,D820-D823 -level 10 -assigned-  
cm cm5cpu0  
docli create raid-group -name R10-90 -disks E800-E803,F800-F803 -level 10 -assigned-  
cm cm0cpu0  
docli create raid-group -name R10-91 -disks E804-E807,F804-F807 -level 10 -assigned-  
cm cmlcpu0  
docli create raid-group -name R10-92 -disks E808-E811,F808-F811 -level 10 -assigned-  
cm cm2cpu0  
docli create raid-group -name R10-93 -disks E812-E815,F812-F815 -level 10 -assigned-  
cm cm3cpu0  
docli create raid-group -name R10-94 -disks E816-E819,F816-F819 -level 10 -assigned-  
cm cm4cpu0
```

#Create logical-volumes

```
docli create volume -name R10-V#0 -count 1 -rg-name R10-0 -type open -size 700gb  
docli create volume -name R10-V#1 -count 1 -rg-name R10-1 -type open -size 700gb  
docli create volume -name R10-V#2 -count 1 -rg-name R10-2 -type open -size 700gb  
docli create volume -name R10-V#3 -count 1 -rg-name R10-3 -type open -size 700gb  
docli create volume -name R10-V#4 -count 1 -rg-name R10-4 -type open -size 700gb  
docli create volume -name R10-V#5 -count 1 -rg-name R10-5 -type open -size 700gb  
docli create volume -name R10-V#6 -count 1 -rg-name R10-6 -type open -size 700gb  
docli create volume -name R10-V#7 -count 1 -rg-name R10-7 -type open -size 700gb  
docli create volume -name R10-V#8 -count 1 -rg-name R10-8 -type open -size 700gb  
docli create volume -name R10-V#9 -count 1 -rg-name R10-9 -type open -size 700gb  
docli create volume -name R10-V#10 -count 1 -rg-name R10-10 -type open -size 700gb
```



```
docli create volume -name R10-V#74 -count 1 -rg-name R10-74 -type open -size 700gb
docli create volume -name R10-V#75 -count 1 -rg-name R10-75 -type open -size 700gb
docli create volume -name R10-V#76 -count 1 -rg-name R10-76 -type open -size 700gb
docli create volume -name R10-V#77 -count 1 -rg-name R10-77 -type open -size 700gb
docli create volume -name R10-V#78 -count 1 -rg-name R10-78 -type open -size 700gb
docli create volume -name R10-V#79 -count 1 -rg-name R10-79 -type open -size 700gb
docli create volume -name R10-V#80 -count 1 -rg-name R10-80 -type open -size 700gb
docli create volume -name R10-V#81 -count 1 -rg-name R10-81 -type open -size 700gb
docli create volume -name R10-V#82 -count 1 -rg-name R10-82 -type open -size 700gb
docli create volume -name R10-V#83 -count 1 -rg-name R10-83 -type open -size 700gb
docli create volume -name R10-V#84 -count 1 -rg-name R10-84 -type open -size 700gb
docli create volume -name R10-V#85 -count 1 -rg-name R10-85 -type open -size 700gb
docli create volume -name R10-V#86 -count 1 -rg-name R10-86 -type open -size 700gb
docli create volume -name R10-V#87 -count 1 -rg-name R10-87 -type open -size 700gb
docli create volume -name R10-V#88 -count 1 -rg-name R10-88 -type open -size 700gb
docli create volume -name R10-V#89 -count 1 -rg-name R10-89 -type open -size 700gb
docli create volume -name R10-V#90 -count 1 -rg-name R10-90 -type open -size 700gb
docli create volume -name R10-V#91 -count 1 -rg-name R10-91 -type open -size 700gb
docli create volume -name R10-V#92 -count 1 -rg-name R10-92 -type open -size 700gb
docli create volume -name R10-V#93 -count 1 -rg-name R10-93 -type open -size 700gb
docli create volume -name R10-V#94 -count 1 -rg-name R10-94 -type open -size 700gb
```

