



ORACLE

SPC BENCHMARK 2/ENERGY™

FULL DISCLOSURE REPORT

ORACLE CORPORATION

ORACLE ZFS STORAGE ZS3-2 APPLIANCE

(2-NODE CLUSTER)

SPC-2/E™ V1.5

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AUDIT CERTIFICATION



Steven Johnson
 Oracle Corporation
 500 Eldorado Blvd.
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April 25, 2014

The SPC Benchmark 2/Energy™ Reported Data listed below for the **Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)** were produced in compliance with the SPC Benchmark 2/Energy™ V1.5 Onsite Audit requirements.

SPC Benchmark 2/Energy™ V1.5 Reported Data	
Tested Storage Product (TSP) Name:	
Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)	
Metric	Reported Result
SPC-2 MBPS™	16,212.66
ASU Capacity	24,196.836 GB
SPC-2 Price-Performance™	\$12.08
Data Protection Level	Protected 2 (Mirroring)
Total Price	\$195,915.62

Power Environment							
Average RMS Voltage: 208.64				Average Power Factor: 0.940			
	Usage Profile			Nominal			
	Hours of Use per Day			Power	Traffic	Ratio	Heat
	Heavy	Moderate	Idle	watts	MBPS	MBPS/w	BTU/hr
Low Daily Usage:	0	8	16	2850.91	5122.12	1.80	9,727.58
Medium Daily Usage:	4	14	6	3063.23	11797.08	3.85	10,452.04
High Daily Usage:	18	6	0	3209.69	16591.74	5.17	10,951.77
Composite Metrics:				3,041.27	11,170.32	3.67	
Annual Energy Use, kWh:				26,641.57			
Energy Cost, \$/kWh:				\$ 0.12	Annual Energy Cost, \$: \$ 3,196.99		

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AUDIT CERTIFICATION (CONT.)

Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)
SPC-1 Audit Certification

Page 2

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

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by physical inspection and documentation supplied by Oracle Corporation:
 - ✓ Physical Storage Capacity and requirements.
 - ✓ Configured Storage Capacity and requirements.
 - ✓ Addressable Storage Capacity and requirements.
 - ✓ Capacity of each Logical Volume and requirements.
 - ✓ Capacity of the Application Storage Unit (ASU) and requirements.
- The Application Storage Unit (ASU) Capacity was filled with random data using Vdbench 5.03 Beta prior to the execution of the SPC-2/E™ Tests.
- An appropriate diagram of the Benchmark Configuration/Tested Storage Configuration.
- Physical verification of the components to match the above diagram
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters that were changed from default values.
- The following Host System items were verified by physical inspection and documentation supplied by Oracle Corporation:
 - ✓ Required Host System configuration information.
 - ✓ The TSC boundary within the Host System.
- The following SPC-2 Workload Generator information was verified by physical inspection and documentation supplied by Oracle Corporation:
 - ✓ The presence and version number of the Workload Generator on each Host System.
 - ✓ Commands and parameters used to configure the SPC-2 Workload Generator.
- The execution of each Test, Test Phase, and Test Run was observed and found compliant with all of the requirements and constraints of Clauses 6, 7 and 12 of the SPC-2 Benchmark Specification.
- The Test Results Files and resultant Summary Results Files received from Oracle Corporation for each of the following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 6, 7 and 12 of the SPC Benchmark 2/Energy™ Specification:
 - ✓ Idle Test
 - Pre-Idle Phase
 - Idle Phase
 - Post-Idle Phase
 - ✓ Data Persistence Test
 - ✓ Large File Processing Test
 - ✓ Large Database Query Test
 - ✓ Video on Demand Delivery Test

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AUDIT CERTIFICATION (CONT.)

Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)
SPC-1 Audit Certification

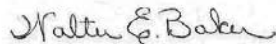
Page 3

- The Yokogawa WT500 Digital Power Meter, used to record power consumption, was verified as an SPC approved "Power Extension apparatus" with a current calibration certificate.
- All power supplies present in the Tested Storage Configuration were verified as active.
- Oracle Corporation provided documentation of the following:
 - ✓ Voltage, amperage, and phase characteristics of the AC inputs used for powering the Tested Storage Configuration.
 - ✓ The configured power supplies were configured for mutual failover.
- Concurrent power measurements were taken at each active AC input so that the total power requirement of the Tested Storage Configuration was recorded.
- The ambient temperature was recorded at the following times in near proximity to the Tested Storage configuration with a precision of at least $\pm 0.1^{\circ}\text{C}$:
 - ✓ During the first one minute of the Idle Test (*Initial Energy Extension temperature*).
 - ✓ During the last one minute of the Video on Demand Delivery Test (*Final Energy Extension temperature*).
- The Benchmark Configuration/Tested Storage Configuration diagram included the electrical metering, which illustrates the measurement apparatus used and the relationship between the active AC inputs and the associated measurement apparatus inputs.
- There were no differences between the Tested Storage Configuration and Priced Storage Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 9 of the SPC Benchmark 2/Energy™ Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clauses 10, 11 and 12 of the SPC Benchmark 2/Energy™ 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

ORACLE

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March 6, 2014
From:
Oracle Corporation
Steven A. Johnson
500 Eldorado Blvd.
Broomfield, CO 80021

To: Walter Baker
Gradient System
643 Blair Island road, Suite 103
Redwood City, CA 94063

Subject: SPC-2E Letter of Good Faith for the Oracle's Sun ZFS Storage ZS3-2

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

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

Sincerely,



Scott Tracy - Vice President



Date of Signature

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Oracle Corporation – http://www.oracle.com Steven Johnson – Steven.A.Johnson@oracle.com 500 Eldorado Blvd. Broomfield, CO 80021 Phone: (303) 272-9476
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Revision Information and Key Dates

Revision Information and Key Dates	
SPC-2 Specification revision number	V1.5
SPC-2 Workload Generator revision number	V1.2
Date Results were first used publicly	June 25, 2014
Date FDR was submitted to the SPC	June 25, 2014
Date the TSC will be available for shipment to customers	May 9, 2014
Date the TSC completed audit certification	April 25, 2014

Tested Storage Product (TSP) Description

Oracle's ZFS Storage ZS3-2 is a high-performance storage system that offers enterprise-class SAN and NAS capabilities with industry-leading Oracle Database integration, in a cost-effective high-availability configuration. The ZFS Storage ZS3-2 offers simplified set up and management combined with industry-leading storage analytics and a performance-optimized platform that uses specialized Read and Write Flash-bases SSD caching devices. The ZFS Storage ZS3-2 can scale to 512 GB Memory, 32 CPU cores, and 768 TB capacity, with up to 12.8 TB of Flash Cache in a high-availability configuration. ZFS Storage Appliances deliver additional economic value bundled data services such as file- and block-level protocols including connectivity over InfiniBand, Compression, Deduplication, Thin provisioning, DTrace Analytics, Virus Scan, Snapshots, Triple Mirror, Triple Parity RAID, Phone-home, NDMP, Clustering, etc."

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 21.

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

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

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

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

SPC-2 Reported Data (continued)

SPC-2 Reported Data				
Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)				
SPC-2 MBPS™	SPC-2 Price-Performance	ASU Capacity (GB)	Total Price	Data Protection Level
16,212.66	\$12.08	24,186.836	\$195,915.62	Protected 2 (Mirroring)
The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD)				
Currency Used:		"Target Country":		
U.S. dollars		USA		
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LFP Composite	10,810.07			\$18.12
Write Only:				
1024 KiB Transfer	7,996.97	512	15.62	
256 KiB Transfer	2,144.48	1,024	2.09	
Read-Write:				
1024 KiB Transfer	12,007.56	2,048	5.86	
256 KiB Transfer	3,574.41	1,024	3.49	
Read Only:				
1024 KiB Transfer	19,686.43	256	76.90	
256 KiB Transfer	19,450.59	1,024	18.99	
The above SPC-2 Data Rate value for LFP Composite represents the aggregate performance of all three LFP Test Phases: (Write Only, Read-Write, and Read Only).				
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LDQ Composite	18,953.80			\$10.34
1024 KiB Transfer Size				
4 I/Os Outstanding	19,867.07	256	77.61	
1 I/O Outstanding	19,847.23	256	77.53	
64 KiB Transfer Size				
4 I/Os Outstanding	18,171.34	512	35.49	
1 I/O Outstanding	17,929.58	1,024	17.51	
The above SPC-2 Data Rate value for LDQ Composite represents the aggregate performance of the two LDQ Test Phases: (1024 KiB and 64 KiB Transfer Sizes).				
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
	18,874.09	24,000	0.79	\$10.38

SPC-2/E Reported Data

The initial temperature, recorded during the first one minute of the SPC-2/E Idle Test was 73.20F. The final temperature, recorded during the last one minute of the SPC-2/E Large Database Query (LDQ) Test was 73.20F.

Power Environment

Average RMS Voltage: 208.64

Average Power Factor: 0.940

	Usage Profile			Nominal			
	Hours of Use per Day			Power watts	Traffic MBPS	Ratio MBPS/w	Heat BTU/hr
	Heavy	Moderate	Idle				
Low Daily Usage:	0	8	16	2850.91	5122.12	1.80	9,727.58
Medium Daily Usage:	4	14	6	3063.23	11797.08	3.85	10,452.04
High Daily Usage:	18	6	0	3209.69	16591.74	5.17	10,951.77
Composite Metrics:				3,041.27	11,170.32	3.67	

Annual Energy Use, kWh: 26,641.57

Energy Cost, \$/kWh: \$ 0.12

Annual Energy Cost, \$: \$ 3,196.99

HEAVY SPC-2 Workload: 3,219.55W at a data rate of 17,000.30 MB/s.

MODERATE SPC-2 Workload: 3,180.10W at a data rate of 15,366.36 MB/s.

IDLE SPC-2 Workload: 2,686.31W at data rate of zero (0).

The above usage profile describes conditions in environments that respectively impose light (**Low Daily Usage**), moderate (**Medium Daily Usage**), and extensive (**High Daily Usage**) demands on the Tested Storage Configuration (TSC). The data in this profile represents the combined results of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ) and Video on Demand Delivery (VOD).

The detailed SPC-2/E Reported Data and associated charts for each workload, including the Idle Test, are available in this document, via the hyperlinks listed below:

- [The SPC-2/E Idle Test table and associated chart](#)
- [SPC-2/E Large File Processing \(LFP\) Reported Data table and associated charts](#)
- SPC-2/E Large Database Query (LDQ) Reported Data table and associated charts
- SPC-2/E Video on Demand Delivery (VOD) Reported Data table and associated charts

The definitions, listed below, for the remaining items in the above SPC-2/E Reported Data table, are identical for the SPC-2/E Reported Data tables for each of the three individual SPC-2 workloads: LFP, LDQ and VOD.

AVERAGE RMS VOLTAGE: The average supply voltage applied to the Tested Storage Product (TSP) as measured during the Measurement Intervals of the SPC-2 Tests.

AVERAGE POWER FACTOR: The ratio of average real power, in watts, to the average apparent power, in volt-amps flowing into the Tested Storage Product (TSP) during the Measurement Intervals of the SPC-2 Tests.

NOMINAL POWER, W: The average power consumption over the course of a day (*24 hours*), taking into account hourly load variations.

NOMINAL TRAFFIC, MBPS: The average data rate over the course of a day (*24 hours*), taking into account hourly load variations.

NOMINAL MBPS/W: The overall efficiency with which the reported data rate can be supported, reflected by the ratio of **NOMINAL TRAFFIC** versus the **NOMINAL POWER**.

NOMINAL HEAT, BTU/HR: The average amount of heat required to be dissipated over the course of a day (*24 hours*), taking into account hourly load variations. (*1 watt = 3.412 BTU/hr*)

COMPOSITE METRICS: The aggregated **NOMINAL POWER**, **NOMINAL TRAFFIC**, and **NOMINAL MBPS/W** for all three environments: **LOW**, **MEDIUM**, and **HIGH DAILY USAGE**.

ANNUAL ENERGY USE, KWH: An estimate of the average energy use across the three environments over the course of a year and computed as (**NOMINAL POWER** * 24 * 0.365).

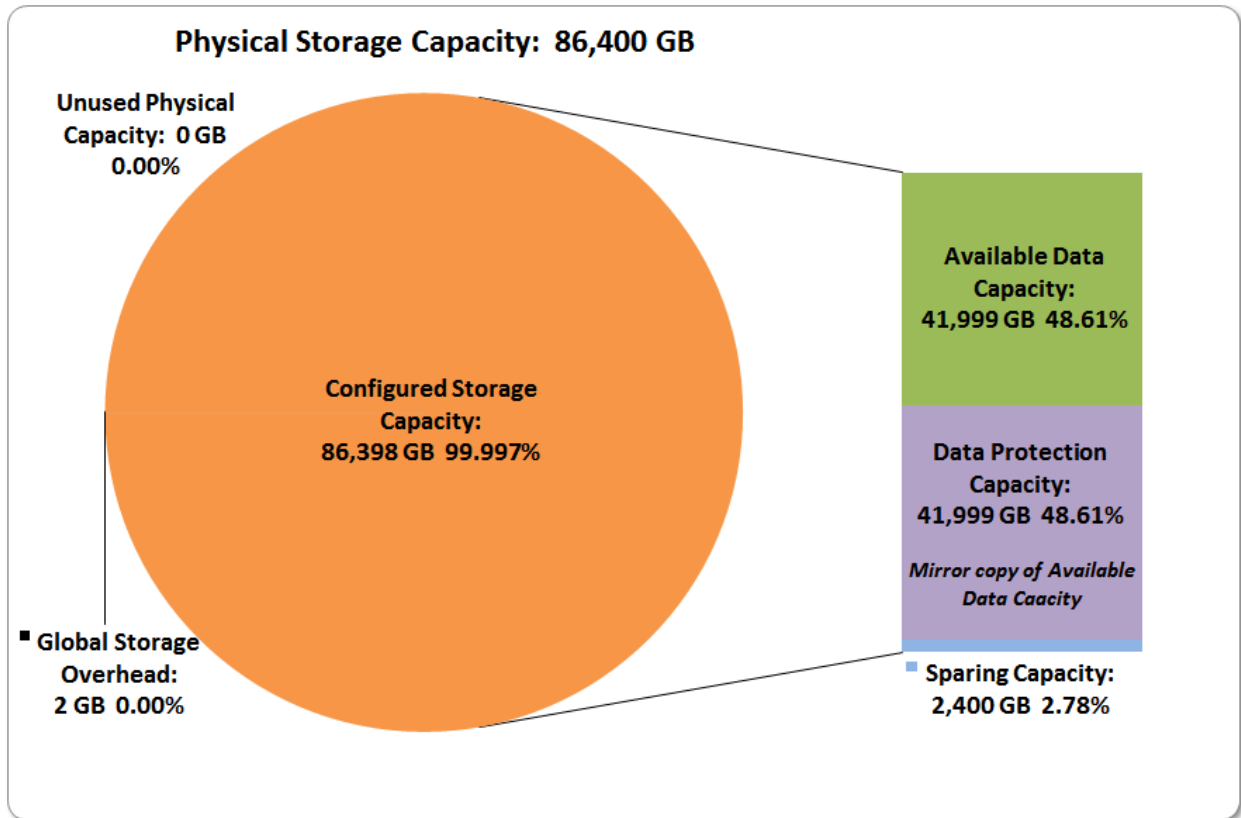
ENERGY COST, \$/KWH: A standardized energy cost per kilowatt hour.

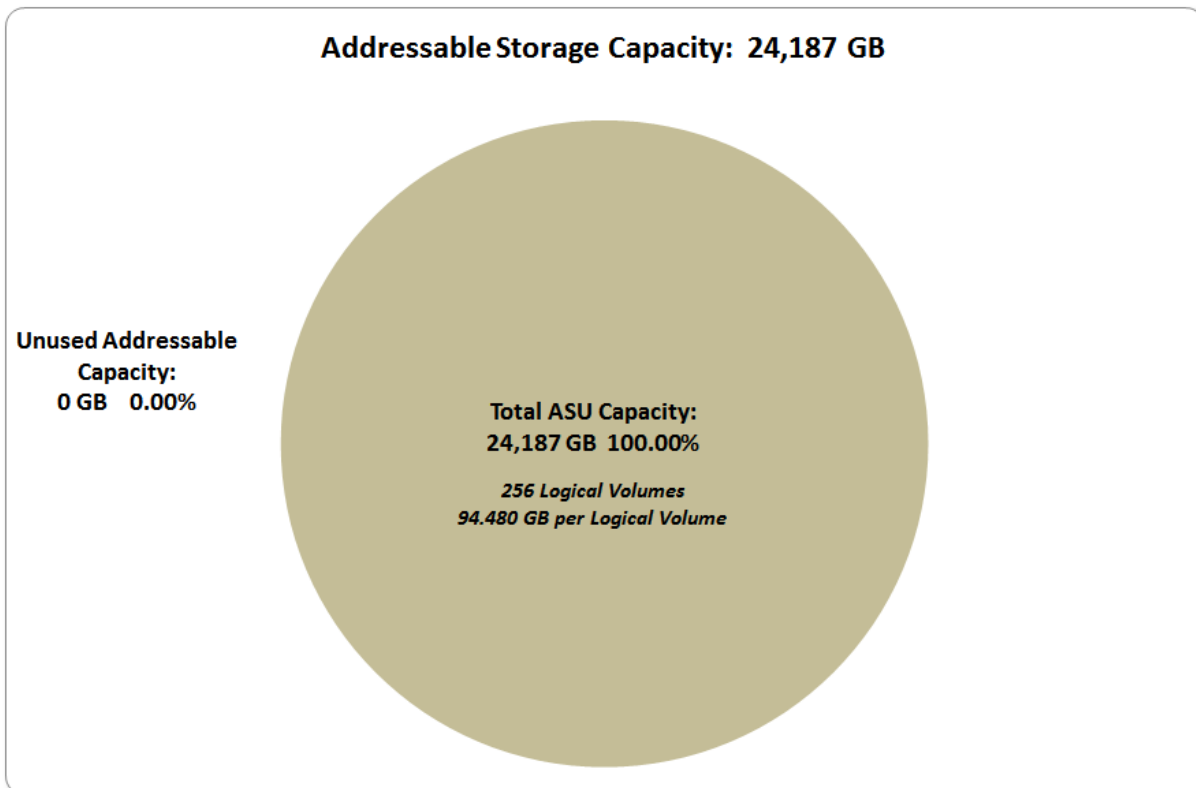
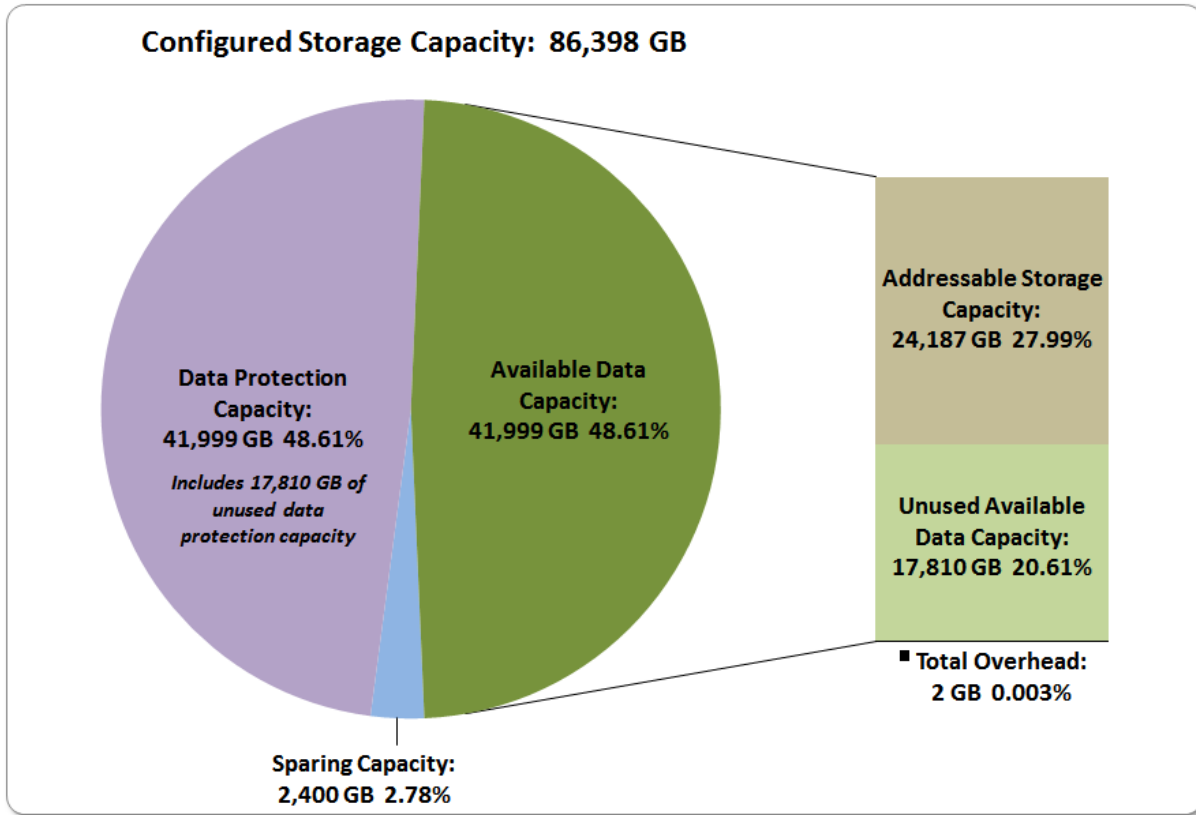
ANNUAL ENERGY COST: An estimate of the annual energy use across the three environments over the course of a year and computed as (**ANNUAL ENERGY USE** * **ENERGY COST**).