```
#define spares
docli set global-spare -disks E820,F820
```

```
#release any previous port mapping
docli release mapping -port all
```

```
#setup Host Interface Port Mapping
```

```
docli set mapping -port 000 -volume-number 6,18,30,42,54,66,78,90 -lun 0-7
docli set mapping -port 002 -volume-number 6,18,30,42,54,66,78,90 -lun 0-7
docli set mapping -port 010 -volume-number 6,18,30,42,54,66,78,90 -lun 0-7
docli set mapping -port 003 -volume-number 0,12,24,36,48,60,72,84 -lun 0-7
docli set mapping -port 011 -volume-number 0,12,24,36,48,60,72,84 -lun 0-7
docli set mapping -port 013 -volume-number 0,12,24,36,48,60,72,84 -lun 0-7
docli set mapping -port 100 -volume-number 7,19,31,43,55,67,79,91 -lun 0-7
docli set mapping -port 102 -volume-number 7,19,31,43,55,67,79,91 -lun 0-7
docli set mapping -port 110 -volume-number 7,19,31,43,55,67,79,91 -lun 0-7
docli set mapping -port 103 -volume-number 1,13,25,37,49,61,73,85 -lun 0-7
docli set mapping -port 111 -volume-number 1,13,25,37,49,61,73,85 -lun 0-7
docli set mapping -port 113 -volume-number 1,13,25,37,49,61,73,85 -lun 0-7
docli set mapping -port 200 -volume-number 8,20,32,44,56,68,80,92 -lun 0-7
docli set mapping -port 202 -volume-number 8,20,32,44,56,68,80,92 -lun 0-7
docli set mapping -port 210 -volume-number 8,20,32,44,56,68,80,92 -lun 0-7
docli set mapping -port 203 -volume-number 2,14,26,38,50,62,74,86 -lun 0-7
docli set mapping -port 211 -volume-number 2,14,26,38,50,62,74,86 -lun 0-7
docli set mapping -port 213 -volume-number 2,14,26,38,50,62,74,86 -lun 0-7
docli set mapping -port 300 -volume-number 9,21,33,45,57,69,81,93 -lun 0-7
docli set mapping -port 302 -volume-number 9,21,33,45,57,69,81,93 -lun 0-7
docli set mapping -port 310 -volume-number 9,21,33,45,57,69,81,93 -lun 0-7
docli set mapping -port 303 -volume-number 3,15,27,39,51,63,75,87 -lun 0-7
docli set mapping -port 311 -volume-number 3,15,27,39,51,63,75,87 -lun 0-7
docli set mapping -port 313 -volume-number 3,15,27,39,51,63,75,87 -lun 0-7
docli set mapping -port 400 -volume-number 10,22,34,46,58,70,82,94 -lun 0-7
docli set mapping -port 402 -volume-number 10,22,34,46,58,70,82,94 -lun 0-7
docli set mapping -port 410 -volume-number 10,22,34,46,58,70,82,94 -lun 0-7
docli set mapping -port 403 -volume-number 4,16,28,40,52,64,76,88 -lun 0-7
docli set mapping -port 411 -volume-number 4,16,28,40,52,64,76,88 -lun 0-7
docli set mapping -port 413 -volume-number 4,16,28,40,52,64,76,88 -lun 0-7
docli set mapping -port 500 -volume-number 11,23,35,47,59,71,83 -lun 0-6
docli set mapping -port 502 -volume-number 11,23,35,47,59,71,83 -lun 0-6
docli set mapping -port 510 -volume-number 11,23,35,47,59,71,83 -lun 0-6
docli set mapping -port 503 -volume-number 5,17,29,41,53,65,77,89 -lun 0-7
```

```
docli set mapping -port 511 -volume-number 5,17,29,41,53,65,77,89 -lun 0-7
docli set mapping -port 513 -volume-number 5,17,29,41,53,65,77,89 -lun 0-7

#exit from CLI
doexit
```

APPENDIX D: SPC-2 WORKLOAD GENERATOR STORAGE COMMANDS AND PARAMETERS

ASU Pre-Fill