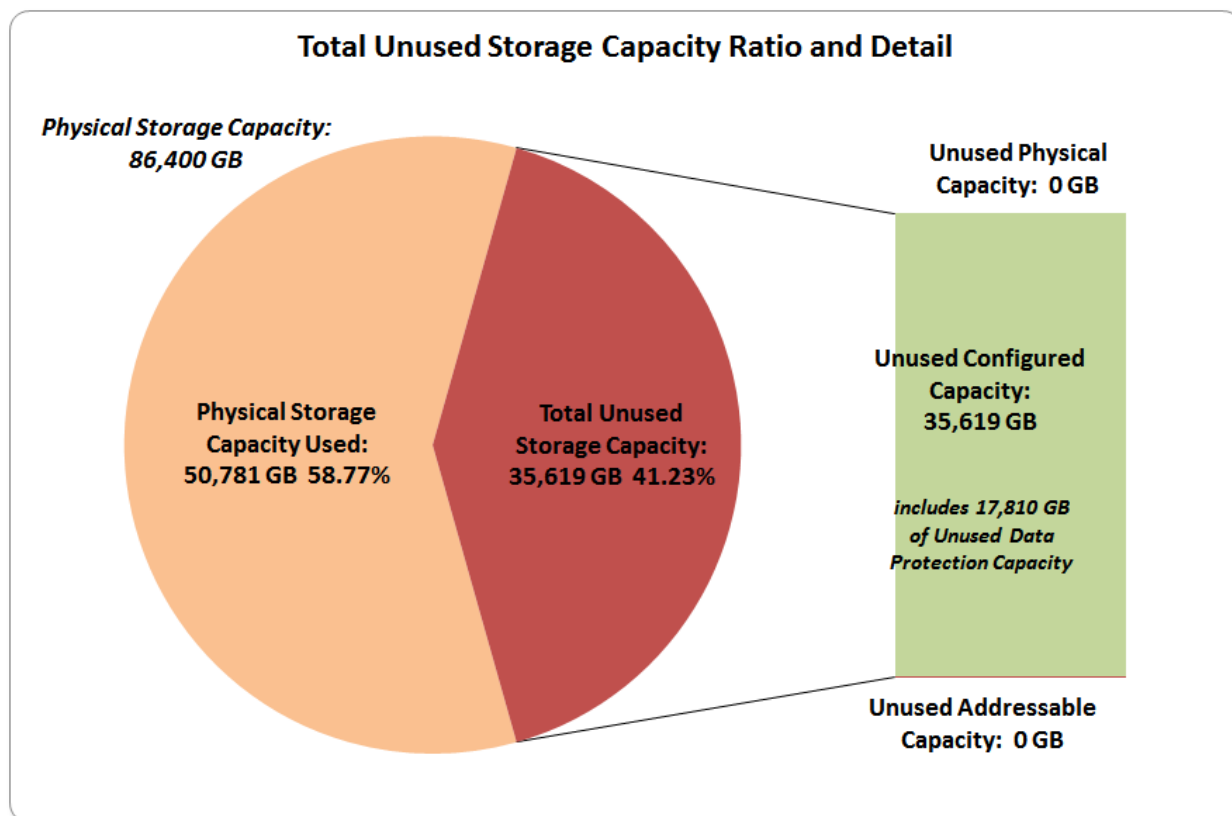
Storage Capacities, Relationships and Utilization

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

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







SPC-2 Storage Capacity Utilization	
Application Utilization	27.99%
Protected Application Utilization	55.99%
Unused Storage Ratio	41.23%

Application Utilization: Total ASU Capacity (24,186.836 GB) divided by Physical Storage Capacity (86,400.000 GB).

Protected Application Utilization: Total ASU Capacity (24,186.836 GB) plus total Data Protection Capacity (41,998.805 GB) minus unused Data Protection Capacity 17,809.549 (GB) divided by Physical Storage Capacity (86,400.000 GB).

Unused Storage Ratio: Total Unused Capacity (35,619.098 GB) divided by Physical Storage Capacity (86,400.000 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 30-31 in the Full Disclosure Report.

Priced Storage Configuration Pricing

Part Number	Description	Quantity	US List	Total List	Discount	Net Price
7103829	Oracle ZFS Storage ZS3-2: controller, includes SAS2 PCIE 16 port HBA	2	\$17,097.00	\$34,194.00	40.00%	\$20,516.40
7102984	One 16 GB DDR3-1600 registered DIMM (for factory installation)	32	\$302.00	\$9,664.00	20.00%	\$7,731.20
7103790	SAS PCIE 6Gbs 16 port (for factory installation)	2	\$1,167.00	\$2,334.00	40.00%	\$1,400.40
7104928	Cable: 3 meters, mini SAS to mini SAS HD (for factory installation)	8	\$186.00	\$1,488.00	40.00%	\$892.80
7101673	Sun Storage 16Gbs FC PCIe HBA, dual port, Qlogic	6	\$1,696.00	\$10,176.00	40.00%	\$6,105.60
7101675	Sun Storage 2x16Gbs FC optics, SR, Qlogic	6	\$960.00	\$5,760.00	40.00%	\$3,456.00
SR-JUMP-1MC13	Power cord: Sun Rack 2 jumper, 1 meter, C14RA plug, C13 connector, 13 A (for factory installation)	4	\$29.00	\$116.00	40.00%	\$69.60
7103910	Oracle Storage Drive Enclosure DE2-24P: base chassis (for factory installation)	12	\$4,071.00	\$48,852.00	40.00%	\$29,311.20
7103911	One 300 GB 10000 rpm 2.5 inch SAS-2 HDD with evo bracket (for factory installation)	288	\$345.00	\$99,360.00	40.00%	\$59,616.00
SR-JUMP-1MC13	Power cord: Sun Rack 2 jumper, 1 meter, C14RA plug, C13 connector, 13 A (for factory installation)	24	\$29.00	\$696.00	40.00%	\$417.60
SR-1242-N	Sun Rack II, 42U, 1200mm depth, 600mm width, empty shipping only (do not install product inside the rack while it is on this pallet)	1	\$2,149.00	\$2,149.00	20.00%	\$1,719.20
SR-10K-L630-N	Sun Rack II 10kVA PDU, Single Phase, 48 Supplied Amps Max, NEMA L6-30P on 4m captive cords, Data Center Two 30A NEMA L6-30R (30A breakers), 42 C13 and 6 C19 Outlets in 6 Groups, Current Metering.	1	\$900.00	\$900.00	20.00%	\$720.00
SR-JUMPKIT-N	Jumper Cable Start Up Kit: qty 10 of 1 meter C13 plugs + qty 10 of 2 meter C13 plugs + qty 2 1 meter C19 plugs + Qty 2 2meter C19 plugs	1	\$198.00	\$198.00	20.00%	\$158.40
7101674	Sun Storage 16Gbs FC PCIe HBA, dual port, Qlogic	6	\$2,035.00	\$12,210.00	40.00%	\$7,326.00
7101676	Sun Storage 2x16Gbs FC optics, SR, Qlogic	6	\$1,152.00	\$6,912.00	40.00%	\$4,147.20
X9732A-Z-N	2M LC to LC FC Optical Cable RoHS-6 compliant	12	\$65.00	\$780.00	40.00%	\$468.00
	Oracle Premium Support for Systems: 1-Year 7/24, 2 hour response time.	3		\$84,884.04		\$51,860.02
	TOTALS			\$320,673.04		\$195,915.62

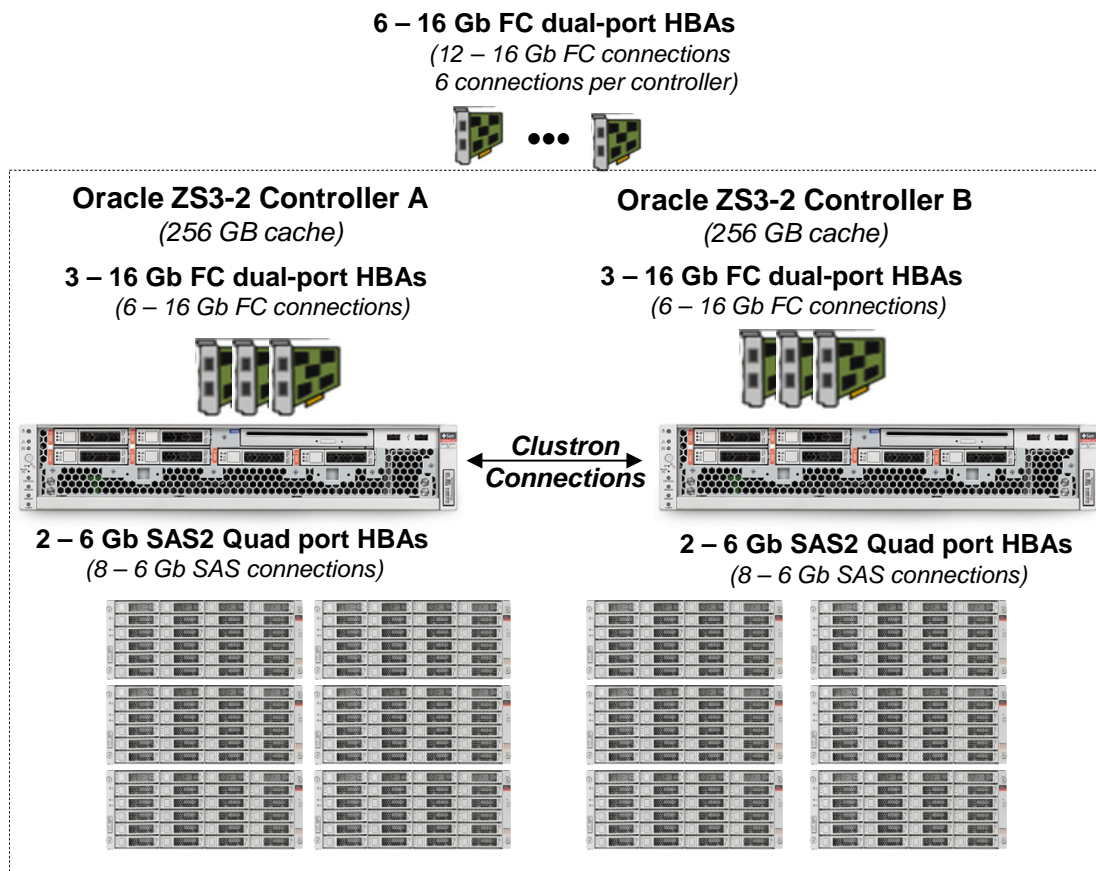
The above pricing includes the following:

- 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

The TSC was configured with two PDUs to better distribute the measurement demand on the Yokogawa power meter. The Priced Storage was configured with a single PDU, which is sufficient to power the both the TSC and Priced Storage Configuration. The use of one PDU in the TSC would have no impact on the reported performance.

Priced Storage Configuration Diagram



Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)

- 2 – Oracle ZFS ZS3-2 controllers** (cluster configuration)
(256 GB cache per controller, 512 GB total)
- 6 – 16 Gb FC dual-port HBAs** (3 HBAs per controller)
(6 – 16 Gb FC connections per controller, 12 total, 12 used)
- 4 – 6 Gb SAS 16 port HBAs** (2 HBAs per controller)
(32 – 6 Gb logical SAS connections per controller, 64 total, 64 used)
- 12 – Sun disk shelf base** (2 SAS I/O modules per base)
- 288 – 300 GB 10K RPM 2.5" SAS-2 Disk Drives**
- 1 – Sun Rack II 42U**
- 2 – Sun Rack II 10kVA PDUs**

Priced Storage Configuration Components

Priced Storage Configuration
6 – Sun Storage 16 Gbps FC PCIe dual-port HBAs with 12 – Sun Storage 16 Gbps FC optics
Oracle ZFS Storage ZS3-2 Appliance (2-node cluster) 2 – Oracle ZFS ZS3-2 controllers (<i>cluster configuration</i>) 256 GB cache/memory per controller (<i>512 GB total</i>) 6 – Sun Storage 16 Gbps FC PCIe dual-port HBAs with 12 – Sun Storage 16 Gbps FC optics (<i>3 FC HBAs and 6 FC optics per controller</i>) 6 – 16 Gb FC front-end connections per controller (<i>12 – 16 Gb FC front-end connections total, 12 used</i>) 2 – SAS PCIe 6 Gb 16 port adapters (<i>1 adapter included with each controller</i>) 4 physical SAS connections per adapter 4 logical SAS connections per physical connection 16 logical SAS connections per adapter 8 physical SAS connections per controller (<i>32 total logical connections, 32 used</i>)
2 – SAS PCIe 6 Gb 16 port adapters (<i>1 additional adapter per controller</i>) 4 physical SAS connections per adapter 4 logical SAS connections per physical connection 16 logical SAS connections per adapter 8 physical SAS connections per controller (<i>32 total logical connections, 32 connections used</i>)
12 – Sun disk shelf base each with 2 SAS I/O modules, 2 AC PSUs and 2 cooling fans
288 – 300 GB 10K RPM 2.5" SAS-2 disk drives
1 – Sun Rack II, 42U
1 – Sun Rack II 10kVA PDU, single phase, 48 supported amps max

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 [25 \(Benchmark Configuration \(BC\)/Tested Storage Configuration \(TSC\) Diagram\)](#).

Storage Network Configuration

Clause 10.6.6.1

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration described in Clause 10.6.6 contains a high-level illustration of the network configuration, the Executive Summary will contain a one page topology diagram of the storage network as illustrated in Figure 10.11.

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) was configured with local storage and, as such, did not employ a storage network.

Host System and Tested Storage Configuration Table

Clause 10.6.6.2

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

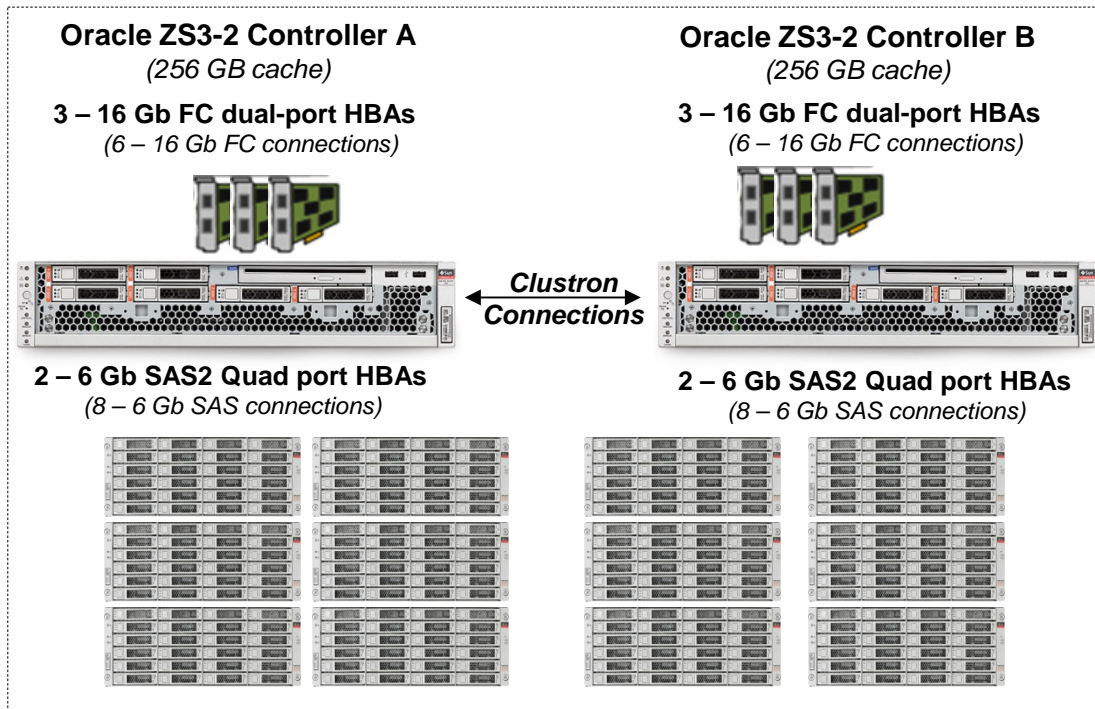
The components that comprise each Host System and the Tested Storage Configuration are listed in the table that appears on page [27 \(Host System and Tested Storage Configuration Components\)](#).

Benchmark Configuration/Tested Storage Configuration Diagram

6 – Oracle Sun Fire X4170 M2 servers



6 – 16 Gb FC dual-port HBAs
 (1 HBA per server,
 2 – 16 Gb ports per server,
 12 – 16 Gb FC ports total)



Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)

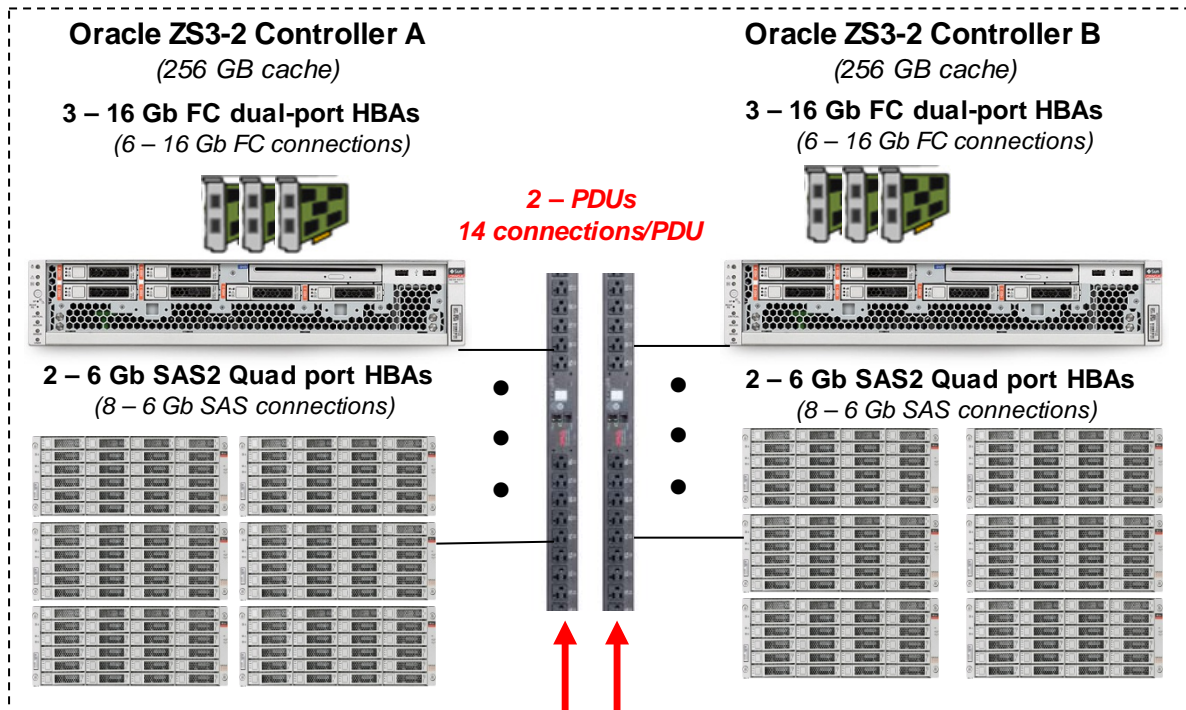
- 2 – Oracle ZFS ZS3-2 controllers** (cluster configuration)
 (256 GB cache per controller, 512 GB total)
- 6 – 16 Gb FC dual-port HBAs** (3 HBAs per controller)
 (6 – 16 Gb FC connections per controller, 12 total, 12 used)
- 4 – 6 Gb SAS 16 port HBAs** (2 HBAs per controller)
 (32 – 6 Gb logical SAS connections per controller, 64 total, 64 used)
- 12 – Sun disk shelf base** (2 SAS I/O modules per base)
- 288 – 300 GB 10K RPM 2.5” SAS-2 Disk Drives**
- 1 – Sun Rack II 42U**
- 2 – Sun Rack II 10kVA PDUs**

**Benchmark Configuration/Tested Storage Configuration Diagram
(power source, power meter, power feed)**

6 – Oracle Sun Fire X4170 M2 servers



6 – 16 Gb FC dual-port HBAs
 (1 HBA per server,
 2 – 16 Gb ports per server,
 12 – 16 Gb FC ports total)



Host System and Tested Storage Configuration Components

Host Systems
<p>6 – Oracle Sun Fire x4170 M2 servers, each with:</p> <ul style="list-style-type: none"> 2 – Intel® Xeon® X5675 3.07 Ghz processors, 32 KB instruction and 32 KB data L1 cache, 256 KB unified L2 cache, 12 MB shared inclusive L3 cache 48 GB main memory Oracle Solaris 11.2 x86 64-bit PCIe Gen2
Other BC Component
1 – Yokogawa WT500 Power Meter
Tested Storage Configuration
<p>6 – Sun Storage 16 Gbps FC PCIe dual-port HBAs with 12 – Sun Storage 16 Gbps FC optics</p>
<p>Oracle ZFS Storage ZS3-2 Appliance (2-node cluster)</p> <ul style="list-style-type: none"> 2 – Oracle ZFS ZS3-2 controllers (<i>cluster configuration</i>) 256 GB cache/memory per controller (<i>512 GB total</i>) 6 – Sun Storage 16 Gbps FC PCIe dual-port HBAs with 12 – Sun Storage 16 Gbps FC optics (<i>3 FC HBAs and 6 FC optics per controller</i>) 6 – 16 Gb FC front-end connections per controller (<i>12 – 16 Gb FC front-end connections total, 12 used</i>) 2 – SAS PCIe 6 Gb 16 port adapters (<i>1 adapter included with each controller</i>) 4 physical SAS connections per adapter 4 logical SAS connections per physical connection 16 logical SAS connections per adapter 8 physical SAS connections per controller (<i>32 total logical connections, 32 used</i>)
<ul style="list-style-type: none"> 2 – SAS PCIe 6 Gb 16 port adapters (<i>1 additional adapter per controller</i>) 4 physical SAS connections per adapter 4 logical SAS connections per physical connection 16 logical SAS connections per adapter 8 physical SAS connections per controller (<i>32 total logical connections, 32 connections used</i>)
12 – Sun disk shelf base each with 2 SAS I/O modules, 2 AC PSUs and 2 cooling fans
288 – 300 GB 10K RPM 2.5" SAS-2 disk drives
1 – Sun Rack II, 42U
2 – Sun Rack II 10kVA PDU, single phase, 48 supported amps max

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 [81](#) 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 [82](#) contains the detailed information that describes how to create and configure the logical TSC.

SPC-2 Workload Generator Storage Configuration

Clause 10.6.7.3

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

The SPC-2 Workload Generator storage configuration commands and parameters for this measurement appear in [Appendix D: SPC-2 Workload Generator Storage Commands and Parameter Files](#) on page [100](#).

ASU Pre-Fill

Clause 6.3.3

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

...

Clause 6.3.3.3

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

Clause 6.3.3.4

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

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

The configuration file used to complete the required ASU pre-fill appears in [Appendix D: SPC-2 Workload Generator Storage Commands and Parameter Files](#) on page [100](#).

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 [76](#) contains definitions of terms specific to the SPC-2 Data Repository.

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

SPC-2 Storage Capacities and Relationships

Clause 10.6.8.1

Two tables and four charts documenting the storage capacities and relationships of the SPC-2 Storage Hierarchy (Clause 2.1) shall be included in the FDR. ... The capacity value in each chart may be listed as an integer value, for readability, rather than the decimal value listed in the table below.

SPC-2 Storage Capacities

The Physical Storage Capacity consisted of 86,400.000 GB distributed over 288 disk drives each with a formatted capacity of 300.000 GB. There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 2.459 GB (0.003%) of the Physical Storage Capacity. There was 35,619.098 GB (41.23%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100.00% 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 41,998.805 GB of which 24,189.256 GB was utilized. The total Unused Storage was 35,619.098 GB.

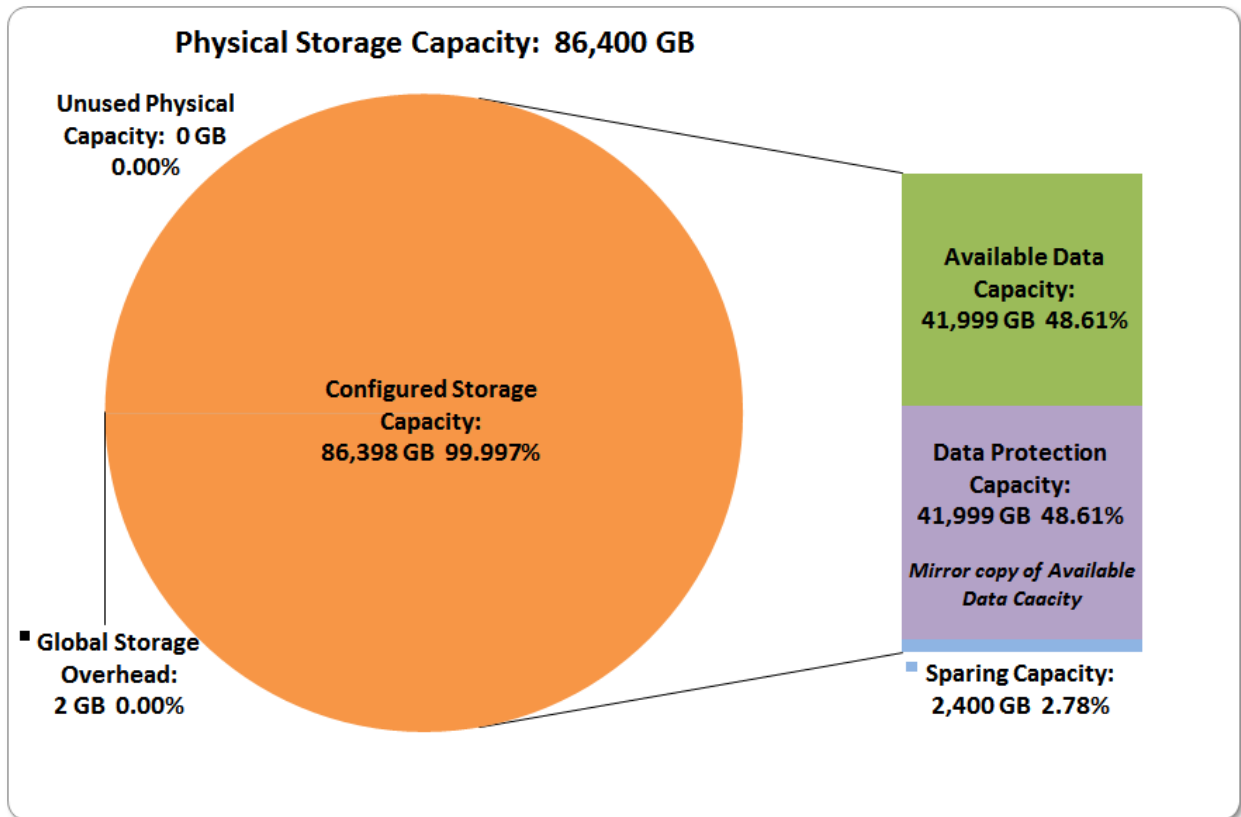
Note: The configured Storage Devices may include additional storage capacity reserved for system overhead, which is not accessible for application use. That storage capacity may not be included in the value presented for Physical Storage Capacity.

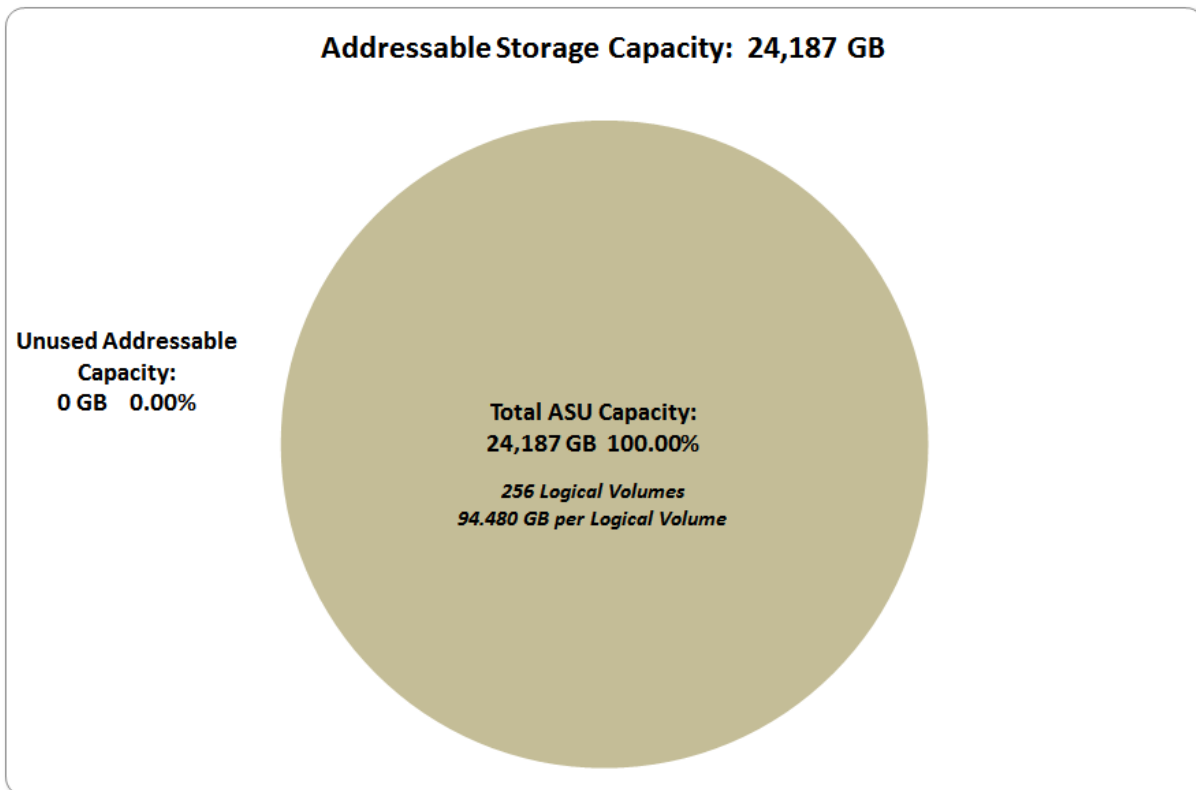
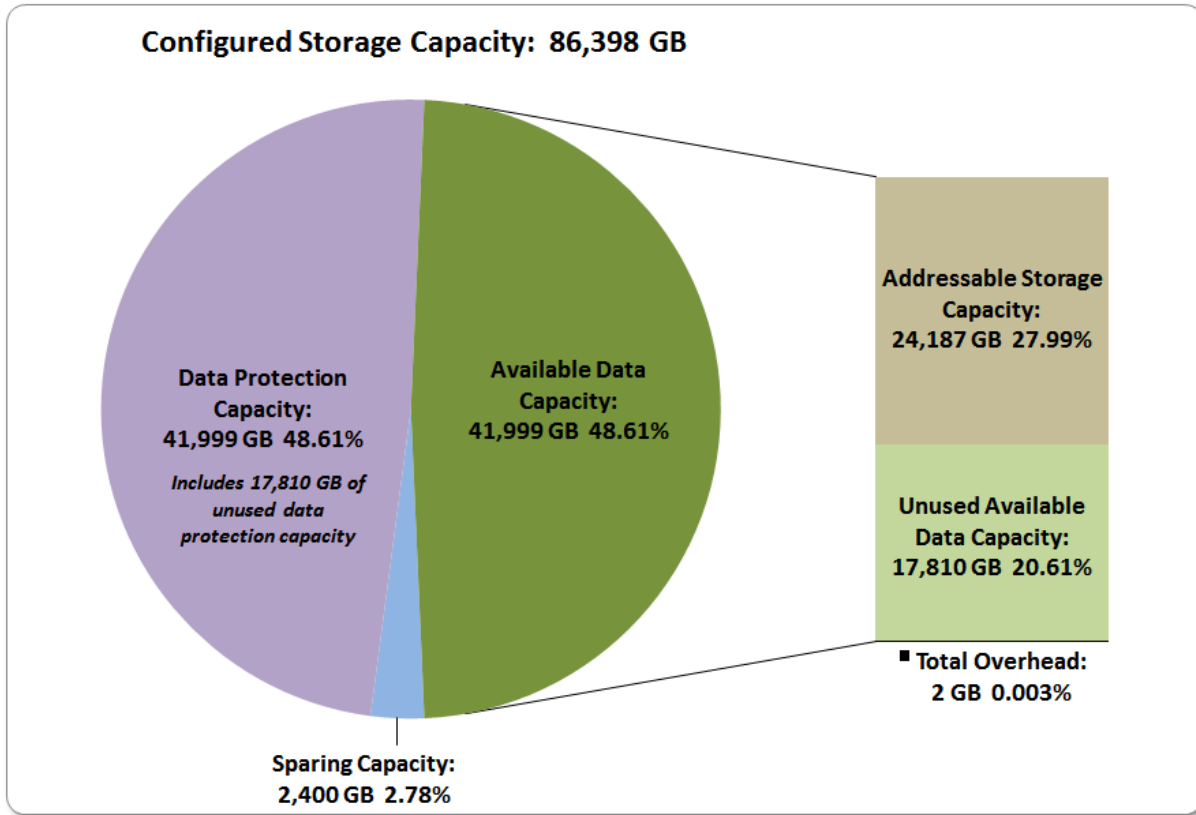
SPC-2 Storage Capacities		
Storage Hierarchy Component	Units	Capacity
Total ASU Capacity	Gigabytes (GB)	24,186.836
Addressable Storage Capacity	Gigabytes (GB)	24,186.836
Configured Storage Capacity	Gigabytes (GB)	86,397.541
Physical Storage Capacity	Gigabytes (GB)	86,400.000
Data Protection (<i>Mirroring</i>)	Gigabytes (GB)	41,998,805
Required Storage	Gigabytes (GB)	2,404.772
Global Storage Overhead	Gigabytes (GB)	2.459
Total Unused Storage	Gigabytes (GB)	35,619.098

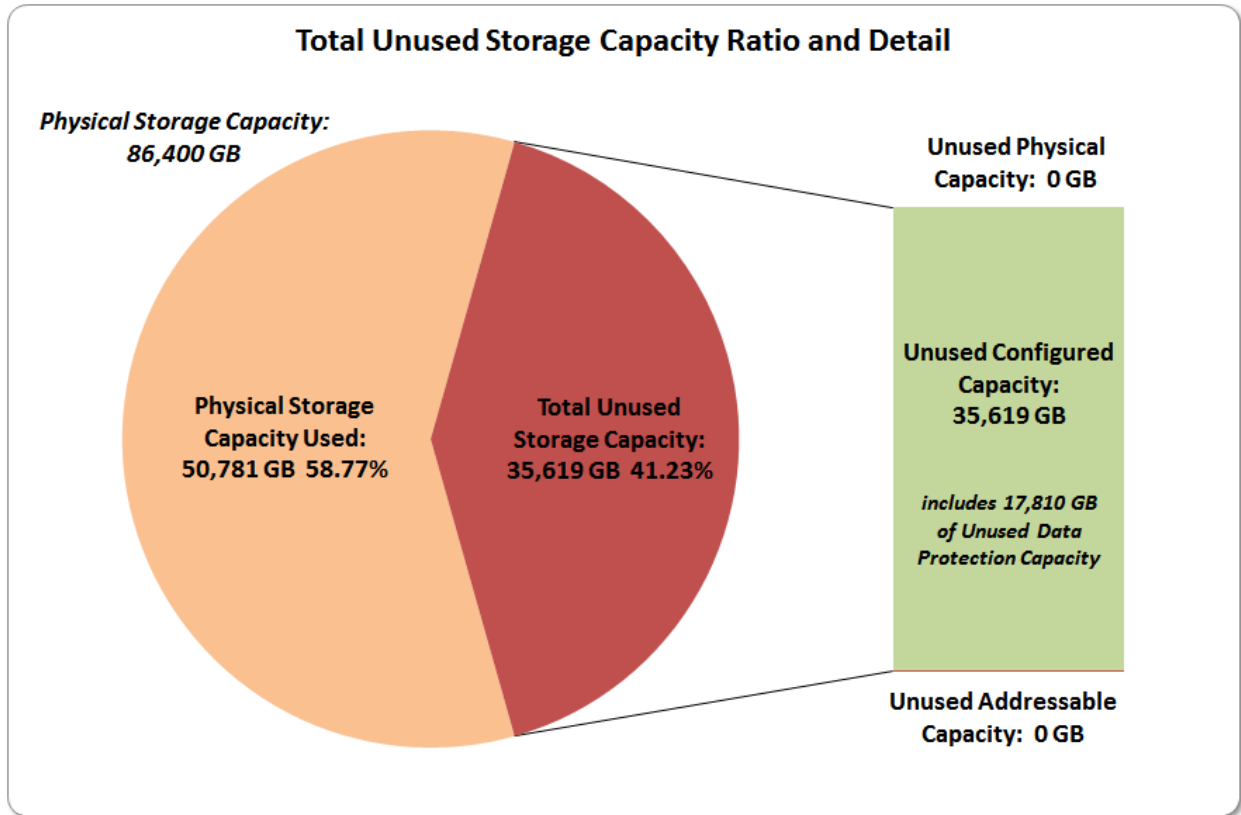
SPC-2 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	27.99%	27.99%
Data Protection (<i>mirroring</i>)		48.61%	48.61%
Addressable Storage Capacity		27.99%	27.99%
Required Storage		2.78%	2.78%
Configured Storage Capacity			99.997%
Global Storage Overhead			0.003%
Unused Storage:			
Addressable	0.00%		
Configured		41.23%	
Physical			0.00%

SPC-1 Storage Capacity Charts







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	27.99%
Protected Application Utilization	55.99%
Unused Storage Ratio	41.23%

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 (GB)			
	Total Capacity (GB)	Capacity Used (GB)	Capacity Unused (GB)
256 Logical Volumes	94.480 per LV	94.480 per LV	0.000 per LV

See the Storage Definition (sd) entries in [Appendix D: SPC-2 Workload Generator Storage Commands and Parameter Files](#) on page [100](#) for more detailed configuration information.

SPC-2 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-2 Tests, Test Phases, Test Run Sequences, and Test Runs. An [SPC-2 glossary](#) on page [66](#) 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 [133](#).

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.

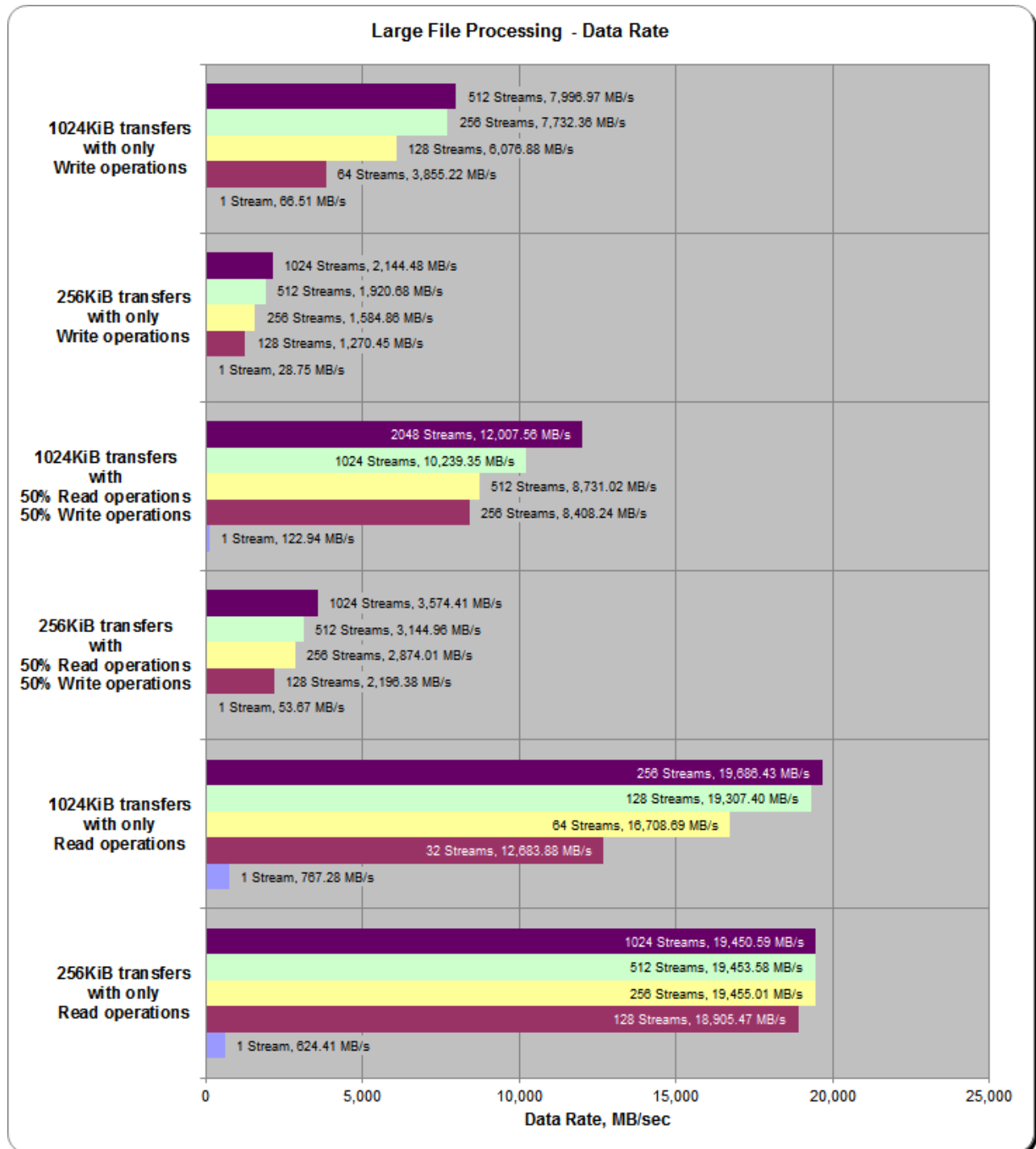
[SPC-2 Large File Processing Test Results File](#)

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	64 Streams	128 Streams	256 Streams	512 Streams
Write 1024KiB	66.51	3,855.22	6,076.88	7,732.36	7,996.97
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Write 256KiB	28.75	1,270.45	1,584.86	1,920.68	2,144.48
Test Run Sequence	1 Stream	256 Streams	512 Streams	1024 Streams	2048 Streams
Read/Write 1024KiB	122.94	8,408.24	8,731.02	10,239.35	12,007.56
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Read/Write 256KiB	53.67	2,196.38	2,874.01	3,144.96	3,574.41
Test Run Sequence	1 Stream	32 Streams	64 Streams	128 Streams	256 Streams
Read 1024KiB	767.28	12,683.88	16,708.69	19,307.40	19,686.43
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Read 256KiB	624.41	18,905.47	19,455.01	19,453.58	19,450.59

SPC-2 Large File Processing Average Data Rates Graph

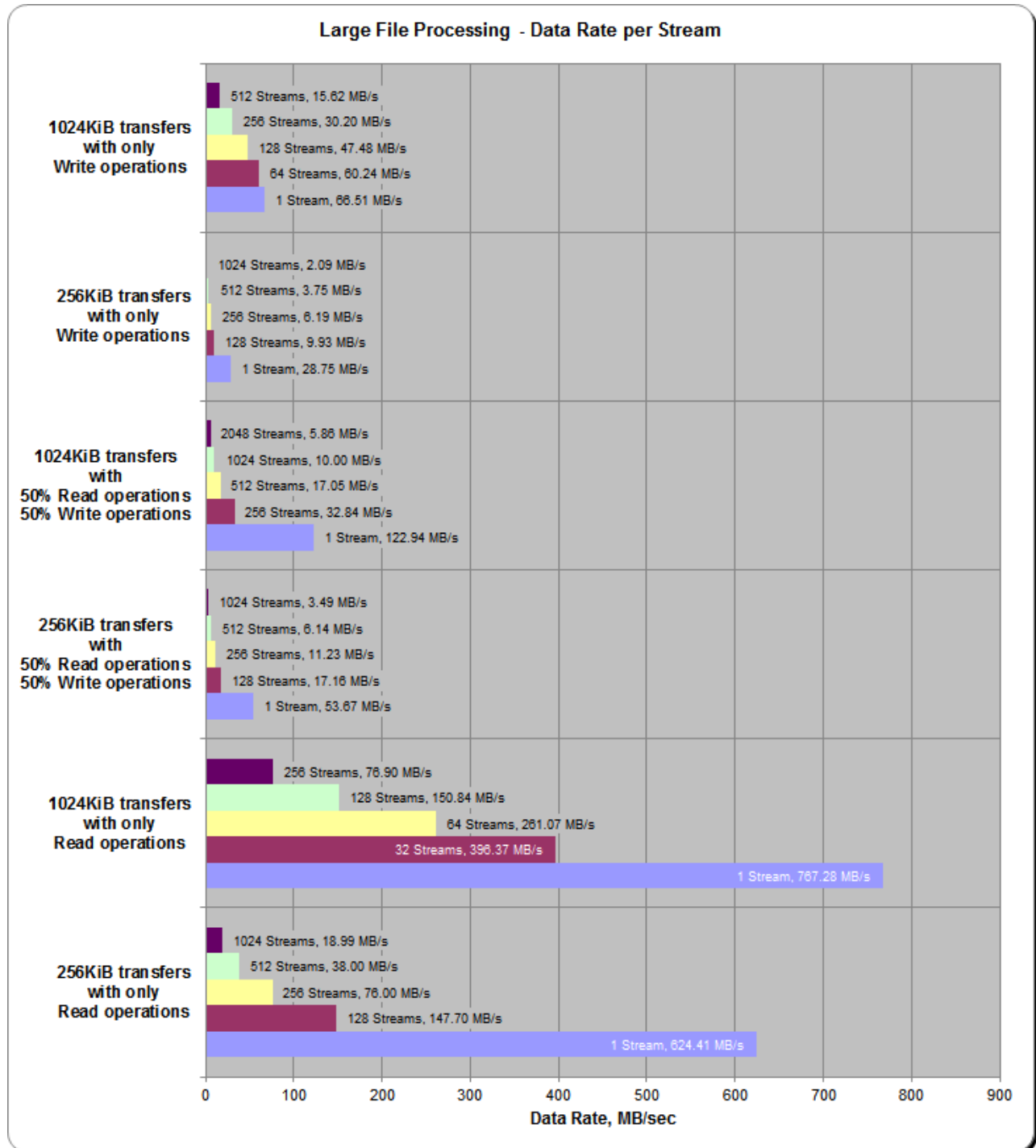


SPC-2 Large File Processing Average Data Rate per Stream

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	64 Streams	128 Streams	256 Streams	512 Streams
Write 1024KiB	66.51	60.24	47.48	30.20	15.62
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Write 256KiB	28.75	9.93	6.19	3.75	2.09
Test Run Sequence	1 Stream	256 Streams	512 Streams	1024 Streams	2048 Streams
Read/Write 1024KiB	122.94	32.84	17.05	10.00	5.86
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Read/Write 256KiB	53.67	17.16	11.23	6.14	3.49
Test Run Sequence	1 Stream	32 Streams	64 Streams	128 Streams	256 Streams
Read 1024KiB	767.28	396.37	261.07	150.84	76.90
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Read 256KiB	624.41	147.70	76.00	38.00	18.99