```
*
* This will produce a random data pattern of the entire LBA range using LSF 32bit
* (replaced pattern=random with compratio=1 (for v5.03RC11) -
*
compratio=1
*
*
* The first SPC-1/SPC-1C Logical Volume (LUN) for ASU-1
* or the first SPC-2/SPC-2C LUN for the single SPC-2/SPC-2/C ASU
*
sd=sd1,lun=\\.\PhysicalDrive1,threads=32
sd=sd2,lun=\\.\PhysicalDrive2,threads=32
sd=sd3,lun=\\.\PhysicalDrive3,threads=32
sd=sd4,lun=\\.\PhysicalDrive4,threads=32
sd=sd5,lun=\\.\PhysicalDrive5,threads=32
sd=sd6,lun=\\.\PhysicalDrive6,threads=32
sd=sd7,lun=\\.\PhysicalDrive7,threads=32
sd=sd8,lun=\\.\PhysicalDrive8,threads=32
sd=sd9,lun=\\.\PhysicalDrive9,threads=32
sd=sd10,lun=\\.\PhysicalDrive10,threads=32
sd=sd11,lun=\\.\PhysicalDrive11,threads=32
sd=sd12,lun=\\.\PhysicalDrive12,threads=32
sd=sd13,lun=\\.\PhysicalDrive13,threads=32
sd=sd14,lun=\\.\PhysicalDrive14,threads=32
sd=sd15,lun=\\.\PhysicalDrive15,threads=32
sd=sd16,lun=\\.\PhysicalDrive16,threads=32
sd=sd17,lun=\\.\PhysicalDrive17,threads=32
sd=sd18,lun=\\.\PhysicalDrive18,threads=32
sd=sd19,lun=\\.\PhysicalDrive19,threads=32
sd=sd20,lun=\\.\PhysicalDrive20,threads=32
sd=sd21,lun=\\.\PhysicalDrive21,threads=32
sd=sd22,lun=\\.\PhysicalDrive22,threads=32
sd=sd23,lun=\\.\PhysicalDrive23,threads=32
sd=sd24,lun=\\.\PhysicalDrive24,threads=32
sd=sd25,lun=\\.\PhysicalDrive25,threads=32
sd=sd26,lun=\\.\PhysicalDrive26,threads=32
sd=sd27,lun=\\.\PhysicalDrive27,threads=32
sd=sd28,lun=\\.\PhysicalDrive28,threads=32
sd=sd29,lun=\\.\PhysicalDrive29,threads=32
sd=sd30,lun=\\.\PhysicalDrive30,threads=32
sd=sd31,lun=\\.\PhysicalDrive31,threads=32
sd=sd32,lun=\\.\PhysicalDrive32,threads=32
sd=sd33,lun=\\.\PhysicalDrive33,threads=32
sd=sd34,lun=\\.\PhysicalDrive34,threads=32
sd=sd35,lun=\\.\PhysicalDrive35,threads=32
sd=sd36,lun=\\.\PhysicalDrive36,threads=32
sd=sd37,lun=\\.\PhysicalDrive37,threads=32
sd=sd38,lun=\\.\PhysicalDrive38,threads=32
sd=sd39,lun=\\.\PhysicalDrive39,threads=32
sd=sd40,lun=\\.\PhysicalDrive40,threads=32
sd=sd41,lun=\\.\PhysicalDrive41,threads=32
sd=sd42,lun=\\.\PhysicalDrive42,threads=32
sd=sd43,lun=\\.\PhysicalDrive43,threads=32
sd=sd44,lun=\\.\PhysicalDrive44,threads=32
sd=sd45,lun=\\.\PhysicalDrive45,threads=32
```