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

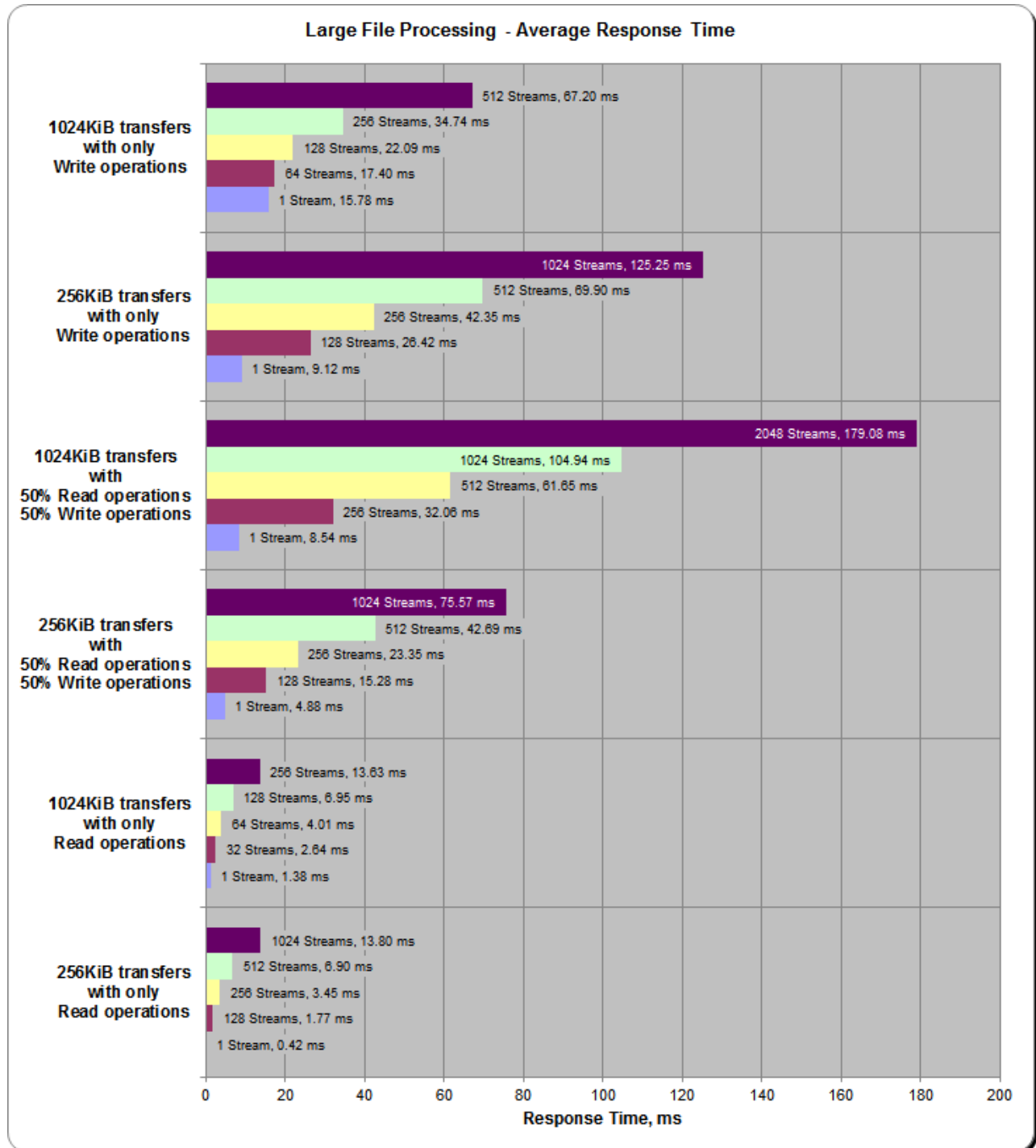


SPC-2 Large File Processing Average Response Time

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	64 Streams	128 Streams	256 Streams	512 Streams
Write 1024KiB	15.78	17.40	22.09	34.74	67.20
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Write 256KiB	9.12	26.42	42.35	69.90	125.25
Test Run Sequence	1 Stream	256 Streams	512 Streams	1024 Streams	2048 Streams
Read/Write 1024KiB	8.54	32.06	61.65	104.94	179.08
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Read/Write 256KiB	4.88	15.28	23.35	42.69	75.57
Test Run Sequence	1 Stream	32 Streams	64 Streams	128 Streams	256 Streams
Read 1024KiB	1.38	2.64	4.01	6.95	13.63
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
Read 256KiB	0.42	1.77	3.45	6.90	13.80

SPC-2 Large File Processing Average Response Time Graph



Large File Processing Test – WRITE ONLY Test Phase

Clause 10.6.9.1.1

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

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

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

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

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

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

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large File Processing/WRITE ONLY/1024 KiB Transfer Size” graphs](#)
(four pages, 1 graph per page)

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

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

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large File Processing/WRITE ONLY/256 KiB Transfer Size” graphs](#)
(four pages, 1 graph per page)

Large File Processing Test – READ-WRITE Test Phase

Clause 10.6.9.1.2

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

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

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

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

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

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

SPC-2 “Large File Processing/READ-WRITE/1024 KiB Transfer Size” Graphs

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large File Processing/READ-WRITE/1024 KiB Transfer Size” graphs](#)
(four pages, 1 graph per page)

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

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

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large File Processing/READ-WRITE/256 KiB Transfer Size” graphs](#)
(four pages, 1 graph per page)

Large File Processing Test – READ ONLY Test Phase

Clause 10.6.9.1.3

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.*

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

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

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

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

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

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large File Processing/READ ONLY/1024 KiB Transfer Size” graphs](#)
(four pages, 1 graph per page)

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

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

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large File Processing/READ ONLY/256 KiB Transfer Size” graphs](#)
(four pages, 1 graph per page)

Large Database Query Test

Clause 6.4.4.1

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

Clause 6.4.4.2

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

- 1. 1024 KiB TRANSFER SIZE*
- 2. 64 KiB TRANSFER SIZE*

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

Clause 10.6.9.2

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

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

SPC-2 Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Large Database Query Test Runs are documented in [Appendix E: SPC-2 Workload Generator Execution Commands and Parameters](#) on Page [133](#).

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.

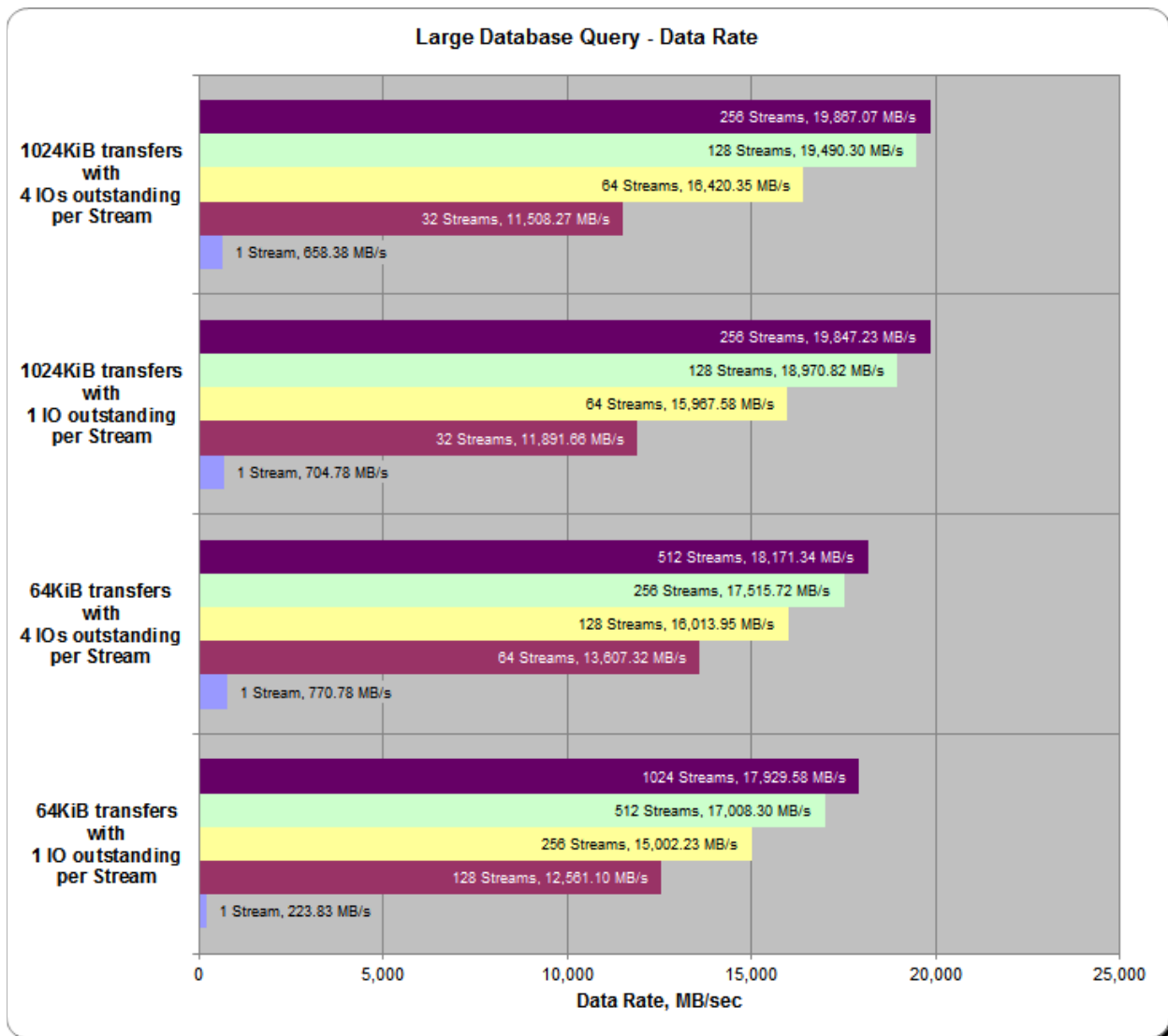
[SPC-2 Large Database Query Test Results File](#)

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	32 Streams	64 Streams	128 Streams	256 Streams
1024KiB w/ 4 IOs/Stream	658.38	11,508.27	16,420.35	19,490.30	19,867.07
Test Run Sequence	1 Stream	32 Streams	64 Streams	128 Streams	256 Streams
1024KiB w/ 1 IO/Stream	704.78	11,891.66	15,967.58	18,970.82	19,847.23
Test Run Sequence	1 Stream	64 Streams	128 Streams	256 Streams	512 Streams
64KiB w/ 4 IOs/Stream	770.78	13,607.32	16,013.95	17,515.72	18,171.34
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
64KiB w/ 1 IO/Stream	223.83	12,561.10	15,002.23	17,008.30	17,929.58

SPC-2 Large Database Query Average Data Rates Graph

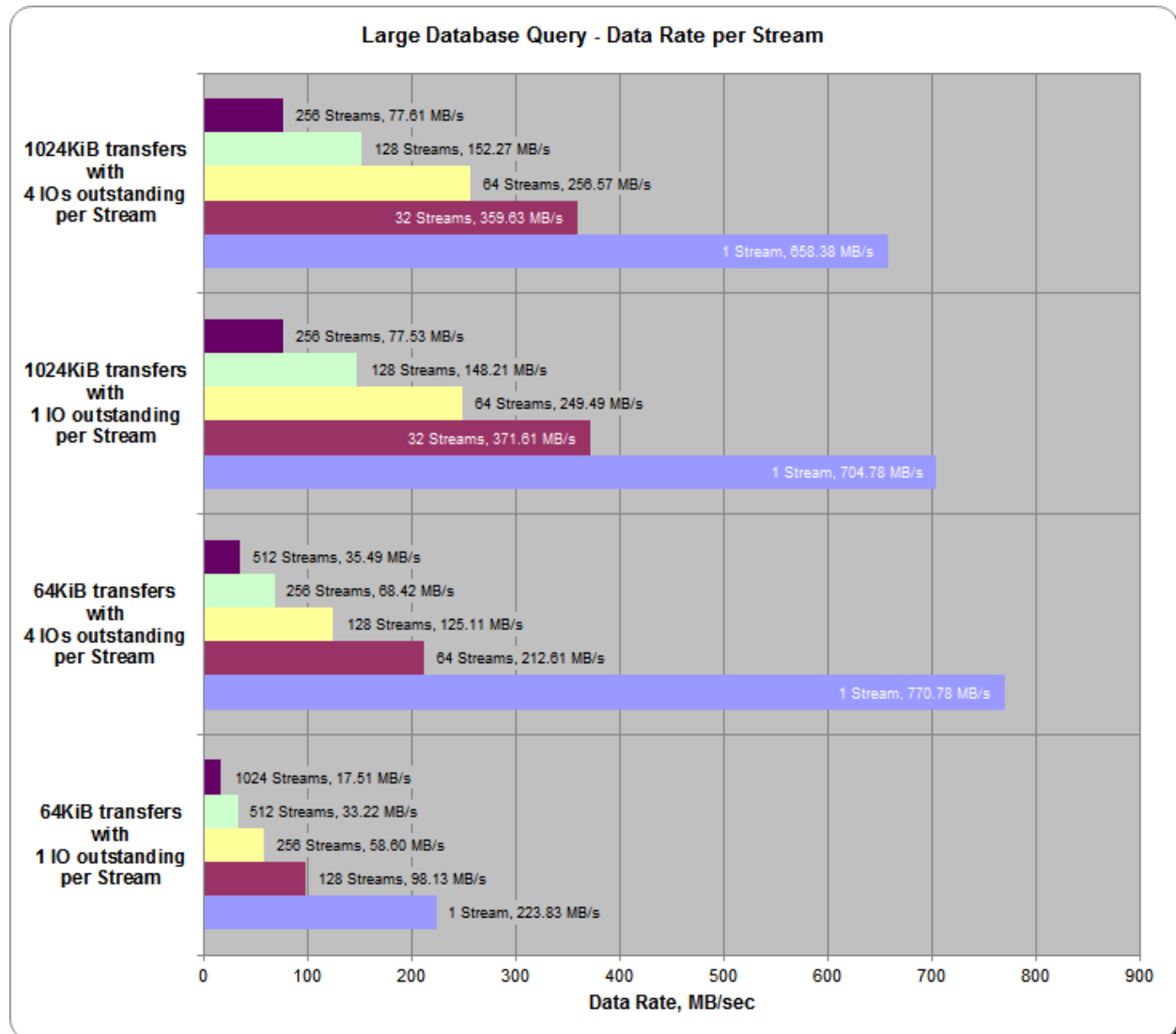


SPC-2 Large Database Query Average Data Rate per Stream

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	32 Streams	64 Streams	128 Streams	256 Streams
1024KiB w/ 4 IOs/Stream	658.38	359.63	256.57	152.27	77.61
Test Run Sequence	1 Stream	32 Streams	64 Streams	128 Streams	256 Streams
1024KiB w/ 1 IO/Stream	704.78	371.61	249.49	148.21	77.53
Test Run Sequence	1 Stream	64 Streams	128 Streams	256 Streams	512 Streams
64KiB w/ 4 IOs/Stream	770.78	212.61	125.11	68.42	35.49
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
64KiB w/ 1 IO/Stream	223.83	98.13	58.60	33.22	17.51

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

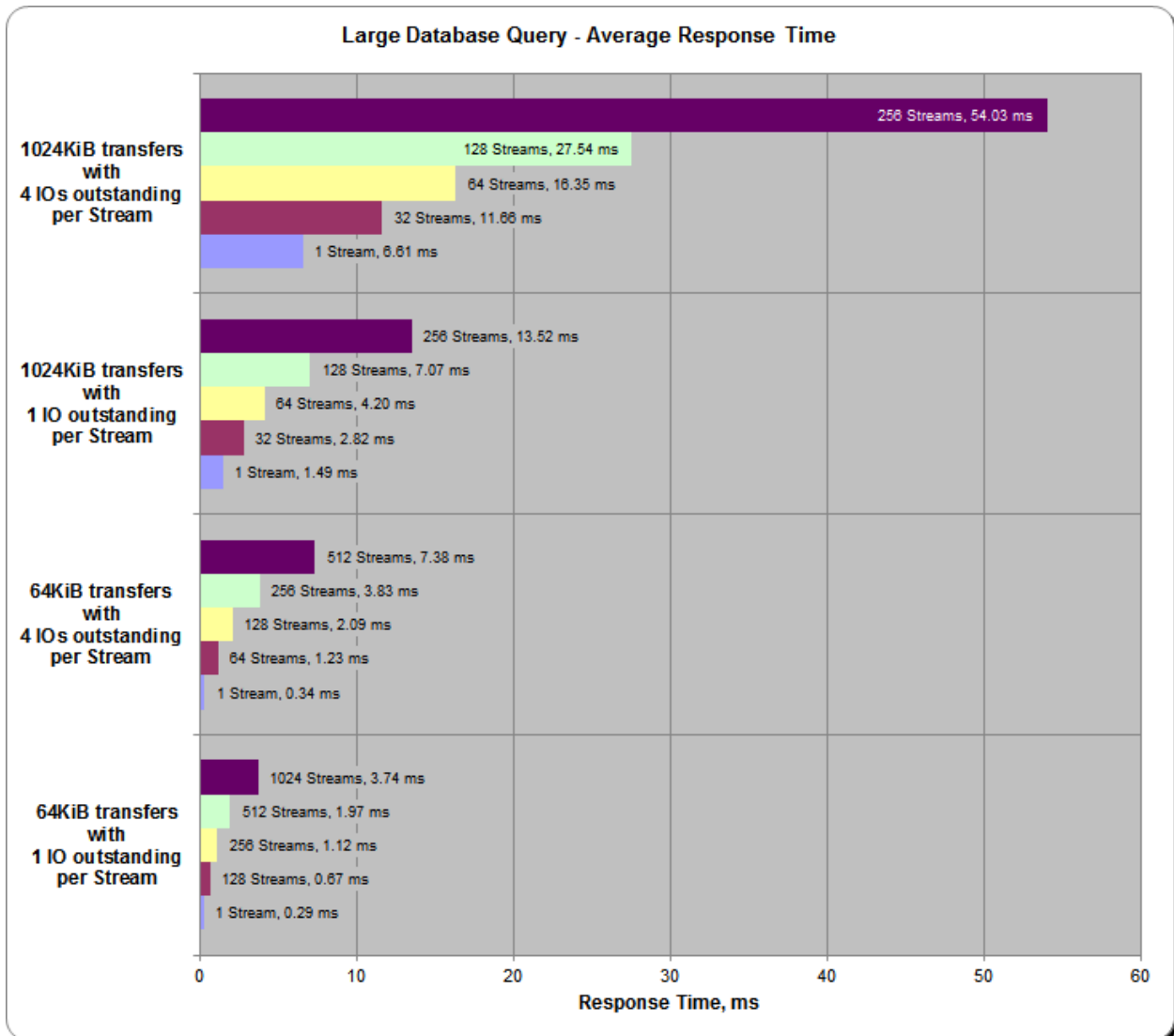


SPC-2 Large Database Query Average Response Time

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	32 Streams	64 Streams	128 Streams	256 Streams
1024KiB w/ 4 IOs/Stream	6.61	11.66	16.35	27.54	54.03
Test Run Sequence	1 Stream	32 Streams	64 Streams	128 Streams	256 Streams
1024KiB w/ 1 IO/Stream	1.49	2.82	4.20	7.07	13.52
Test Run Sequence	1 Stream	64 Streams	128 Streams	256 Streams	512 Streams
64KiB w/ 4 IOs/Stream	0.34	1.23	2.09	3.83	7.38
Test Run Sequence	1 Stream	128 Streams	256 Streams	512 Streams	1024 Streams
64KiB w/ 1 IO/Stream	0.29	0.67	1.12	1.97	3.74

SPC-2 Large Database Query Average Response Time Graph



Large Database Query Test – 1024 KiB TRANSFER SIZE Test Phase

Clause 10.6.9.2.1

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

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

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

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

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

[SPC-2 “Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os” Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods](#)

(3 pages)

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large Database Query/1024 KIB TRANSFER SIZE/4 Outstanding I/Os” graphs](#)

(four pages, 1 graph per page)

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

[SPC-2 “Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O” Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods](#)

(3 pages)

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

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large Database Query/1024 KIB TRANSFER SIZE/1 Outstanding I/O” graphs](#)

(four pages, 1 graph per page)

Large Database Query Test – 64 KiB TRANSFER SIZE Test Phase

Clause 10.6.9.2.2

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

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

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

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

SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/4 Outstanding I/Os” Test Run Data

[SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/4 Outstanding I/Os” Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods](#)

(3 pages)

SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/4 Outstanding I/Os” Graphs

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/4 Outstanding I/Os” graphs](#)

(four pages, 1 graph per page)

SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/1 Outstanding I/O” Test Run Data

[SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/1 Outstanding I/O” Test Run Data Tables: Ramp-Up, Measurement Interval, Run-Out, and Ramp-Down Periods](#)

(3 pages)

SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/1 Outstanding I/O” Graphs

Average Data Rate – Complete Test Run

Average Data Rate – Measurement Interval (MI) Only

Average Data Rate per Stream

Average Response Time

[SPC-2 “Large Database Query/64 KiB TRANSFER SIZE/1 Outstanding I/O” graphs](#)

(four pages, 1 graph per page)

Video on Demand Delivery Test

Clause 6.4.5.1

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

Clause 6.4.5.2

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

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

Clause 10.6.9.3

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

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

SPC-2 Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Video on Demand Delivery Test Run are documented in [Appendix E: SPC-2 Workload Generator Execution Commands and Parameters](#) on Page [133](#)..

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.

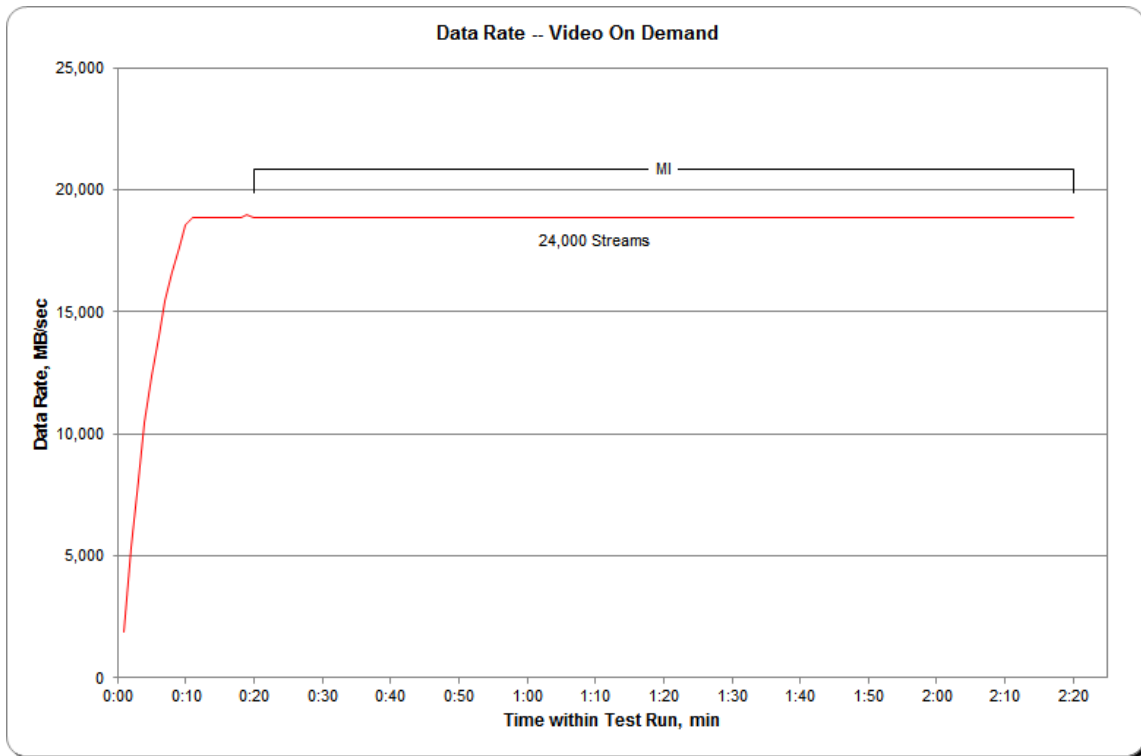
SPC-2-VOD	TR1
Number of Streams	24,000
Ramp-up Time, sec	1,200
Measurement Interval, sec	7,200
Average Data Rate, MB/sec	18,874.09
Per Stream Data Rate, MB/sec	0.79
Average Response Time, ms	10.81
Average Max Response Time, ms	472.96

Video on Demand Delivery Test – TEST RUN DATA BY INTERVAL

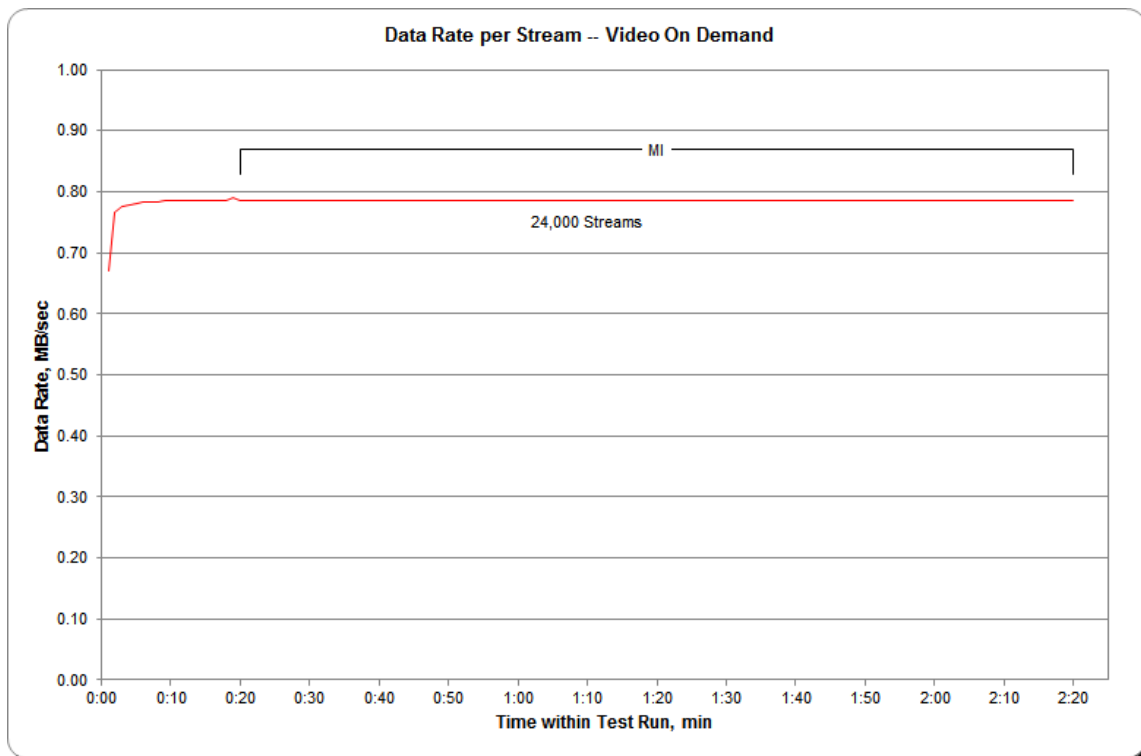
The SPC-2 Video on Demand Delivery Test Run data is contained in the table that appears below. That table is followed by graphs illustrating the average Data Rate and average Data Rate per Stream produced by the same Test Runs. The table and graphs present the data at sixty second intervals.

24,000 Streams					24,000 Streams					24,000 Streams				
Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Maximum Response Time, ms	Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Maximum Response Time, ms	Test Run Sequence Time	Data Rate, MB/sec	Data Rate / Stream, MB/sec	Response Time, ms	Maximum Response Time, ms
0:01:00	1,906.66	0.67	3.68	77.58	0:48:00	18,872.99	0.79	10.75	445.20	1:35:00	18,873.55	0.79	10.73	530.39
0:02:00	5,386.39	0.77	4.08	91.90	0:49:00	18,873.98	0.79	10.68	447.74	1:36:00	18,874.20	0.79	10.74	461.84
0:03:00	8,098.40	0.77	4.56	150.43	0:50:00	18,874.83	0.79	10.67	412.32	1:37:00	18,872.93	0.79	10.72	487.81
0:04:00	10,437.59	0.78	5.15	177.66	0:51:00	18,872.96	0.79	10.66	442.29	1:38:00	18,874.24	0.79	10.74	484.94
0:05:00	12,347.64	0.78	5.84	214.96	0:52:00	18,875.42	0.79	10.67	437.90	1:39:00	18,873.53	0.79	10.74	464.82
0:06:00	14,024.06	0.78	6.15	249.78	0:53:00	18,872.59	0.79	10.66	444.45	1:40:00	18,873.10	0.79	10.72	469.22
0:07:00	15,430.13	0.78	7.29	315.61	0:54:00	18,874.62	0.79	10.63	457.21	1:41:00	18,873.41	0.79	10.90	498.64
0:08:00	16,633.20	0.78	7.57	391.21	0:55:00	18,873.78	0.79	10.66	450.39	1:42:00	18,874.24	0.79	10.85	452.49
0:09:00	17,657.43	0.78	8.41	394.36	0:56:00	18,873.78	0.79	10.62	482.03	1:43:00	18,873.94	0.79	10.93	480.80
0:10:00	18,556.21	0.78	11.97	443.19	0:57:00	18,874.26	0.79	10.66	441.58	1:44:00	18,874.51	0.79	10.83	536.08
0:11:00	18,873.78	0.79	10.65	464.37	0:58:00	18,873.04	0.79	10.66	456.90	1:45:00	18,873.94	0.79	10.89	577.78
0:12:00	18,874.61	0.79	10.57	509.91	0:59:00	18,875.27	0.79	10.64	481.81	1:46:00	18,874.58	0.79	10.85	443.59
0:13:00	18,872.46	0.79	10.63	447.59	1:00:00	18,873.28	0.79	10.66	465.50	1:47:00	18,874.31	0.79	10.78	520.98
0:14:00	18,873.77	0.79	10.58	462.79	1:01:00	18,873.45	0.79	11.25	486.62	1:48:00	18,874.59	0.79	10.80	510.90
0:15:00	18,872.69	0.79	10.54	453.24	1:02:00	18,874.18	0.79	12.49	462.52	1:49:00	18,872.91	0.79	10.89	473.14
0:16:00	18,874.79	0.79	10.66	553.67	1:03:00	18,874.78	0.79	10.71	467.37	1:50:00	18,874.80	0.79	10.89	458.75
0:17:00	18,872.98	0.79	10.55	452.39	1:04:00	18,873.59	0.79	10.77	490.47	1:51:00	18,873.52	0.79	10.91	472.70
0:18:00	18,874.37	0.79	10.54	497.03	1:05:00	18,872.32	0.79	10.63	430.49	1:52:00	18,874.47	0.79	10.84	437.72
0:19:00	18,943.12	0.79	10.67	456.41	1:06:00	18,874.33	0.79	10.67	451.58	1:53:00	18,874.58	0.79	10.87	470.99
0:20:00	18,873.50	0.79	11.42	432.55	1:07:00	18,873.57	0.79	10.64	437.62	1:54:00	18,873.19	0.79	10.96	553.30
0:21:00	18,875.72	0.79	11.24	500.40	1:08:00	18,873.94	0.79	10.60	432.37	1:55:00	18,874.48	0.79	10.87	519.19
0:22:00	18,873.91	0.79	10.84	464.53	1:09:00	18,874.70	0.79	10.67	423.48	1:56:00	18,872.74	0.79	10.86	505.69
0:23:00	18,873.79	0.79	10.87	435.43	1:10:00	18,874.34	0.79	10.64	496.98	1:57:00	18,874.42	0.79	11.85	478.82
0:24:00	18,874.96	0.79	10.93	469.49	1:11:00	18,874.03	0.79	10.63	437.70	1:58:00	18,874.33	0.79	10.86	471.48
0:25:00	18,873.09	0.79	10.84	434.12	1:12:00	18,873.43	0.79	10.63	459.42	1:59:00	18,873.39	0.79	10.88	454.27
0:26:00	18,874.95	0.79	10.77	447.88	1:13:00	18,875.47	0.79	10.65	437.77	2:00:00	18,873.97	0.79	11.31	551.07
0:27:00	18,874.63	0.79	10.82	481.07	1:14:00	18,873.59	0.79	10.59	422.75	2:01:00	18,874.01	0.79	12.86	479.73
0:28:00	18,872.86	0.79	10.81	500.22	1:15:00	18,874.57	0.79	10.61	461.13	2:02:00	18,874.22	0.79	10.98	519.41
0:29:00	18,874.97	0.79	10.68	496.59	1:16:00	18,873.64	0.79	10.62	500.72	2:03:00	18,873.86	0.79	10.80	483.74
0:30:00	18,874.83	0.79	10.70	454.02	1:17:00	18,874.46	0.79	10.67	485.62	2:04:00	18,874.00	0.79	10.81	490.40
0:31:00	18,873.83	0.79	10.74	518.18	1:18:00	18,873.30	0.79	10.63	421.90	2:05:00	18,874.96	0.79	10.80	462.67
0:32:00	18,874.35	0.79	10.69	460.53	1:19:00	18,873.91	0.79	10.65	461.68	2:06:00	18,873.20	0.79	10.73	452.68
0:33:00	18,873.87	0.79	10.73	485.34	1:20:00	18,874.46	0.79	10.63	447.14	2:07:00	18,874.12	0.79	10.76	457.67
0:34:00	18,874.34	0.79	10.64	463.84	1:21:00	18,874.04	0.79	10.98	438.73	2:08:00	18,874.10	0.79	10.72	539.51
0:35:00	18,875.57	0.79	10.66	416.02	1:22:00	18,873.95	0.79	11.06	464.74	2:09:00	18,874.79	0.79	10.59	477.56
0:36:00	18,873.53	0.79	10.74	452.60	1:23:00	18,874.17	0.79	11.03	497.96	2:10:00	18,874.05	0.79	10.59	448.51
0:37:00	18,874.23	0.79	10.65	469.09	1:24:00	18,873.04	0.79	10.96	469.66	2:11:00	18,875.25	0.79	10.55	446.34
0:38:00	18,874.62	0.79	10.66	492.67	1:25:00	18,874.16	0.79	10.98	451.46	2:12:00	18,874.71	0.79	10.57	482.42
0:39:00	18,872.71	0.79	10.65	430.03	1:26:00	18,872.23	0.79	10.93	469.17	2:13:00	18,874.28	0.79	10.50	451.62
0:40:00	18,874.61	0.79	10.62	508.80	1:27:00	18,874.78	0.79	10.92	487.25	2:14:00	18,874.07	0.79	10.57	472.02
0:41:00	18,873.52	0.79	10.82	482.85	1:28:00	18,873.63	0.79	10.87	497.79	2:15:00	18,874.36	0.79	10.56	477.64
0:42:00	18,874.04	0.79	10.86	436.64	1:29:00	18,872.69	0.79	10.83	489.21	2:16:00	18,874.93	0.79	10.55	427.56
0:43:00	18,873.88	0.79	10.73	492.33	1:30:00	18,874.88	0.79	10.78	465.65	2:17:00	18,874.30	0.79	10.55	472.69
0:44:00	18,874.57	0.79	11.00	455.54	1:31:00	18,871.30	0.79	10.72	446.08	2:18:00	18,874.62	0.79	10.56	473.43
0:45:00	18,873.60	0.79	11.38	505.09	1:32:00	18,874.80	0.79	10.79	595.61	2:19:00	18,874.61	0.79	10.54	480.48
0:46:00	18,874.43	0.79	10.79	476.97	1:33:00	18,873.66	0.79	10.73	444.50	2:20:00	18,874.15	0.79	10.58	474.56
0:47:00	18,873.91	0.79	10.86	452.86	1:34:00	18,872.89	0.79	10.75	496.02	0:00:00	0.00	0.00	0.00	0.00

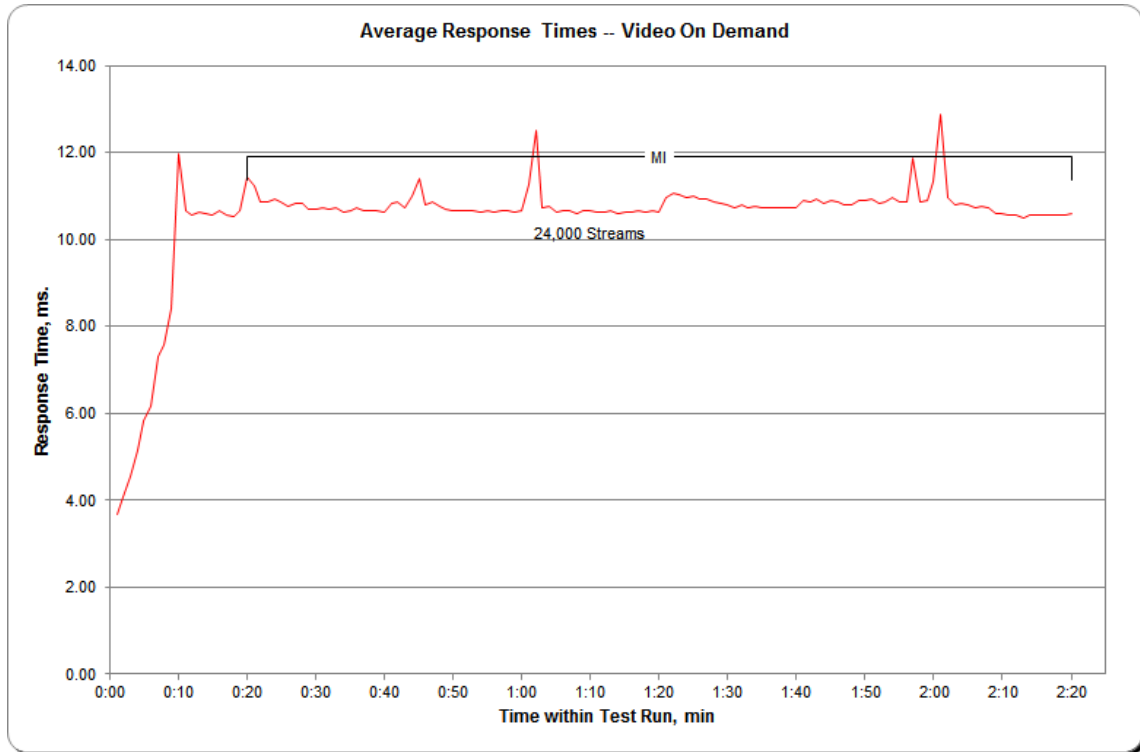
SPC-2 Video on Demand Delivery Average Data Rate Graph



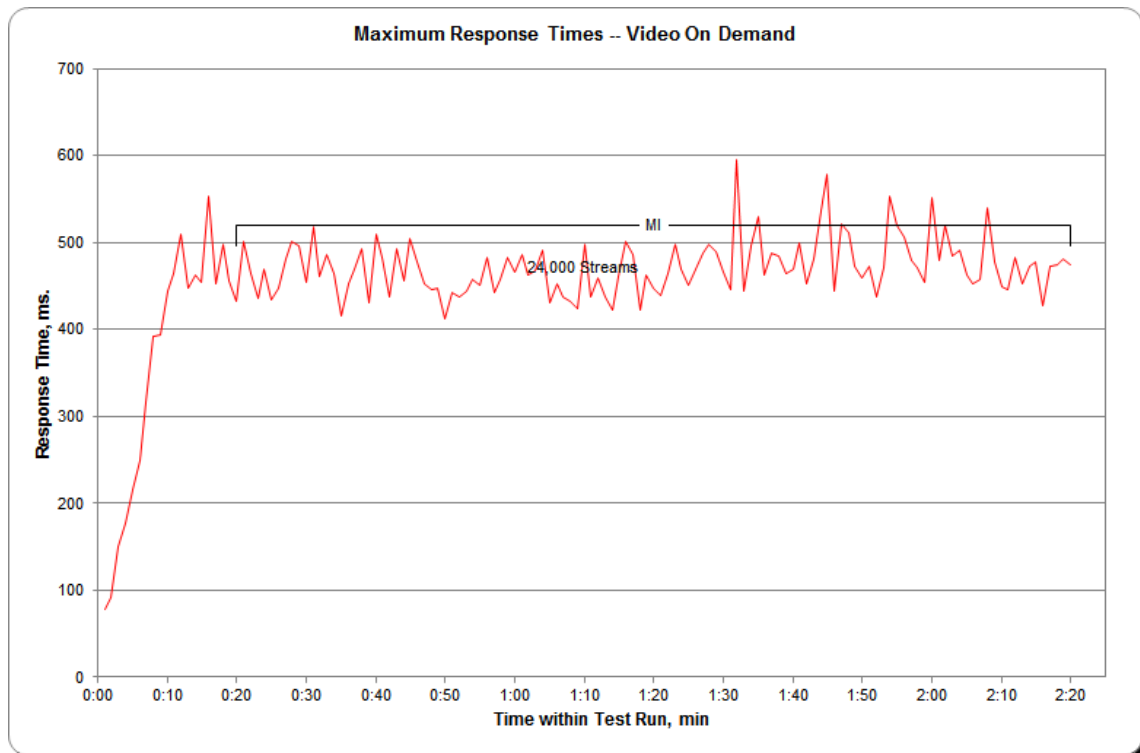
SPC-2 Video on Demand Delivery Average Data Rate per Stream Graph



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 [133](#).

Data Persistence Test Results File

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

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

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

Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Number: 1	
Total Number of Logical Blocks Written	2,804,675
Total Number of Logical Blocks Re-referenced	165,020
Total Number of Logical Blocks Verified	2,639,655
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 Oracle ZFS Storage ZS3-2 Appliance, as documented in this SPC-2 Full Disclosure Report, will become available May 9, 2014 for customer purchase and shipment.

ANOMALIES OR IRREGULARITIES

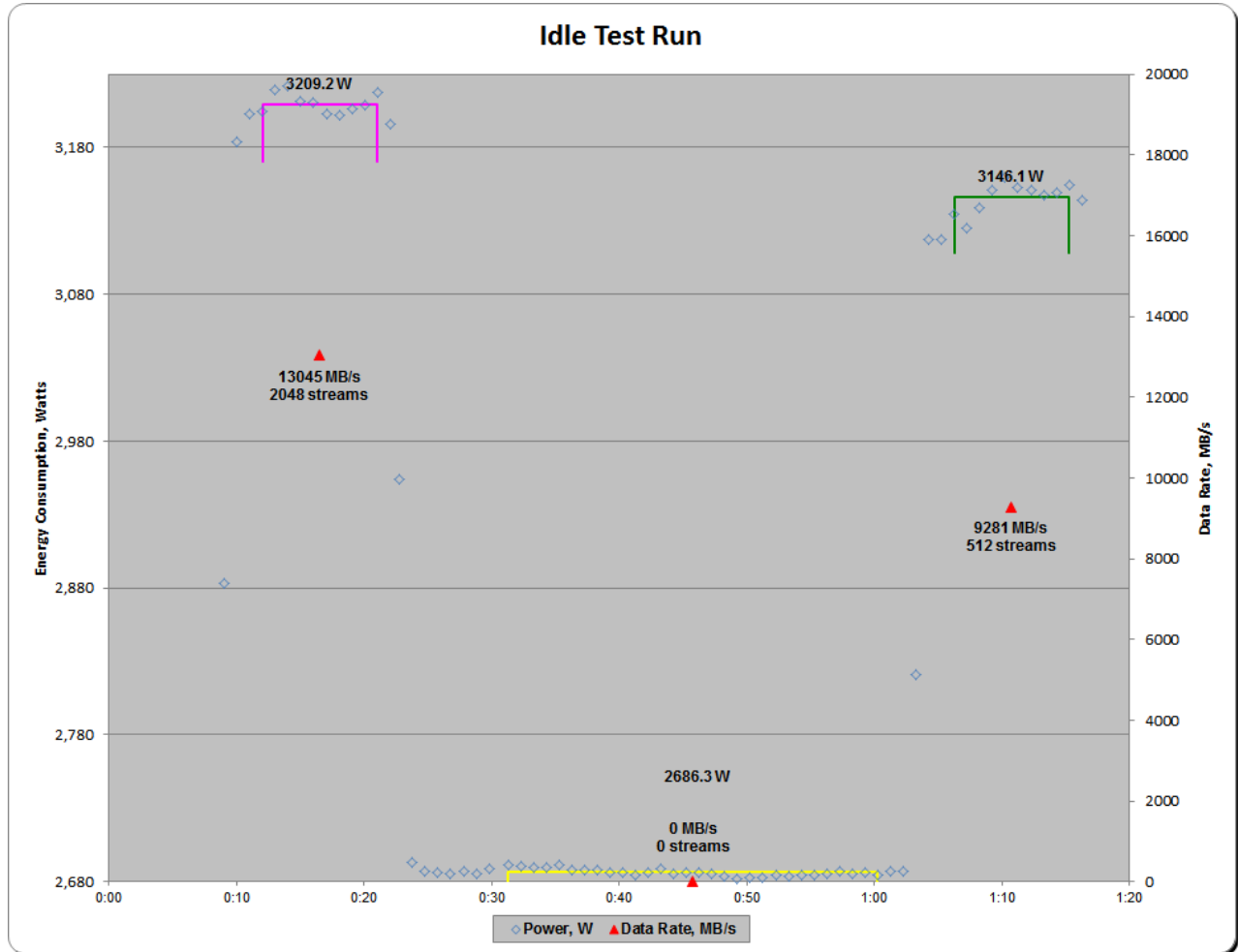
Clause 10.6.12

The FDR shall include a clear and complete description of any anomalies or irregularities encountered in the course of executing the SPC-2 benchmark that may in any way call into question the accuracy, verifiability, or authenticity of information published in this FDR.