```
sd=sd46,lun=\\.\PhysicalDrive46,threads=32
sd=sd47,lun=\\.\PhysicalDrive47,threads=32
sd=sd48,lun=\\.\PhysicalDrive48,threads=32
sd=sd49,lun=\\.\PhysicalDrive49,threads=32
sd=sd50,lun=\\.\PhysicalDrive50,threads=32
sd=sd51,lun=\\.\PhysicalDrive51,threads=32
sd=sd52,lun=\\.\PhysicalDrive52,threads=32
sd=sd53,lun=\\.\PhysicalDrive53,threads=32
sd=sd54,lun=\\.\PhysicalDrive54,threads=32
sd=sd55,lun=\\.\PhysicalDrive55,threads=32
sd=sd56,lun=\\.\PhysicalDrive56,threads=32
sd=sd57,lun=\\.\PhysicalDrive57,threads=32
sd=sd58,lun=\\.\PhysicalDrive58,threads=32
sd=sd59,lun=\\.\PhysicalDrive59,threads=32
sd=sd60,lun=\\.\PhysicalDrive60,threads=32
sd=sd61,lun=\\.\PhysicalDrive61,threads=32
sd=sd62,lun=\\.\PhysicalDrive62,threads=32
sd=sd63,lun=\\.\PhysicalDrive63,threads=32
sd=sd64,lun=\\.\PhysicalDrive64,threads=32
sd=sd65,lun=\\.\PhysicalDrive65,threads=32
sd=sd66,lun=\\.\PhysicalDrive66,threads=32
sd=sd67,lun=\\.\PhysicalDrive67,threads=32
sd=sd68,lun=\\.\PhysicalDrive68,threads=32
sd=sd69,lun=\\.\PhysicalDrive69,threads=32
sd=sd70,lun=\\.\PhysicalDrive70,threads=32
sd=sd71,lun=\\.\PhysicalDrive71,threads=32
sd=sd72,lun=\\.\PhysicalDrive72,threads=32
sd=sd73,lun=\\.\PhysicalDrive73,threads=32
sd=sd74,lun=\\.\PhysicalDrive74,threads=32
sd=sd75,lun=\\.\PhysicalDrive75,threads=32
sd=sd76,lun=\\.\PhysicalDrive76,threads=32
sd=sd77,lun=\\.\PhysicalDrive77,threads=32
sd=sd78,lun=\\.\PhysicalDrive78,threads=32
sd=sd79,lun=\\.\PhysicalDrive79,threads=32
sd=sd80,lun=\\.\PhysicalDrive80,threads=32
sd=sd81,lun=\\.\PhysicalDrive81,threads=32
sd=sd82,lun=\\.\PhysicalDrive82,threads=32
sd=sd83,lun=\\.\PhysicalDrive83,threads=32
sd=sd84,lun=\\.\PhysicalDrive84,threads=32
sd=sd85,lun=\\.\PhysicalDrive85,threads=32
sd=sd86,lun=\\.\PhysicalDrive86,threads=32
sd=sd87,lun=\\.\PhysicalDrive87,threads=32
sd=sd88,lun=\\.\PhysicalDrive88,threads=32
sd=sd89,lun=\\.\PhysicalDrive89,threads=32
sd=sd90,lun=\\.\PhysicalDrive90,threads=32
sd=sd91,lun=\\.\PhysicalDrive91,threads=32
sd=sd92,lun=\\.\PhysicalDrive92,threads=32
sd=sd93,lun=\\.\PhysicalDrive93,threads=32
sd=sd94,lun=\\.\PhysicalDrive94,threads=32
sd=sd95,lun=\\.\PhysicalDrive95,threads=32
*
* The second SPC-1/SPC-1C Logical Volume (LUN) for ASU-1
* or the second SPC-2/SPC-2C LUN for the single SPC-2/SPC-2/C ASU
*
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
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
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
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
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
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
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
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=PREPSSD,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 and LDQ

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

```
* 10.21.151.140 rxs6-1 rxs6-1.fs1.file.cs.fujitsu.co.jp
* 10.21.151.141 rxs6-2 rxs6-2.fs1.file.cs.fujitsu.co.jp
* 10.21.151.142 rxs6-3 rxs6-3.fs1.file.cs.fujitsu.co.jp
* 10.21.151.143 rxs6-4 rxs6-4.fs1.file.cs.fujitsu.co.jp
* 10.21.151.144 rxs6-5 rxs6-5.fs1.file.cs.fujitsu.co.jp
* 10.21.151.145 rxs6-6 rxs6-6.fs1.file.cs.fujitsu.co.jp
* 10.21.151.146 rxs6-7 rxs6-7.fs1.file.cs.fujitsu.co.jp
* 10.21.151.147 rxs6-8 rxs6-8.fs1.file.cs.fujitsu.co.jp
```

```
host=localhost,
jvms=4,
java=( "C:/Java64/jdk1.7.0_07/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
maxstreams=500
```

```
host=(10.21.151.141,Slave-1),
java=( "C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
shell=spc2,
jvms=4,
output=C:/spc/output/out_LDQ_Slave-1,
maxstreams=500
```

```
host=(10.21.151.142,Slave-2),
java=( "C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
shell=spc2,
jvms=4,
output=C:/spc/output/out_LDQ_Slave-2,
maxstreams=500
```

```
host=(10.21.151.143,Slave-3),
java=( "C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
shell=spc2,
jvms=4,
output=C:/spc/output/out_LDQ_Slave-3,
maxstreams=500
```

```
host=(10.21.151.144,Slave-4),
java=( "C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
shell=spc2,
jvms=4,
output=C:/spc/output/out_LDQ_Slave-4,
maxstreams=500
```

```
host=(10.21.151.145,Slave-5),
java=( "C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
shell=spc2,
jvms=4,
output=C:/spc/output/out_LDQ_Slave-5,
maxstreams=500
```

```
host=(10.21.151.146,Slave-6),
java=( "C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k" ),
shell=spc2,
jvms=4,
output=C:/spc/output/out_LDQ_Slave-6,
maxstreams=500
```

```
host=(10.21.151.147,Slave-7),  
java=("C:/Java64/bin/java.exe", "-Xmx2048m -Xms2048m -Xss104k"),  
shell=spc2,  
jvms=4,  
output=C:/spc/output/out_LDQ_Slave-7,  
maxstreams=500
```