There were no anomalies or irregularities encountered during the SPC-2 Onsite Audit of the Oracle ZFS Storage ZS3-2 Appliance.

SPC-2/E REPORTED DATA AND CHARTS

SPC-2/E Idle Test Chart and Data Table



Test Run	Average Power (Watts)	Data Rate (MB/s)
Pre Idle - 576 streams, Read/Write	3,209.20	13,045.13
Idle - 0 streams,	2,686.31	-
Post Idle - 144 streams, Read/Write	3,146.14	9,280.66

SPC-2/E Large File Processing (LFP) Reported Data

Power Environment							
Average RMS Voltage: 209.51				Average Power Factor: 0.936			
	Usage Profile			Nominal			
	Hours of Use per Day			Power watts	Traffic MBPS	Ratio MBPS/w	Heat BTU/hr
	Heavy	Moderate	Idle				
Low Daily Usage:	0	8	16	2815.82	3229.06	1.15	9,607.86
Medium Daily Usage:	4	14	6	2986.12	7540.05	2.53	10,188.96
High Daily Usage:	18	6	0	3112.72	10923.18	3.51	10,620.92
Composite Metrics:				2,971.56	7,230.76	2.43	
Annual Energy Use, kWh:		26,030.83					
Energy Cost, \$/kWh:		\$ 0.12		Annual Energy Cost, \$: \$ 3,123.70			

HEAVY SPC-2 LFP Workload: 3,125.35W at a data rate of 11,335.18 MB/s.

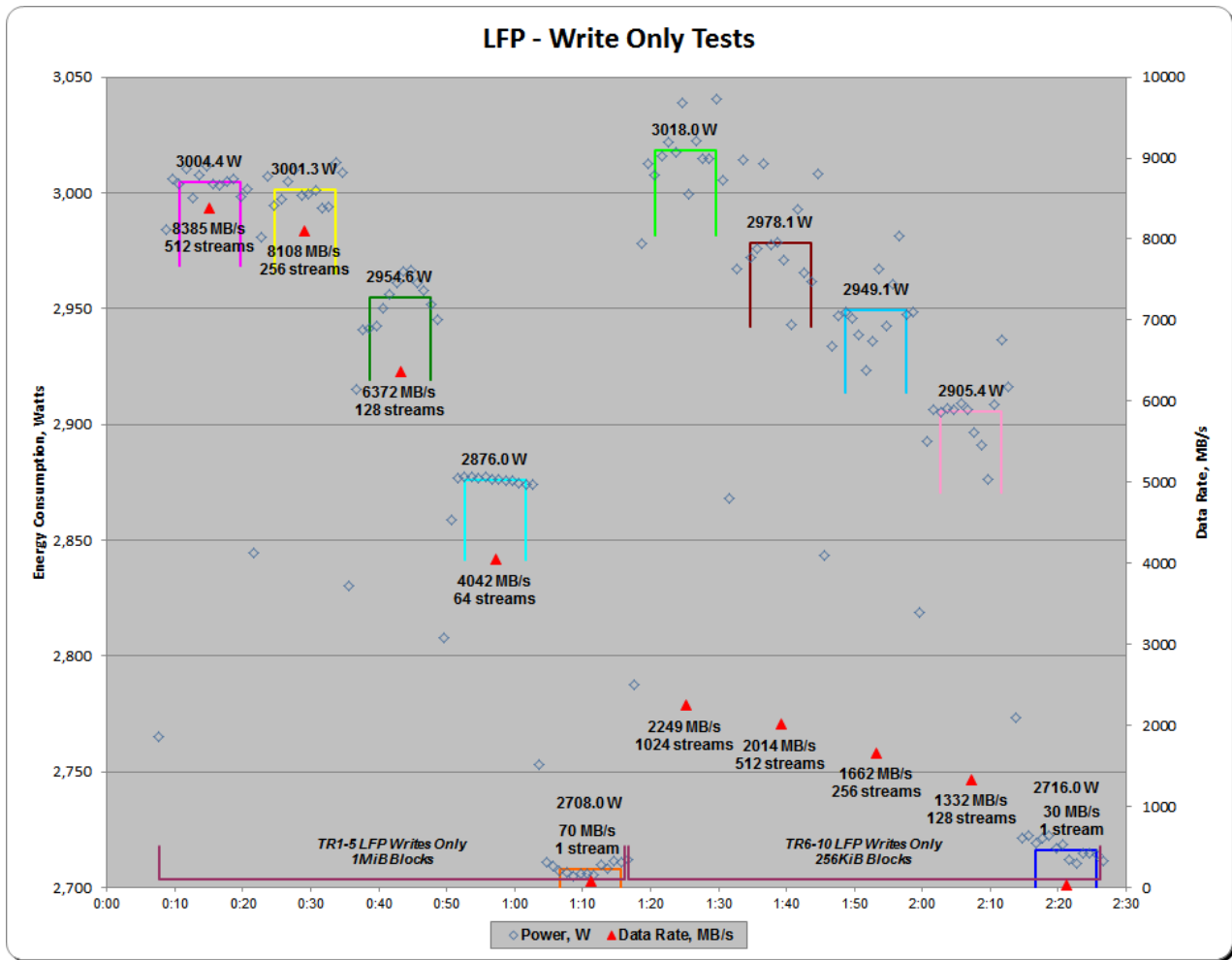
MODERATE SPC-2 LFP Workload: 3,074.84W at a data rate of 9,687.18 MB/s.

IDLE SPC-2 LFP Workload: 2,686.31W at a data rate of zero (0).

The above usage profile describes conditions in environments that respectively impose light (**Low Daily Usage**), moderate (**Medium Daily Usage**), and extensive (**High Daily Usage**) demands on the Tested Storage Configuration (TSC) while executing only the SPC-2 Large File Processing (LFP) workload.

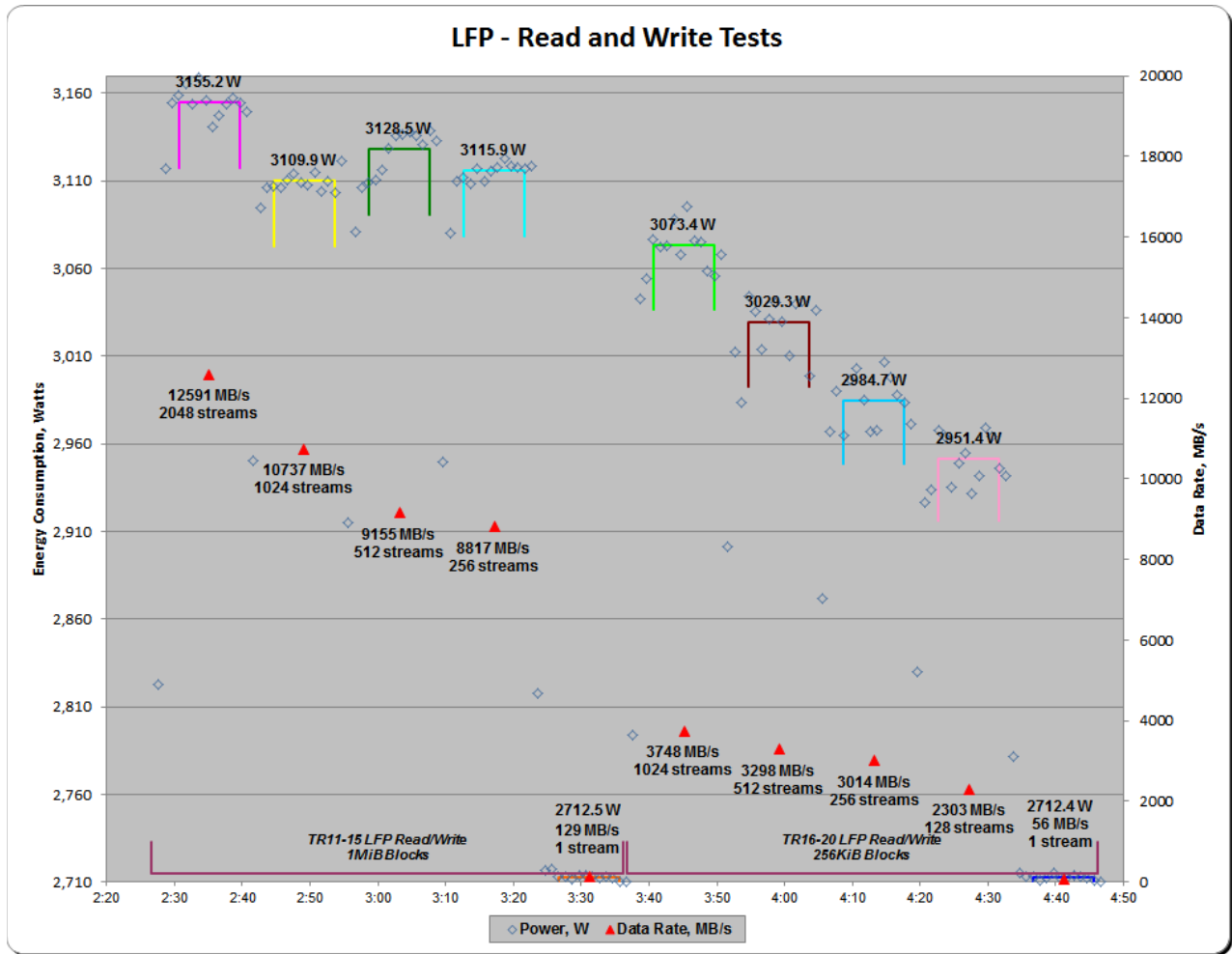
The definitions for the remaining items in the above LFP SPC-2/E Reported Data table are available on at the following location in the Executive Summary portion of this document: [reported data definitions](#).

SPC-2/E Large File Processing (LFP) WRITE ONLY Chart and Data Table



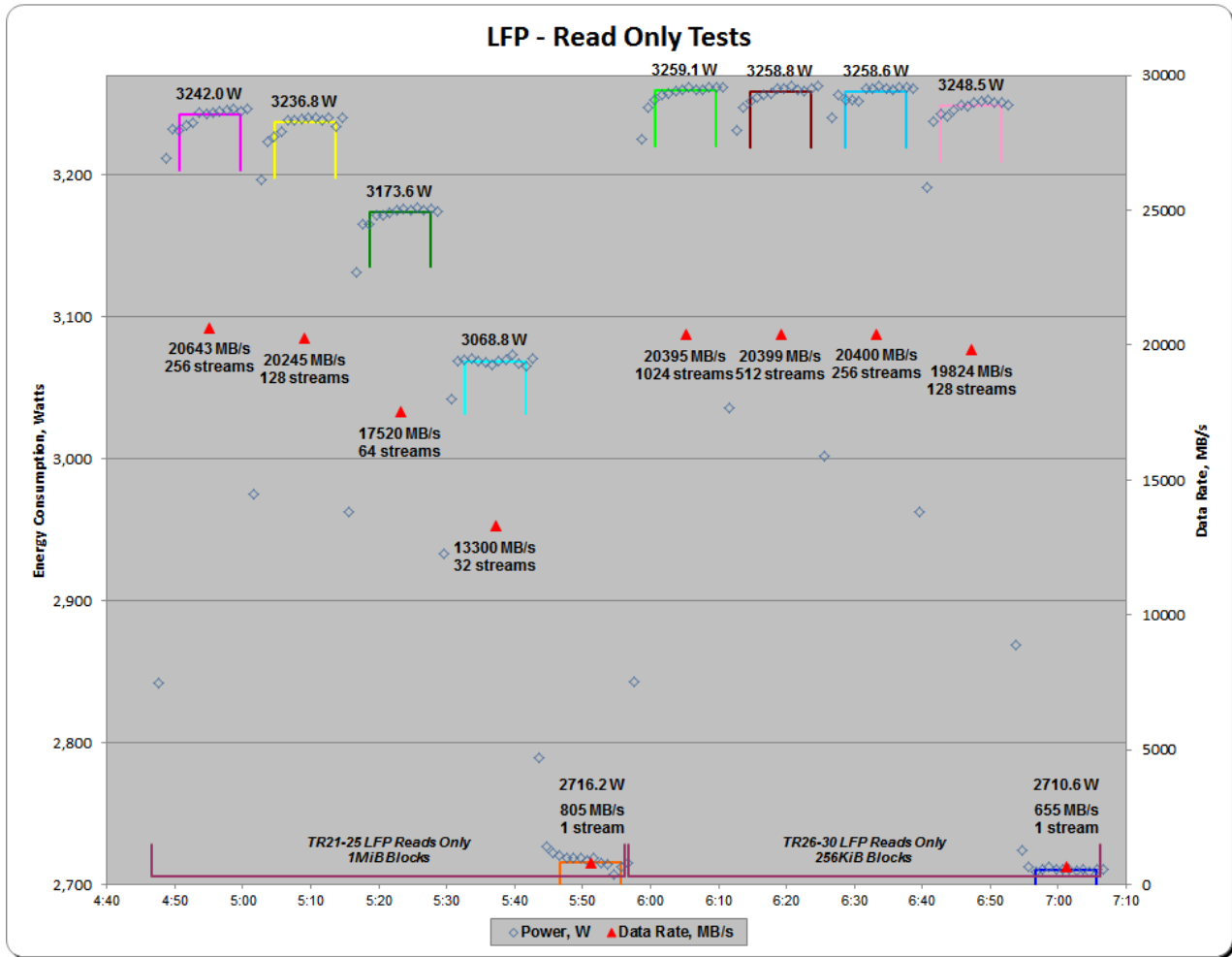
Test Run (TR)	Average Power (Watts)	Data Rate (MB/s)
100% Writes, 1024 KiB transfer		
TR1 - 512 streams	3,004.39	8,385.43
TR2 - 256 streams	3,001.28	8,107.96
TR3 - 128 streams	2,954.55	6,372.07
TR4 - 64 streams	2,876.01	4,042.50
TR5 - 1 stream	2,708.01	69.74
100% Writes, 256 KiB transfer		
TR6 - 1,024 streams	3,018.05	2,248.65
TR7 - 512 streams	2,978.07	2,013.98
TR8 - 256 streams	2,949.06	1,661.85
TR9 - 128 streams	2,905.37	1,332.17
TR10 - 1 stream	2,716.01	30.14

SPC-2/E Large File Processing (LFP) READ-WRITE Chart and Data Table



Test Run (TR)	Average Power (Watts)	Data Rate (MB/s)
50% Reads/50% Writes, 1024 KiB transfers		
TR11 - 2,048 streams	3,155.21	12,590.84
TR12 - 1,024 streams	3,109.92	10,736.73
TR13 - 512 streams	3,128.50	9,155.14
TR14 - 256 streams	3,115.88	8,816.68
TR15 - 1 stream	2,712.50	128.91
50% Reads/50% Writes, 256 KiB transfers		
TR16 - 1,024 streams	3,073.36	3,748.04
TR17 - 512 streams	3,029.27	3,297.73
TR18 - 256 streams	2,984.68	3,013.62
TR19 - 128 streams	2,951.38	2,303.08
TR20 - 1 stream	2,712.40	56.28

SPC-2/E Large File Processing (LFP) READ ONLY Chart and Data Table



Test Run (TR)	Average Power (Watts)	Data Rate (MB/s)
100% Reads, 1024 KiB transfers		
TR21 - 256 streams	3,241.99	20,642.72
TR22 - 128 streams	3,236.84	20,245.27
TR23 - 64 streams	3,173.63	17,520.33
TR24 - 32 streams	3,068.77	13,300.02
TR25 - 1 stream	2,716.21	804.55
100% Reads, 256 KiB transfers		
TR26 - 1,024 streams	3,259.10	20,395.42
TR27 - 512 streams	3,258.75	20,398.56
TR28 - 256 streams	3,258.60	20,400.06
TR29 - 128 streams	3,248.45	19,823.83
TR30 - 1 stream	2,710.57	654.74

SPC-2/E Large Database Query (LDQ) Reported Data

Power Environment							
Average RMS Voltage: 207.93				Average Power Factor: 0.942			
	Usage Profile			Nominal			
	Hours of Use per Day			Power	Traffic	Ratio	Heat
	Heavy	Moderate	Idle	watts	MBPS	MBPS/w	BTU/hr
Low Daily Usage:	0	8	16	2866.40	5540.34	1.93	9,780.43
Medium Daily Usage:	4	14	6	3102.80	13008.00	4.19	10,587.08
High Daily Usage:	18	6	0	3277.43	19061.13	5.82	11,182.93
Composite Metrics:				3,082.21	12,536.49	4.07	
Annual Energy Use, kWh:		27,000.17					
Energy Cost, \$/kWh:		\$ 0.12		Annual Energy Cost, \$:		\$ 3,240.02	

HEAVY SPC-2 LDQ Workload: 3,294.39W at a data rate of 19,874.50 MB/s.

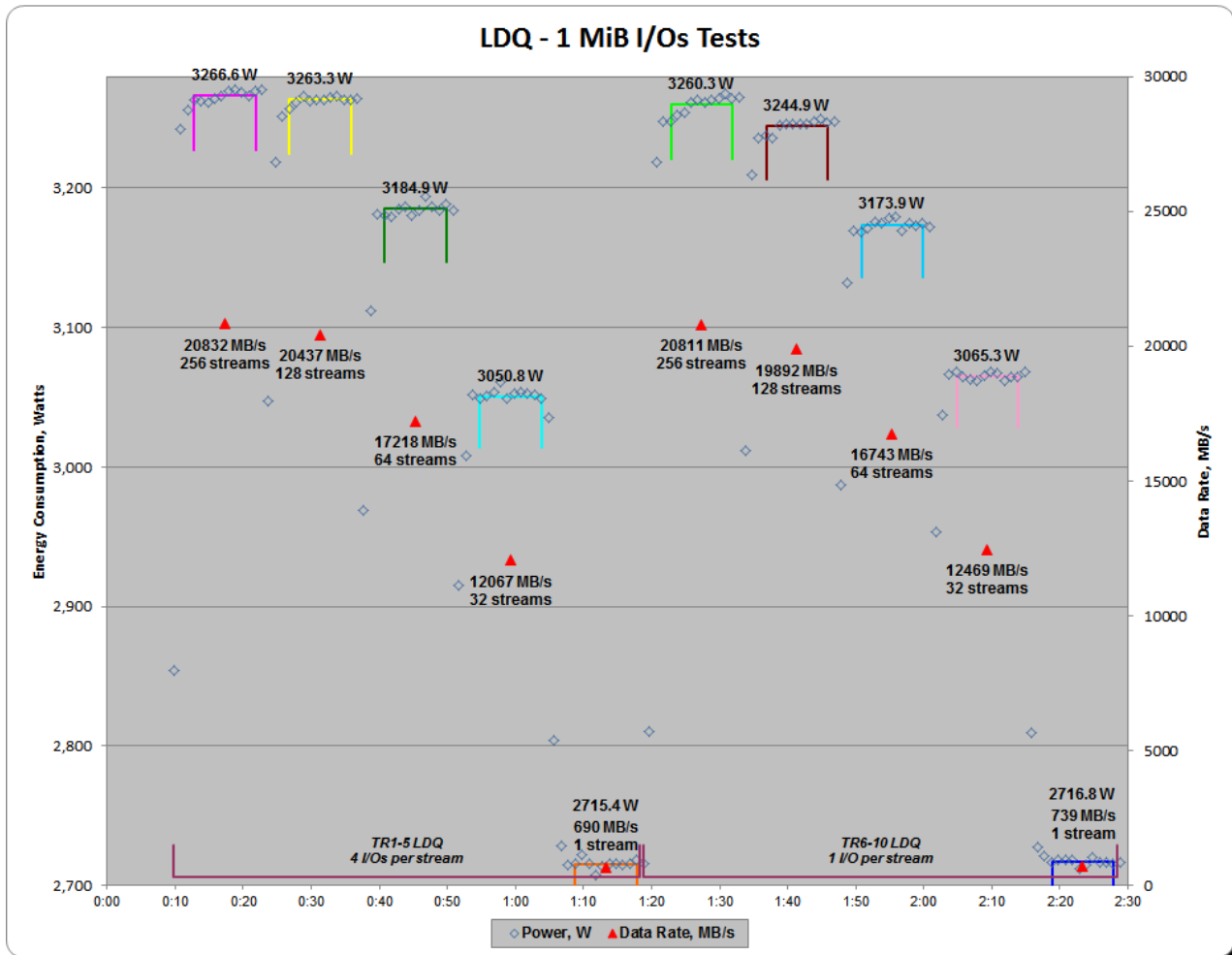
MODERATE SPC-2 LDQ Workload: 3,226.56W at a data rate of 16,621.01 MB/s

IDLE SPC-2 LDQ Workload: 2,686.31W at a data rate of zero (0).

The above usage profile describes conditions in environments that respectively impose light (**Low Daily Usage**), moderate (**Medium Daily Usage**), and extensive (**High Daily Usage**) demands on the Tested Storage Configuration (TSC) while executing only the SPC-2 Large Database Query (LDQ) workload.

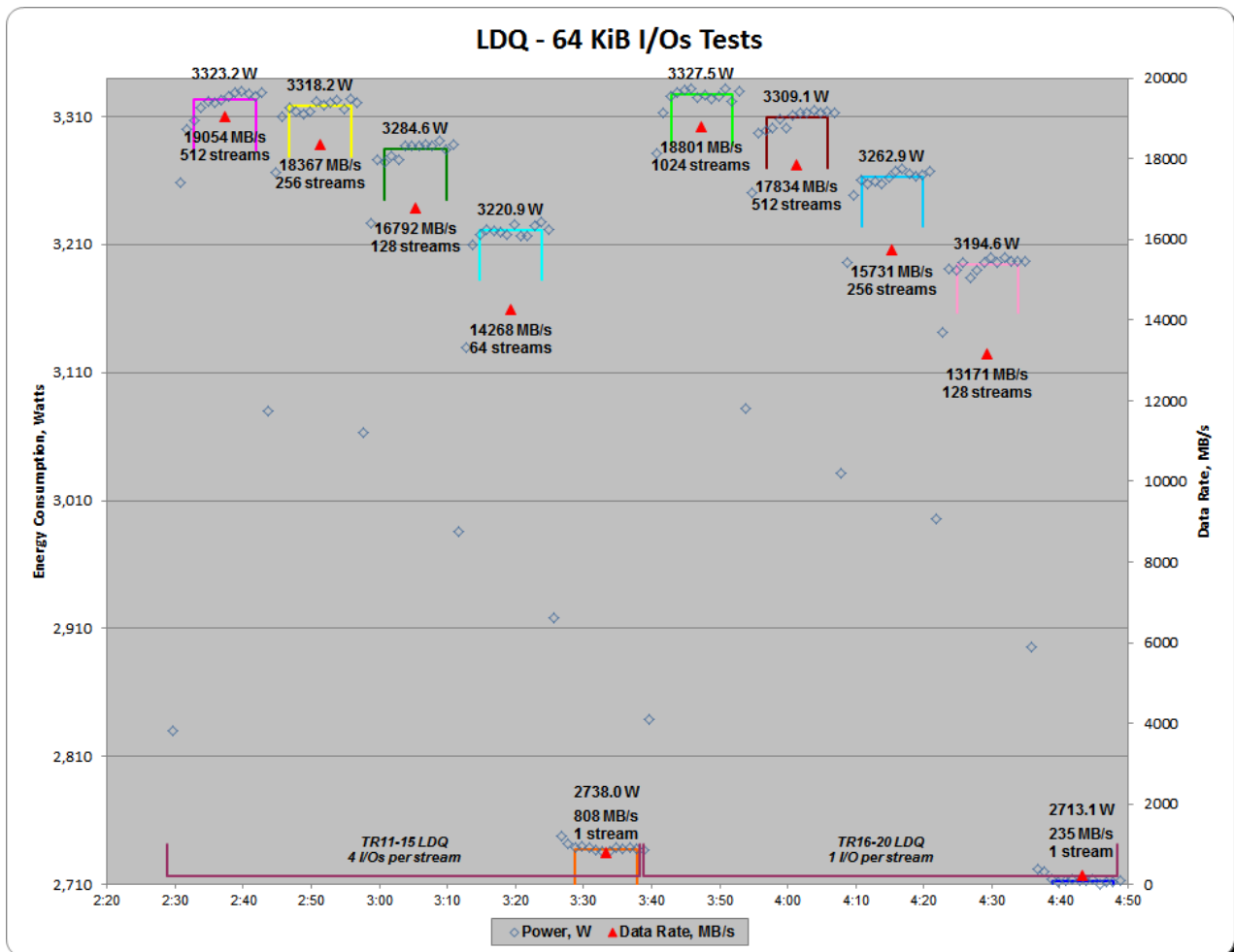
The definitions for the remaining items in the above LDQ SPC-2/E Reported Data table are available on at the following location in the Executive Summary portion of this document: [reported data definitions](#).

SPC-2/E Large Database Query (LDQ) 1024 KiB TRANSFER SIZE Chart and Data Table



Test Run (TR)	Average Power (Watts)	Data Rate (MB/s)
4 outstanding I/Os per Stream, 1024 KiB transfers		
TR1 - 256 streams	3,266.58	20,832.13
TR2 - 128 streams	3,263.28	20,437.06
TR3 - 64 streams	3,184.90	17,217.98
TR4 - 32 streams	3,050.82	12,067.29
TR5 - 1 stream	2,715.45	690.36
1 outstanding I/O per Stream, 1024 KiB transfers		
TR6 - 256 streams	3,260.30	20,811.33
TR7 - 128 streams	3,244.92	19,892.35
TR8 - 64 streams	3,173.88	16,743.22
TR9 - 32 streams	3,065.30	12,469.30
TR10 - 1 stream	2,716.77	739.01

SPC-2/E Large Database Query (LDQ) 64 KiB TRANSFER SIZE Chart and Data Table



Test Run (TR)	Average Power (Watts)	Data Rate (MB/s)
4 outstanding I/Os per Stream, 64 KiB transfers		
TR11 - 256 streams	3,323.22	19,054.03
TR12 - 128 streams	3,318.18	18,366.56
TR13 - 64 streams	3,284.56	16,791.84
TR14 - 32 streams	3,220.91	14,268.31
TR15 - 1 stream	2,737.95	808.22
1 outstanding I/O per Stream, 64 KiB transfers		
TR16 - 256 streams	3,327.47	18,800.53
TR17 - 128 streams	3,309.06	17,834.49
TR18 - 64 streams	3,262.91	15,730.98
TR19 - 32 streams	3,194.62	13,171.27
TR20 - 1 stream	2,713.08	234.70

SPC-2/E Video on Demand Delivery (VOD) Reported Data

Power Environment							
Average RMS Voltage: 209.03				Average Power Factor: 0.944			
Usage Profile			Nominal				
Hours of Use per Day			Power watts	Traffic MBPS	Ratio MBPS/w	Heat BTU/hr	
Heavy	Moderate	Idle					
Low Daily Usage:	0	8	16	2870.51	6596.97	2.30	9,794.46
Medium Daily Usage:	4	14	6	3100.76	14843.19	4.79	10,580.09
High Daily Usage:	18	6	0	3238.90	19790.92	6.11	11,051.47
Composite Metrics:				3,070.06	13,743.70	4.48	
Annual Energy Use, kWh:		26,893.70					
Energy Cost, \$/kWh:		\$ 0.12		Annual Energy Cost, \$:		\$ 3,227.24	

HEAVY SPC-2 VOD Workload: 3,238.90W at a data rate of 19,790.92 MB/s.

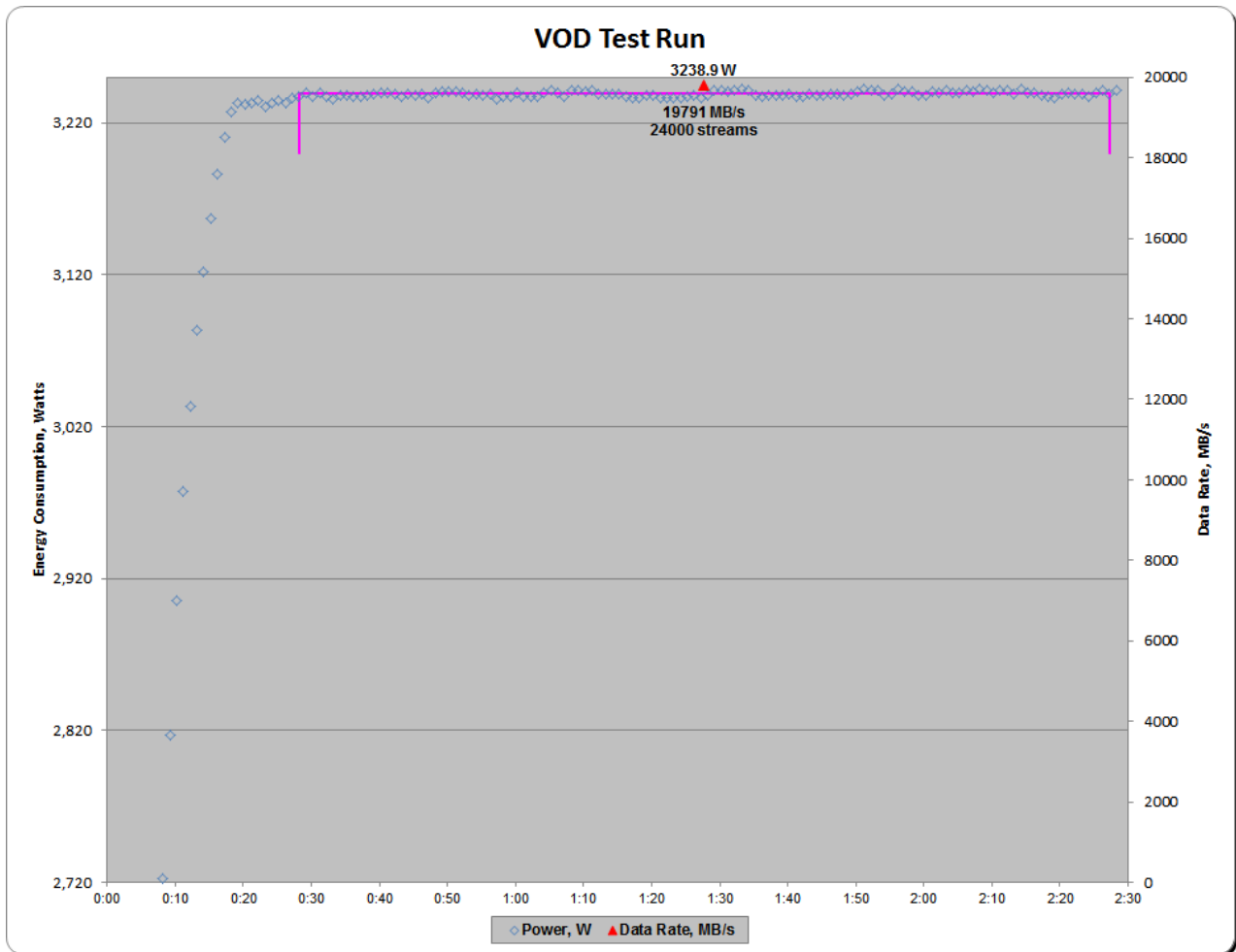
MODERATE SPC-2 VOD Workload: 3,238.90W at a data rate of 19,790.92 MB/s.

IDLE SPC-2 VOD Workload: 2,686.31W at a data rate of zero (0).

The above usage profile describes conditions in environments that respectively impose light (**Low Daily Usage**), moderate (**Medium Daily Usage**), and extensive (**High Daily Usage**) demands on the Tested Storage Configuration (TSC) while executing only the SPC-2 Video on Demand Delivery (VOD) workload.

The definitions for the remaining items in the above VOD SPC-2/E Reported Data table are available on at the following location in the Executive Summary portion of this document: [reported data definitions](#).

SPC-2/E Video on Demand Delivery (VOD) Chart and Data Table



Test Run (TR)	Average Power (Watts)	Data Rate (MB/s)
TR1 - 24,000 streams,	3,238.90	19,790.92

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:

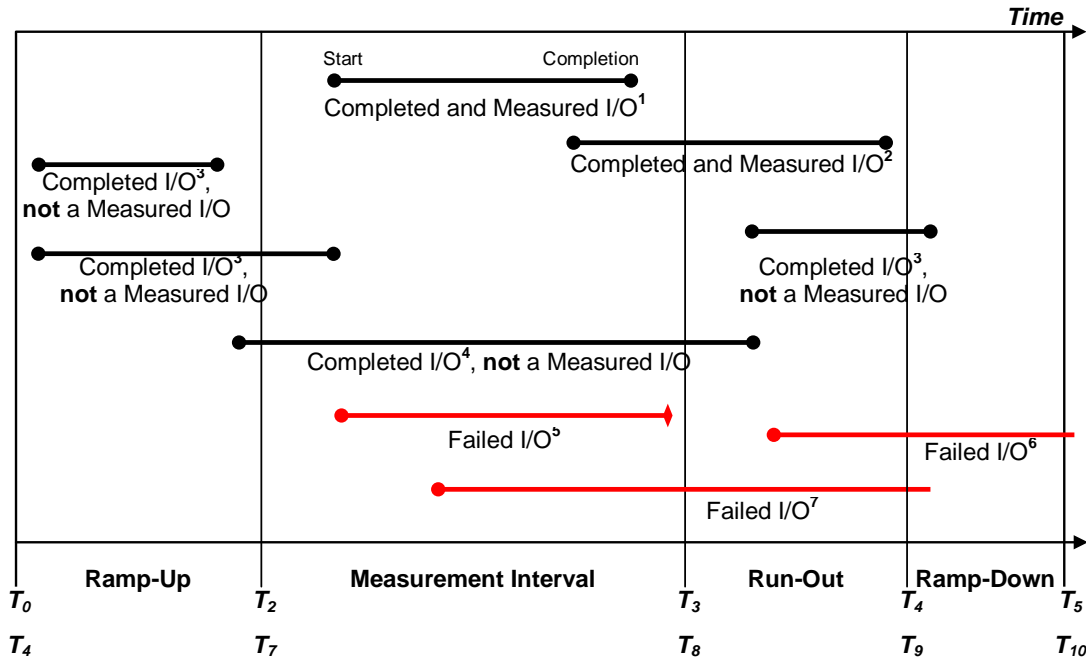
- Test Run 1: Maximum number of Streams, which is selected by the Test Sponsor
- Test Run 2: 50% of the maximum number of Streams used in Test Run 1.
- Test Run 3: 25% of the maximum number of Streams used in Test Run 1.
- Test Run 4: 12.5% of the maximum number of Streams used in Test Run 1.
- Test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

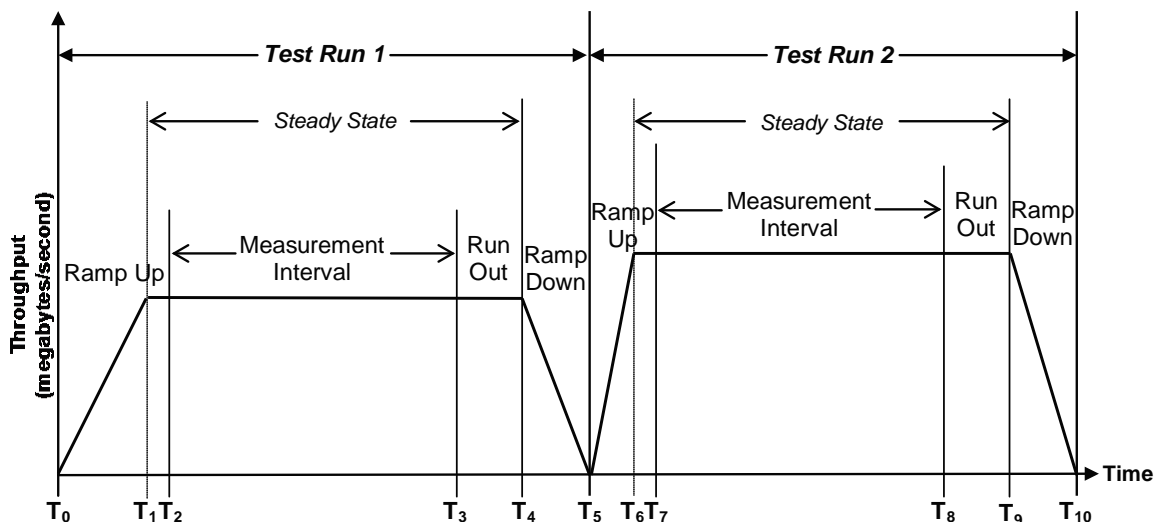
Transfer Size: The Transfer Size parameter specifies the number of bytes in KiB to transfer. (*Clause 3.4.7 of the SPC-2 Benchmark Specification*)

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

Solaris System Parameters

The following Solaris system parameter entries were changed in the **/etc/system** file for each Host System:

set sd:sd_max_throttle=256
defines the max queue depth per lun

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

All referenced scripts appear at the end of this appendix in the [Referenced Scripts](#) section.

Assign Host Names and IP Addresses

The Oracle ZFS Storage ZS3-2 Appliance is shipped with Quick Start instructions that provide details for assigning host names, IP addresses and Clustron cards. The Clustron cards support communication between storage controllers.

Configure the Tested Storage Configuration (TSC)

The Oracle ZFS Storage ZS3-2 Appliance includes two controllers, referenced below as **C** and **B**. The TSC will be configured using the scripts described below, which are performed on the Master Host System via the “**root**” user.

Build the Cluster

The script, [Build-12T-Cluster.sh](#), will invoke scripts to:

- Build One RAID pool on each controller
- Create 128 volumes on each controller, 1 pool per Controller
- Format and align LUNS
- Create all disk listing and parameter files

Build RAID Pools

The script, [Build 12T 2P.sh](#) will create one RAID Mirror Pools per controller. Each of the pools is a 70+70 with 4 spares

Create Volumes

The script, [Build-Vols-Cluster.sh](#), will create 128 volumes on each controller. All 256 volumes are accessible by both controllers.

Format and Align LUNs

The script, [Label-64bit-Multi-Host-spc2e.sh](#), uses the manually created [ldq-Cluster.txt](#) and [lfp-Cluster.txt](#) files to create SPC-2 parameter files and will create a volume listing from the two controllers in order to format and align the LUNs. In addition, this script is used to create various documentation listings and configuration files used in the benchmark execution.

Text files created by [Label-64bit-Multi-host-spc2e.sh](#):

- **Cluster_HW_List.txt**: Physical hardware list from both controllers of the ZS3-2 cluster
- **Cluster_Lun_List.txt**: Logical Volume listing from the ZS3-2 cluster
- **disklist.txt**: Logical volume listing from the master client
- **prtvtoc.txt**: Logical volume prtvtoc listing from the master client
- **pre.txt**: Vdbench parameter file for pre-filling logical volumes

- **spc2-vod.txt**: SPC-2 VOD parameter file
- **spc2-ldq.txt**: SPC-2 LDQ parameter file
- **spc2-lfp.txt**: SPC-2 LFP parameter file
- **spc2-persist1.txt**: SPC-2 Persist 1 parameter file
- **spc2-persist2.txt**: SPC-2 Persist 2 parameter file
- **spc2-pre.txt**: SPC-2 Pre Idle parameter file
- **spc2-post.txt**: SPC-2 Post Idle parameter file

Referenced Scripts and Files

Build-12T-Cluster.sh

```
#!/bin/bash
#
# Builds SPC2 cluster
#
#
clear
banner " Building"
echo " "
banner " SPC2 "
echo " "
banner " Cluster"
echo " "
echo " Please wait"
echo " "
# Remove Both pools from both heads and build new pools
Build_12T_2P.sh

# Remove old volumes a on client
devfsadm -C ; devfsadm

# Create volumes on all pools on Both Controllers
Build-Vols-Cluster.sh
#
#
# Remove old volumes and add new volumes on the clients
cfgadm -la ;devfsadm -C ; devfsadm

#
# Label new volumes and create all Parameters files
Label-64bit-Multi-Host-spc2e.sh
```

Build_12T_2P.sh

```
#!/bin/bash
#
# Build 2 pools on a 12-tray Cluster for SPC2
#
A_HEAD=sbm-7330c
B_HEAD=sbm-7330b

echo "Testing connectivity to $A_HEAD..."
echo "Testing connectivity to $B_HEAD..."
#
# Check that host is up
ping $A_HEAD > /dev/null
```

```
if [ $? = 1 ]
then
    echo "Unable to contact appliance. Please check hostname and network
connectivity."
exit
fi
## Check that host is up
ping $B_HEAD > /dev/null
if [ $? = 1 ]
then
    echo "Unable to contact appliance. Please check hostname and network
connectivity."
exit
fi
##
echo "Removing old pools..."
ssh -T root@$A_HEAD <<EOF
script
    run('configuration storage');
    run('unconfig C-pool');
    run('confirm done');
    run('done');
EOF
#
## Check that host is up
echo "Testing connectivity to $B_HEAD..."
ping $B_HEAD > /dev/null
if [ $? = 1 ]
then
    echo "Unable to contact appliance. Please check hostname and network
connectivity."
fi
#
echo "Removing old pools..."
ssh -T root@$B_HEAD <<EOF
script
    run('configuration storage');
    run('unconfig B-pool');
    run('confirm done');
    run('done');
EOF
#exit
sleep 10
echo "Building B-pool ..."
ssh -T root@$B_HEAD <<EOF
script
    run('configuration storage');
    run('config B-pool');
    run('set 1-data=12');
    run('set 2-data=12');
    run('set 3-data=12');
    run('set 4-data=12');
    run('set 5-data=12');
    run('set 6-data=12');
    run('set 7-data=12');
    run('set 8-data=12');
    run('set 9-data=12');
    run('set 10-data=12');
    run('set 11-data=12');
    run('set 12-data=12');
    run('done');
    run('set profile=mirror');
    run('done');
```

```
    run('done');
EOF

sleep 15

echo "Building C-pool..."
ssh -T root@$A_HEAD <<EOF
script
    run('configuration storage');
    run('config C-pool');
    run('set 1-data=12');
    run('set 2-data=12');
    run('set 3-data=12');
    run('set 4-data=12');
    run('set 5-data=12');
    run('set 6-data=12');
    run('set 7-data=12');
    run('set 8-data=12');
    run('set 9-data=12');
    run('set 10-data=12');
    run('set 11-data=12');
    run('set 12-data=12');
    run('done');
    run('set profile=mirror');
    run('done');
    run('done');
EOF

exit
```

Build-Vols-Cluster.sh

```
#!/bin/bash
#
#
AR_HOSTNAME_C=sbm-7330c
AR_HOSTNAME_B=sbm-7330b

LUNS=129
COUNT=1
while (test "$COUNT" -lt "$LUNS")
do
ssh -T $AR_HOSTNAME_B <<EOF
script
    run('shares');
    run('set pool=B-pool');
    run('select default lun spc2-$COUNT');
    run('set volsize=88g');
    run('set volblocksize=1m');
    run('set targetgroup=default');
    run('set initiatorgroup=default');
    run('commit');
    run('done');
EOF
COUNT=`expr $COUNT + 1`
done

ssh -T $AR_HOSTNAME_B <<EOF
script
    run('shares');
    run('set pool=B-pool');
    run('select default');
```

```
run('set logbias=throughput');
run('commit');
run('done');
EOF

COUNT=1
while (test "$COUNT" -lt "$LUNS")
do
ssh -T $AR_HOSTNAME_C <<EOF
script
run('shares');
run('set pool=C-pool');
run('select default lun spc2-$COUNT');
run('set volsize=88g');
run('set volblocksize=1m');
run('set targetgroup=default');
run('set initiatorgroup=default');
run('commit');
run('done');
EOF
COUNT=`expr $COUNT + 1`
done

ssh -T $AR_HOSTNAME_C <<EOF
script
run('shares');
run('set pool=C-pool');
run('select default');
run('set logbias=throughput');
run('commit');
run('done');
EOF
exit
```