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

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,host=localhost,size=700.00g  
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
```

Large File Processing Test (LFP)

* Large File Processing (LFP)

Common Commands/Parameters – LFP and LDQ

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

```
maxlatestart=1
reportinginterval=5
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=95
rd=TR2_SPC-2-FP,streams=47
rd=TR3_SPC-2-FP,streams=23
rd=TR4_SPC-2-FP,streams=11
rd=TR5_SPC-2-FP,streams=1
```

```
rd=default,rdpct=0,xfersize=256k
rd=TR6_SPC-2-FP,streams=95
rd=TR7_SPC-2-FP,streams=47
rd=TR8_SPC-2-FP,streams=23
rd=TR9_SPC-2-FP,streams=11
rd=TR10_SPC-2-FP,streams=1
```

* LFP, Read/Write Phase

```
rd=default,rdpct=50,xfersize=1024k
rd=TR11_SPC-2-FP,streams=190
rd=TR12_SPC-2-FP,streams=95
rd=TR13_SPC-2-FP,streams=47
rd=TR14_SPC-2-FP,streams=23
rd=TR15_SPC-2-FP,streams=1
```

```
rd=default,rdpct=50,xfersize=256k
rd=TR16_SPC-2-FP,streams=190
rd=TR17_SPC-2-FP,streams=95
rd=TR18_SPC-2-FP,streams=47
rd=TR19_SPC-2-FP,streams=23
rd=TR20_SPC-2-FP,streams=1
```

* LFP, Read Phase

```
rd=default,rdpct=100,xfersize=1024k
rd=TR21_SPC-2-FP,streams=380
rd=TR22_SPC-2-FP,streams=190
rd=TR23_SPC-2-FP,streams=95
rd=TR24_SPC-2-FP,streams=47
rd=TR25_SPC-2-FP,streams=1
```

```
rd=default,rdpct=100,xfersize=256k
rd=TR26_SPC-2-FP,streams=475
rd=TR27_SPC-2-FP,streams=237
rd=TR28_SPC-2-FP,streams=118
rd=TR29_SPC-2-FP,streams=59
rd=TR30_SPC-2-FP,streams=1
```

Large Database Query Test (LDQ)

* Large Database Query Test (LDQ)

Common Commands/Parameters – LFP and LDQ

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

```
maxlatestart=1
reportinginterval=5
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=380
rd=TR2_SPC-2-DQ,streams=190
rd=TR3_SPC-2-DQ,streams=95
rd=TR4_SPC-2-DQ,streams=47
rd=TR5_SPC-2-DQ,streams=1
```

```
rd=default,buffers=1,xfersize=1024k
rd=TR6_SPC-2-DQ,streams=380
rd=TR7_SPC-2-DQ,streams=190
rd=TR8_SPC-2-DQ,streams=95
rd=TR9_SPC-2-DQ,streams=47
rd=TR10_SPC-2-DQ,streams=1
```

* LDQ, 64KiB Phase

```
rd=default,buffers=4,xfersize=64k
rd=TR11_SPC-2-DQ,streams=475
rd=TR12_SPC-2-DQ,streams=237
rd=TR13_SPC-2-DQ,streams=118
rd=TR14_SPC-2-DQ,streams=59
rd=TR15_SPC-2-DQ,streams=1
```

```
rd=default,buffers=1,xfersize=64k
rd=TR16_SPC-2-DQ,streams=475
rd=TR17_SPC-2-DQ,streams=237
rd=TR18_SPC-2-DQ,streams=118
rd=TR19_SPC-2-DQ,streams=59
rd=TR20_SPC-2-DQ,streams=1
```

Video on Demand Delivery (VOD)

```
* Video On Demand Test (VOD)
* 10.21.151.140   rxs6-1   rxs6-1.fs1.file.cs.fujitsu.co.jp
* 10.21.151.141   rxs6-2   rxs6-2.fs1.file.cs.fujitsu.co.jp
* 10.21.151.142   rxs6-3   rxs6-3.fs1.file.cs.fujitsu.co.jp
* 10.21.151.143   rxs6-4   rxs6-4.fs1.file.cs.fujitsu.co.jp
* 10.21.151.144   rxs6-5   rxs6-5.fs1.file.cs.fujitsu.co.jp
* 10.21.151.145   rxs6-6   rxs6-6.fs1.file.cs.fujitsu.co.jp
* 10.21.151.146   rxs6-7   rxs6-7.fs1.file.cs.fujitsu.co.jp
* 10.21.151.147   rxs6-8   rxs6-8.fs1.file.cs.fujitsu.co.jp
```

```
host=localhost,
java=( "C:/Java64/jdk1.7.0_07/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
jvms=12,
maxstreams=200
```

```
*host=(10.21.151.140,Slave-1),
*java=( "C:/Java64/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
*shell=spc2,
*jvms=12,
*output=C:/spc/output/out_VOD_Slave-1,
*maxstreams=200
```

```
host=(10.21.151.141,Slave-1),
java=( "C:/Java64/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-1,
maxstreams=200
```

```
host=(10.21.151.142,Slave-2),
java=( "C:/Java64/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-2,
maxstreams=200
```

```
host=(10.21.151.143,Slave-3),
java=( "C:/Java64/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-3,
maxstreams=200
```

```
host=(10.21.151.144,Slave-4),
java=( "C:/Java64/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-4,
maxstreams=200
```

```
host=(10.21.151.145,Slave-5),
java=( "C:/Java64/bin/java.exe", "-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc" ),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-5,
maxstreams=200
```

```
host=(10.21.151.146,Slave-6),
java=("C:/Java64/bin/java.exe",-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-6,
maxstreams=200
```

```
host=(10.21.151.147,Slave-7),
java=("C:/Java64/bin/java.exe",-d64 -Xmx4096m -Xms256m -Xss104k -Xincgc),
shell=spc2,
jvms=12,
output=C:/spc/output/out_VOD_Slave-7,
maxstreams=200
```

[Common Commands/Parameters – LFP, LDQ, VOD and Persistence](#)

```
maxlatestart=10
reportinginterval=5
maxlatevod=0
videosegmentduration=1200
```

```
rd=default,rampup=1200,periods=600,measurement=7200,runout=45,rampdown=15,buffers=8
```

```
rd=TR1_SPC-2-VOD,streams=16000
```

Persistence Test Run 1 (write phase)

```
* Persistence Test - Write Phase
host=localhost,jvms=4,java=("C:/Java64/jdk1.7.0_07/bin/java.exe",-d64 -Xmx2048m -
Xms2048m -Xss104k")
```

[Common Commands/Parameters – LFP, LDQ, VOD and Persistence](#)

```
maxlatestart=1
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=95
```

Persistence Test Run 2 (read phase)

```
* Persistence Test - Read Phase
```

```
host=localhost,jvms=2,java=("C:/Java64/jdk1.7.0_07/bin/java.exe",-d64 -Xmx2048m -
Xms2048m -Xss104k")
```

[Common Commands/Parameters – LFP, LDQ, VOD and Persistence](#)

```
maxlatestart=1
reportinginterval=5
segmentlength=512m
```

```
maxpersistenceerrors=10
```

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

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

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

ASU Pre-Fill, Large File Processing Test, Large Database Query Test, Video on Demand Delivery Test, and Persistence Test Run 1

The following script was used to execute the required ASU pre-fill, Large File Processing Test, Large Database Query Test, Video on Demand Delivery Test and Persistence Test Run 1 in an uninterrupted sequence.

The script also included the appropriate commands to capture the detailed TSC profile listings required for a Remote Audit.

```
#!/usr/bin/bash
#
# Script consists of Part 1 of the SPC2 FDR job
# - Save "Before" logs
# - Prefill (10 hours)
# - LFP (3.5 hours)
# - LDQ (2.3 hours)
# - VOD (2.3 hours)
# - Persistence1 (10 minutes)
# - Power Down (notification)
#-----
# Absolute path of Work Directories
ROOT=/cygdrive/c/spc
# Main SPC2 work directory
WORK=${ROOT}/spc2_fdr
# directory for prefill step
PREFILL=${WORK}/prefill
# main directory for SPC2 benchmark pkg
SPC2=${ROOT}/spc2
SCRIPTS=${WORK}
SPCTMP=/tmp/spc2
CLASSPATH=${SPC2}
export CLASSPATH
LD_LIBRARY_PATH=${SPC2}
java=java
# create tmp directory for spc2 if it does not exist
if [ ! -d /tmp/spc2 ]; then
mkdir /tmp/spc2
fi
# confID uniquely identifies the configuration of the array
confID=DX8700s2_Conf_Plan_20120831
# obtain jobID based on the timestamp
# jobID uniquely identifies the benchmark run
jobID=J`date +%y%m%d%H%M%S`
# save confID and jobID for Part 2 use
echo $confID > /tmp/spc2/lastconfID
echo $jobID > /tmp/spc2/lastjobID
#
# Setup the Java environment variables for WORK
# setup the unique execution context(directory) for WORK job
JOBDIR=${WORK}/${jobID}
cd ${WORK}
mkdir ${JOBDIR}
CONFIG=${JOBDIR}/config
mkdir ${CONFIG}
cp ${WORK}/${confID}* ${CONFIG}
```



```
#
echo SPC2 FDR job start time `date` > /tmp/spc2/${jobID}_message.txt
echo job confID=${confID} >> /tmp/spc2/${jobID}_message.txt
echo job jobID=${jobID} >> /tmp/spc2/${jobID}_message.txt
${SCRIPTS}/sendstatus.sh "Starting FDR Job=${jobID}" ${jobID}_message.txt
# datecode for directory
date=`date +%Y%m%d`
#
# Save beforeP log
#
${SCRIPTS}/sendstatus.sh "Starting BeforeP log save Job=${jobID}"
${jobID}_message.txt
date > ${CONFIG}/Start_beforeP_Log.txt
${SCRIPTS}/exportLog.exp ${jobID}_beforeP
scp fjuser@eternity:/tmp/*${jobID}_beforeP* ${CONFIG}
date > ${CONFIG}/End_beforeP_Log.txt
${SCRIPTS}/sendstatus.sh "Completed BeforeP log save Job=${jobID}"
${jobID}_message.txt
#
# Perform Prefill operation
#
${SCRIPTS}/sendstatus.sh "Starting Prefill step for Job=${jobID}"
${jobID}_message.txt
date
#
# move to prefill context
#
cd ${PREFILL}
/cygdrive/c/Windows/System32/cmd.exe /c c:\\spc\\spc2_fdr\\prefill\\vdbench.bat -f
${confID}_prefill.txt -o ${confID}_prefill

#save the prefill job output
mkdir ${JOBDIR}/prefill
cp ${confID}_prefill.txt ${JOBDIR}/prefill
mv ${confID}_prefill ${JOBDIR}/prefill
${SCRIPTS}/sendstatus.sh "Completed Prefill step for Job=${jobID}"
${jobID}_message.txt
#
# Save beforeF log
#
cd ${WORK}
${SCRIPTS}/sendstatus.sh "Starting BeforeF log save Job=${jobID}"
${jobID}_message.txt
date > ${CONFIG}/Start_beforeF_Log.txt
${SCRIPTS}/exportLog.exp ${jobID}_beforeF
scp fjuser@eternity:/tmp/*${jobID}_beforeF* ${CONFIG}
date > ${CONFIG}/End_beforeF_Log.txt
${SCRIPTS}/sendstatus.sh "Completed BeforeF log save Job=${jobID}"
${jobID}_message.txt
#
# Start sequence of benchmark jobs
#
#copy the parameter files to work directory
cp ${WORK}/parm_doFDR*.txt ${JOBDIR}
#
# LFP job
#
cd ${JOBDIR}
#
```

```

${SCRIPTS}/sendstatus.sh "Starting LFP test step for Job=${jobID}"
${jobID}_message.txt
#runbenchmark
$java -d64 -Xmx2048m -Xms2048m -Xss104k -cp `cygpath -wp $CLASSPATH` vdbench -w SPC2
-f parm_doFDR_lfp.txt -o out_LFP_Master_init -init
#
$java -d64 -Xmx2048m -Xms2048m -Xss104k -cp `cygpath -wp $CLASSPATH` vdbench -w SPC2
-f parm_doFDR_lfp.txt -o out_LFP_Master
#Get Output File (scp:Slave1-7)
for (( i=2;i<8;i+=1 ))
do
scp -r Administrator@slave-${i}:/cygdrive/c/spc/output/out_LFP_Slave-${i} ${JOBDIR}/
done
${SCRIPTS}/sendstatus.sh "Completed LFP test step for Job=${jobID}"
${jobID}_message.txt
#
# LDQ job
#
${SCRIPTS}/sendstatus.sh "Starting LDQ test step for Job=${jobID}"
${jobID}_message.txt
# run benchmark
$java -d64 -Xmx2048m -Xms2048m -Xss104k -cp `cygpath -wp $CLASSPATH` vdbench -w SPC2
-f parm_doFDR_ldq.txt -o out_LDQ_Master
#Get Output File (scp:Slave1-8)
for (( i=2;i<8;i+=1 ))
do
scp -r Administrator@slave-${i}:/cygdrive/c/spc/output/out_LDQ_Slave-${i} ${JOBDIR}/
done
${SCRIPTS}/sendstatus.sh "Completed LDQ test step for Job=${jobID}"
${jobID}_message.txt
#
# VOD job
#
${SCRIPTS}/sendstatus.sh "Starting VOD test step for Job=${jobID}"
${jobID}_message.txt
#runbenchmark
$java -d64 -Xmx4096m -Xms254m -Xss104k -cp `cygpath -wp $CLASSPATH` vdbench -w SPC2
-f parm_doFDR_vod.txt -o out_VOD_Master
#Get Output File (scp:Slave1-8)
for (( i=2;i<8;i+=1 ))
do
scp -r Administrator@slave-${i}:/cygdrive/c/spc/output/out_VOD_Slave-${i} ${JOBDIR}/
done
${SCRIPTS}/sendstatus.sh "Completed VOD test step for Job=${jobID}"
${jobID}_message.txt
#
#Pers-Write job
#
${SCRIPTS}/sendstatus.sh "Starting Pers-W step for Job=${jobID}"
${jobID}_message.txt
$java -d64 -Xmx2048m -Xms2048m -Xss104k -cp `cygpath -wp $CLASSPATH` vdbench -w SPC2
-f parm_doFDR_pers_write.txt -o out_Pers-Write
${SCRIPTS}/sendstatus.sh "Completed Pers-W step for Job=${jobID}"
${jobID}_message.txt
${SCRIPTS}/sendstatus.sh "Phase1 complete Please Power Cycle Server and Storage
Job=${jobID}" ${jobID}_message.txt

```

Persistence Test Run 2

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

The script also included the appropriate commands to capture the detailed TSC profile listings required for a Remote Audit.

```
#!/usr/bin/bash
#
# Script consists of Part 2 of the SPC2 FDR job
#
# obtain jobID and confID saved from part 1
# check to see if previous context exists
# create tmp directory for spc2 if it does not exist
if [ ! -d /tmp/spc2 ]; then
  echo Error!
  exit
else
  confID=`cat /tmp/spc2/lastconfID`
  jobID=`cat /tmp/spc2/lastjobID`
fi

#-----
# Absolute path of Work Directories
ROOT=/cygdrive/c/spc
# Main SPC2 work directory
WORK=${ROOT}/spc2_fdr
# directory for prefill step
PREFILL=${WORK}/prefill
# main directory for SPC2 benchmark pkg
SPC2=${ROOT}/spc2
SCRIPTS=${WORK}
SPCTMP=/tmp/spc2
CLASSPATH=${SPC2}
export CLASSPATH
LD_LIBRARY_PATH=${SPC2}
java=java
#
# Setup the Java environment variables for WORK
# setup the unique execution context(directory) for WORK job
JOBDIR=${WORK}/${jobID}
CONFIG=${JOBDIR}/config
# get current date for the directory
date=`date +%Y%m%d`
cd ${JOBDIR}
#
# Run persistence 2
#
${SCRIPTS}/sendstatus.sh "Starting Pers-R step for Job=${jobID}"
${jobID}_message.txt
$java -d64 -Xmx2048m -Xms2048m -Xss104k -cp `cygpath -wp $CLASSPATH` vdbench -w SPC2
-f parm_doFDR_pers_read.txt -o out_Pers-Read
${SCRIPTS}/sendstatus.sh "Completed Pers-R step for Job=${jobID}"
${jobID}_message.txt
#
# Save after log
#
cd ${WORK}
${SCRIPTS}/sendstatus.sh "Starting After log save Job=${jobID}" ${jobID}_message.txt
date > ${CONFIG}/Start_after_Log.txt
```

```
{SCRIPTS}/exportLog.exp ${jobID}_after
scp fjuser@eternity:/tmp/*${jobID}_after* ${CONFIG}
date > ${CONFIG}/End_after_Log.txt
${SCRIPTS}/sendstatus.sh "Completed After log save Job=${jobID}"
${jobID}_message.txt
# Collect Archive
cp *.sh ${jobID} #Copy shell scripts
cp *.exp ${jobID} #Copy expect scripts
${SCRIPTS}/zipUp.sh ${confID} ${jobID}
# Send Archive to repository
${SCRIPTS}/ftpToEternity.sh SPC2_Benchmark DX8700S2 ${date} ${jobID}.zip
${SCRIPTS}/sendstatus.sh "Completed FDR. All data in Eternity
~share3/SPC2Benchmark/DX8700S2/${date} jobID=${jobID}" ${jobID}_message.txt
#clean up jobID
mv /tmp/spc2/lastconfID /tmp/spc2/lastconfID.old
mv /tmp/spc2/lastjobID /tmp/spc2/lastjobID.old
```