Label-64bit-Multi-Host-spc2e.sh

```
#!/bin/ksh
#
set -x

AR_HOSTNAME_C=sbm-7330c
AR_HOSTNAME_B=sbm-7330b

export ZPOOL="yes"

# Set SPC2 Clients
Clients=" sbm-4170m2h sbm-4170m2e sbm-4170m2f sbm-4170m2g sbm-4170m2b"

# Clients with default MaxStreams
FullClients="sbm-4170m2h sbm-4170m2e sbm-4170m2f sbm-4170m2g sbm-4170m2b"

# Set number of JVMS
JVMS=1 # This is per slave

# SET Controller ID
Cid=c0t600144

# Set lun size
export Fsize=184532958e
export size=94479826432

# Set VOD streams
```

```
VOD=24000

# Global Stream count
STREAMS=1024

# Do not edit below this line

PARMS=/spc/SPC2_V1.2/spc2-x86/SPC2-Parm-Stream-Files

# Streams Set for LDQ
LDQ=$PARMS/ldq-Cluster.txt
cp $LDQ .

# Streams Set for LFP
LFP=$PARMS/lfp-Cluster.txt
cp $LFP .

# Set Output directory
mkdir /spc/config/spc2/sbm-7330c
export output=/spc/config/spc2/sbm-7330c/

export NOINUSE_CHECK=1
rm disk* p*.txt spc*.txt
clear
#
banner "      SPC2 "
banner "  Config "
sleep 2
echo " "
echo "  Please wait "
echo " "
# Probe server and remove all old device links
echo " "
devfsadm -C ; cfgadm -la ; devfsadm

echo " "
echo "Running SPC2 config script on `hostname` "
sleep 2
echo " "
echo "Master SPC-2 Client is `hostname` "
sleep 2
echo " "
echo "Slave SPC-2 Client are:  "
echo "$Clients"
sleep 2
echo " "
echo "Configuring all devices on controller $Cid "
sleep 2
echo " "
echo "Volume size has been set to $size "
sleep 2
echo " "
echo "Output directory is $output "
sleep 2
echo " "
echo "Ldq is set for $LDQ "
sleep 2
echo " "
echo "LFP has been set to $LFP "
sleep 2
echo " "
echo "VOD is set to $VOD streams "
sleep 2
```

```
echo " "
clear
echo "Please wait about fifteen minutes "
sleep 2
echo " "
echo " Configuring new disks with zpool"
echo " "
echo " Configuring `ls /dev/rdisk/$Cid*d0s2 | wc -l ` disks"
sleep 1
echo " "
ls /dev/rdisk/$Cid*d0s2 > disks
echo " "
echo " Starting to Label all new disks"
echo " "
# Now we move on to create label on all disks
cat disks | sed 's/d0s2/d0/g' > disk
#
C_disks=disk
#####
if [[ $ZPOOL = "yes" ]]; then
echo " Starting to align all disks"
#for f in `cat $C_disks`
#do
zpool create z `cat $C_disks`
sleep 3
zpool destroy -f z
sleep 3
#done
sleep 2
#
C_disks=disks
#####
for f in `cat $C_disks`
do
format -e $f << EOF
label
1
y
p
p
0
usr
wm
2048
$Fsize
label
1
y
quit
quit
EOFF
done
clear
echo " "

echo " "
echo " All `ls /dev/rdisk/$Cid*d0s2 | wc -l ` disks have been configured"
echo " "
sleep 3
fi
#
echo " Now we start building all parameter files"
sleep 1
```



```
echo " "  
echo " VOD is being created"  
echo " "  
sleep 2  
# Use slice 0 instead of slice 2  
cat disks | sed 's/s2/s0/g' > disk1  
#  
# Vod is first  
touch v.txt  
echo " " >> v.txt  
echo " # Video on Demand Test (VOD) " >> v.txt  
echo " " >> v.txt  
echo "host=localhost,jvms=$JVMS,java=( java,-d64,-Xmx2048m) " >> v.txt  
for x in $FullClients  
do  
echo "host=($x),jvms=$JVMS,java=( java,-d64,-Xmx2048m),shell=spc2 " >> v.txt  
done  
for x in $MaxClients  
do  
echo "host=($x),maxstreams=$MaxStreamsVOD,jvms=$JVMS,java=( java,-d64,-  
Xmx2048m),shell=spc2 " >> v.txt  
done  
echo "sd=default,size=$size " >> v.txt  
echo " " >> v.txt  
for Slave in localhost  
do  
counter=`ls /dev/rdsd/$Cid*d0s2 | wc -l`  
count=1  
while (test "$count" -lt "$counter")  
do  
for x in `cat disk1`  
do  
echo "sd=sd$count,host=$Slave,lun=$x " >>v.txt  
count=`expr $count + 1`  
done  
done  
done  
done  
for Slave in $Clients  
do  
counter=`ls /dev/rdsd/$Cid*d0s2 | wc -l`  
count=1  
while (test "$count" -lt "$counter")  
do  
for x in `cat disk1`  
do  
echo "sd=sd$count,host=$Slave,lun=$x " >>v.txt  
count=`expr $count + 1`  
done  
done  
done  
done  
  
echo " " >>v.txt  
echo "maxlatestart=0" >>v.txt  
echo "videosegmentduration=1200" >>v.txt  
echo "maxlatevod=0" >>v.txt  
echo "#reportinginterval=15" >>v.txt  
echo "reportinginterval=5" >>v.txt  
echo " " >>v.txt  
echo  
"rd=default,rampup=1200,periods=600,measurement=7200,runout=45,rampdown=15,buffers=8  
" >>v.txt  
echo "rd=TR1-"$VOD"s_SPC-2-VOD,streams=$VOD" >>v.txt
```

```

echo " " >>v.txt
echo " "
echo "# To start slaves, run: " >>v.txt
for x in $Clients
do
echo "# nohup java -d64 -cp . RemoteStart > nohup.$x.out 2>&1 & " >>v.txt
done
echo "#Or nohup java -d64 -cp . RemoteStart > nohup.\`hostname\`.out 2>&1 & "
>>v.txt
echo "# On each Client " >>v.txt
echo " " >>v.txt

# pre condition is next
touch pc.txt
echo " " >> pc.txt
echo " # Pre-Conditioning by sequential 1m writes " >> pc.txt
echo " " >> pc.txt
echo " " >> pc.txt
echo "compratio=1 " >> pc.txt

echo "sd=default,th=1" >> pc.txt

counter=`ls /dev/rdsk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
  for x in `cat disk1`
  do
    echo "sd=sd$count,lun=$x " >>pc.txt
    count=`expr $count + 1`
  done
done
echo " " >>pc.txt
done

echo " " >>pc.txt
echo "wd=wd1,sd=sd*,seekpct=eof,rdpct=0,xfersize=1m" >>pc.txt
echo "rd=rdl,wd=wd*,elapsed=72h,interval=60,iorate=max" >>pc.txt
#
#echo "#wd=fmt,sd=sd*,seekpct=eof,rdpct=0,xfersize=1m" >>pc.txt
#echo "#rd=default,wd=fmt,elapsed=72h,interval=60,iorate=max" >>pc.txt
#echo "#rd=rdl,sd=single " >>pc.txt

echo " " >>pc.txt

# Now we start building the persist files
# Persist 1 is 3rd
echo " Persist 1 file is being created"
echo " "
sleep 1
touch pl.txt
echo " " >> pl.txt
echo " # Persist 1 " >> pl.txt
echo " " >> pl.txt
echo "host=localhost,jvms=$JVMS,java=( java,-d64,-Xmx2048m) " >> pl.txt
for x in $FullClients
do
echo "host=($x),jvms=$JVMS,java=( java,-d64,-Xmx2048m),shell=spc2 " >> pl.txt
done
for x in $MaxClients
do
echo "host=($x),maxstreams=$MaxStreamsLDQ,jvms=$JVMS,java=( java,-d64,-
Xmx2048m),shell=spc2 " >> pl.txt
done

```

```
echo "sd=default,size=$size " >> pl.txt
echo " " >> pl.txt

for Slave in localhost $Clients
do
counter=`ls /dev/rdisk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
  for x in `cat disk1`
  do
    echo "sd=sd$count,host=$Slave,lun=$x " >>pl.txt
    count=`expr $count + 1`
  done
done
echo " " >>pl.txt
done
#
echo " " >>pl.txt
echo "maxlatestart=1" >>pl.txt
echo "reportinginterval=5" >>pl.txt
echo "segmentlength=512m " >>pl.txt
echo " " >>pl.txt
echo
"rd=default,rampup=180,periods=90,measurement=300,runout=0,rampdown=0,buffers=1"
>>pl.txt
echo "rd=default,rdpct=0,xfersize=1024k" >>pl.txt
echo "rd=TR1-"$STREAMS"s_SPC-2-persist-w,streams=$STREAMS" >>pl.txt
#
# Pre-Idle 4th
echo " Pre-Idle file is being created"
echo " "
sleep 1
touch pre.txt
echo " " >> pre.txt
echo " # Pre_idle " >> pre.txt
echo " " >> pre.txt
echo "host=localhost,jvms=$JVMS,java=( java,-d64,-Xmx2048m) " >> pre.txt
for x in $FullClients
do
echo "host=($x),jvms=$JVMS,java=( java,-d64,-Xmx2048m),shell=spc2 " >> pre.txt
done
for x in $MaxClients
do
echo "host=($x),maxstreams=$MaxStreamsLDQ,jvms=$JVMS,java=( java,-d64,-
Xmx2048m),shell=spc2 " >> pre.txt
done
echo "sd=default,size=$size " >> pre.txt
echo " " >> pre.txt

for Slave in localhost $Clients
do
counter=`ls /dev/rdisk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
  for x in `cat disk1`
  do
    echo "sd=sd$count,host=$Slave,lun=$x " >>pre.txt
    count=`expr $count + 1`
  done
done
echo " " >>pre.txt
```

```

done
#
echo " " >>pre.txt
echo "maxlatestart=0" >>pre.txt
echo "reportinginterval=5" >>pre.txt
echo "segmentlength=512m " >>pre.txt
echo " " >>pre.txt
echo
"rd=default,rampup=180,measurement=600,runout=45,rampdown=15,buffers=1,periods=90"
>>pre.txt
echo "rd=default,rdpct=50,xfersize=1024k" >>pre.txt
echo "rd=TR11-s2048_SPC-2-FP,streams=2048" >>pre.txt
#
# Post-Idle 5th
echo " Post-Idle file is being created"
echo " "
sleep 1
touch post.txt
echo " " >> post.txt
echo " # Post_idle " >> post.txt
echo " " >> post.txt
echo "host=localhost,jvms=$JVMS,java=(java,-d64,-Xmx2048m) " >> post.txt
for x in $FullClients
do
echo "host=($x),jvms=$JVMS,java=(java,-d64,-Xmx2048m),shell=spc2 " >> post.txt
done
for x in $MaxClients
do
echo "host=($x),maxstreams=$MaxStreamsLDQ,jvms=$JVMS,java=(java,-d64,-Xmx2048m),shell=spc2 " >> post.txt
done
echo "sd=default,size=$size " >> post.txt
echo " " >> post.txt

for Slave in localhost $Clients
do
counter=`ls /dev/rdsk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
for x in `cat disk1`
do
echo "sd=sd$count,host=$Slave,lun=$x " >>post.txt
count=`expr $count + 1`
done
done
echo " " >>post.txt
done
#
echo " " >>post.txt
echo "maxlatestart=0" >>post.txt
echo "reportinginterval=5" >>post.txt
echo "segmentlength=512m " >>post.txt
echo " " >>post.txt
echo
"rd=default,rampup=180,measurement=600,runout=45,rampdown=15,buffers=1,periods=90"
>>post.txt
echo "rd=default,rdpct=50,xfersize=1024k" >>post.txt
echo "rd=TR13-s512_SPC-2-FP,streams=512" >>post.txt
#
# Now we start building the persist 2 file
#
# Persist 2 is next

```

```
echo " Persist 2 file is being created"
echo " "
sleep 3
touch p2.txt
echo " " >> p2.txt
echo " # Persistence Test Run 2 " >> p2.txt
echo " " >> p2.txt
echo "host=localhost,jvms=$JVMS,java=( java,-d64,-Xmx2048m) " >> p2.txt
for x in $FullClients
do
echo "host=($x),jvms=$JVMS,java=( java,-d64,-Xmx2048m),shell=spc2 " >> p2.txt
done
for x in $MaxClients
do
echo "host=($x),maxstreams=$MaxStreamsLDQ,jvms=$JVMS,java=( java,-d64,-
Xmx2048m),shell=spc2 " >> p2.txt
done
echo "sd=default,size=$size " >> p2.txt
echo " " >> p2.txt

for Slave in localhost $Clients
do
counter=`ls /dev/rdsk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
for x in `cat disk1`
do
echo "sd=sd$count,host=$Slave,lun=$x " >>p2.txt
count=`expr $count + 1`
done
done
echo " " >>p2.txt
done
#
echo " " >>p2.txt
echo "maxlateststart=1" >>p2.txt
echo "reportinginterval=5" >>p2.txt
echo "segmentlength=512m " >>p2.txt
echo "maxpersistenceerrors=10" >>p2.txt
echo " " >>p2.txt
echo "*corruptstreams=3" >>p2.txt
echo "rd=default,buffers=1,rdpct=100,xfersize=1024k" >>p2.txt
echo "rd=TR1-"$STREAMS"s_SPC-2-persist-r" >>p2.txt
# Now we start building the LDQ file
#
#
#
# LDQ is next
echo " LDQ file is being created"
echo " "
sleep 3
touch ldq.txt
echo " " >> ldq.txt
echo " # * Large Database Query Test (LDQ) " >> ldq.txt
echo " " >> ldq.txt
echo "host=localhost,jvms=$JVMS,java=( java,-d64,-Xmx2048m) " >> ldq.txt
for x in $FullClients
do
echo "host=($x),jvms=$JVMS,java=( java,-d64,-Xmx2048m),shell=spc2 " >> ldq.txt
done
for x in $MaxClients
```

```
do
echo "host=($x),maxstreams=$MaxStreamsLDQ,jvms=$JVMS,java=( java,-d64,-
Xmx2048m),shell=spc2 " >> ldq.txt
done
echo "sd=default,size=$size " >> ldq.txt
echo " " >> ldq.txt

for Slave in localhost
do

counter=`ls /dev/rdisk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
for x in `cat disk1`
do
echo "sd=sd$count,host=$Slave,lun=$x " >>ldq.txt
count=`expr $count + 1`
done
done
echo " " >>ldq.txt
done

for Slave in $Clients
do

counter=`ls /dev/rdisk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
for x in `cat disk1`
do
echo "sd=sd$count,host=$Slave,lun=$x " >>ldq.txt
count=`expr $count + 1`
done
done
echo " " >>ldq.txt
done
echo " " >>ldq.txt
#
echo " " >>ldq.txt
echo "maxlateststart=0" >>ldq.txt
echo "reportinginterval=5" >>ldq.txt
echo "segmentlength=512m " >>ldq.txt
echo " " >>ldq.txt
echo
"rd=default,rdpct=99,rampup=180,periods=90,measurement=600,runout=45,rampdown=15"
>>ldq.txt
cat $LDQ >>ldq.txt
echo " " >>ldq.txt
# Now we start building the LFP file
#
# LFP is next
echo " LFP file is being created"
echo " "
sleep 3
touch lfp.txt
echo " " >> lfp.txt
echo " # * Large File Processing Test (LFP) " >> lfp.txt
echo " " >> lfp.txt
echo "host=localhost,jvms=$JVMS,java=( java,-d64,-Xmx2048m) " >> lfp.txt
for x in $FullClients
do
```

```
echo "host=( $x ), jvms=$JVMS, java=( java, -d64, -Xmx2048m ), shell=spc2 " >> lfp.txt
done
for x in $MaxClients
do
echo "host=( $x ), maxstreams=$MaxStreamsLFP, jvms=$JVMS, java=( java, -d64, -
Xmx2048m ), shell=spc2 " >> lfp.txt
done
echo "sd=default, size=$size " >> lfp.txt
echo " " >> lfp.txt

for Slave in localhost
do
counter=`ls /dev/rdisk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
for x in `cat disk1`
do
echo "sd=sd$count, host=$Slave, lun=$x " >>lfp.txt
count=`expr $count + 1`
done
done
echo " " >>lfp.txt
done
echo " "

for Slave in $Clients
do
counter=`ls /dev/rdisk/$Cid*d0s2 | wc -l`
count=1
while (test "$count" -lt "$counter")
do
for x in `cat disk1`
#for x in `cat $Slave`
do
echo "sd=sd$count, host=$Slave, lun=$x " >>lfp.txt
count=`expr $count + 1`
done
done
echo " " >>lfp.txt
done
echo " "
#
echo " " >>lfp.txt
echo "maxlatestart=0" >>lfp.txt
echo "reportinginterval=5" >>lfp.txt
echo "segmentlength=512m " >>lfp.txt
echo " " >>lfp.txt
echo
"rd=default, rampup=180, periods=90, measurement=600, runout=45, rampdown=15, buffers=1"
>>lfp.txt
cat $LFP >>lfp.txt
#
mv v.txt spc2-vod.txt
mv p1.txt spc2-persist1.txt
mv pre.txt spc2-pre.txt
mv post.txt spc2-post.txt
mv p2.txt spc2-persist2.txt
mv ldq.txt spc2-ldq.txt
mv lfp.txt spc2-lfp.txt
mv pc.txt pre.txt
#
```

```
# Create prtvtoc.txt file
cat disk1 | sed 's/s0/s2/g' > disk2
mv disk2 disk1
echo " Prtvtoc file is being created"
echo " "
sleep 3
touch prtvtoc.txt
for x in `cat disk1`
do
prtvtoc $x >> prtvtoc.txt
done
mv disk1 disklist.txt
rm disk disks
# Get a hardware and volume listing from Cluster
echo " Create Hardware and Volume list"
# This section replaces Get_Hardware_list.sh

#
AR_HOSTNAME_C=sbm-7330c
AR_HOSTNAME_B=sbm-7330b

echo "Hardware listing from Controller_${AR_HOSTNAME_C} " > C-Controller_hw_list.txt
echo "Hardware listing from Controller_${AR_HOSTNAME_B} " > B-Controller_hw_list.txt

ssh -T ${AR_HOSTNAME_C} <<EOF >> C-Controller_hw_list.txt
script
  run('maintenance hardware');
  lines = run('show');

  for (i = 0; i < lines.length; i++) {
    printf("%s", lines[i])
  }

  run('done');
EOF
echo "##### " >> C-Controller_hw_list.txt
echo "##### " >> C-Controller_hw_list.txt
echo " " >> C-Controller_hw_list.txt

ssh -T ${AR_HOSTNAME_B} <<EOF >> B-Controller_hw_list.txt
script
  run('maintenance hardware');
  lines = run('show');

  for (i = 0; i < lines.length; i++) {
    printf("%s", lines[i])
  }

  run('done');
EOF
echo " " >> B-Controller_hw_list.txt

cat C-Controller_hw_list.txt B-Controller_hw_list.txt > Cluster_HW_List.txt
rm *_hw_list.txt

echo "Volume listing from Controller_${AR_HOSTNAME_C} " > Lun_List_Controller_C.txt
echo "Volume listing from Controller_${AR_HOSTNAME_B} " > Lun_List_Controller_B.txt

for x in C-pool
do
echo "Volume listing from $x " >> Lun_List_Controller_C.txt
ssh -T ${AR_HOSTNAME_C} <<EOF >> Lun_List_Controller_C.txt
script
```



```
    run('shares');
run('set pool=$x');
    run('select default');
    print(run('list lun'))
    run('done');
EOF
echo " " >> Lun_List_Controller_C.txt
done

for x in B-pool
do
echo "Volume listing from $x " >> Lun_List_Controller_B.txt
ssh -T $AR_HOSTNAME_B <<EOF >> Lun_List_Controller_B.txt
script
    run('shares');
    run('set pool=$x');
    run('select default');
    print(run('list lun'))
    run('done');
EOF
echo " " >> Lun_List_Controller_B.txt
done

#
cat Lun_List*.txt > Cluster_Lun_List.txt
rm Lun_List*.txt
#

#

echo " "
# Copy all files to the config directory
echo " "
echo " All files are being copied to $output"
echo " "
sleep 3
cp * $output
echo " "
echo " "
echo " "
banner " Done Deal"
echo " "
```

ldq-Cluster.txt

```
* LDQ, 1024 KiB Test Phase
* Test Run Sequence 1
rd=default,xfersize=1024k,buffers=4
rd=TR1-s256_SPC-2-DQ,streams=256
rd=TR2-s128_SPC-2-DQ,streams=128
rd=TR3-s64_SPC-2-DQ,streams=64
rd=TR4-s32_SPC-2-DQ,streams=32
rd=TR5-s1_SPC-2-DQ,streams=1

* Test Run Sequence 2
rd=default,buffers=1
rd=TR6-s256_SPC-2-DQ,streams=256
rd=TR7-s128_SPC-2-DQ,streams=128
rd=TR8-s64_SPC-2-DQ,streams=64
rd=TR9-s32_SPC-2-DQ,streams=32
rd=TR10-s1_SPC-2-DQ,streams=1
```

```
* LDQ, 64 KiB Test Phase

* Test Run Sequence 3
rd=default,xfersize=64k,buffers=4
rd=TR11-s512_SPC-2-DQ,streams=512
rd=TR12-s256_SPC-2-DQ,streams=256
rd=TR13-s128_SPC-2-DQ,streams=128
rd=TR14-s64_SPC-2-DQ,streams=64
rd=TR15-s1_SPC-2-DQ,streams=1

* Test Run Sequence 4
rd=default,buffers=1
rd=TR16-s1024_SPC-2-DQ,streams=1024
rd=TR17-s512_SPC-2-DQ,streams=512
rd=TR18-s256_SPC-2-DQ,streams=256
rd=TR19-s128_SPC-2-DQ,streams=128
rd=TR20-s1_SPC-2-DQ,streams=1
```

lfp-Cluster.txt

```
* LFP, "write" Test Phase

* Test Run Sequence 1
rd=default,rdpct=0,xfersize=1024k
rd=TR1-s512_SPC-2-FP,streams=512
rd=TR2-s256_SPC-2-FP,streams=256
rd=TR3-s128_SPC-2-FP,streams=128
rd=TR4-s64_SPC-2-FP,streams=64
rd=TR5-s1_SPC-2-FP,streams=1

* Test Run Sequence 2
rd=default,xfersize=256k
rd=TR6-s1024_SPC-2-FP,streams=1024
rd=TR7-s512_SPC-2-FP,streams=512
rd=TR8-s256_SPC-2-FP,streams=256
rd=TR9-s128_SPC-2-FP,streams=128
rd=TR10-s1_SPC-2-FP,streams=1

* LFP, "read-write" Test Phase

* Test Run Sequence 3
rd=default,rdpct=50,xfersize=1024k
rd=TR11-s2048_SPC-2-FP,streams=2048
rd=TR12-s1024_SPC-2-FP,streams=1024
rd=TR13-s512_SPC-2-FP,streams=512
rd=TR14-s256_SPC-2-FP,streams=256
rd=TR15-s1_SPC-2-FP,streams=1

* Test Run Sequence 4
rd=default,xfersize=256k
rd=TR16-s1024_SPC-2-FP,streams=1024
rd=TR17-s512_SPC-2-FP,streams=512
rd=TR18-s256_SPC-2-FP,streams=256
rd=TR19-s128_SPC-2-FP,streams=128
rd=TR20-s1_SPC-2-FP,streams=1

* LFP, "read" Test Phase

* Test Run Sequence 5
rd=default,rdpct=100,xfersize=1024k
rd=TR21-s256_SPC-2-FP,streams=256
rd=TR22-s128_SPC-2-FP,streams=128
```

```
rd=TR23-s64_SPC-2-FP,streams=64
rd=TR24-s32_SPC-2-FP,streams=32
rd=TR25-s1_SPC-2-FP,streams=1

* Test Run Sequence 6
rd=default,xfersize=256k
rd=TR26-s1025_SPC-2-FP,streams=1024
rd=TR27-s512_SPC-2-FP,streams=512
rd=TR28-s256_SPC-2-FP,streams=256
rd=TR29-s128_SPC-2-FP,streams=128
rd=TR30-s1_SPC-2-FP,streams=1
```

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

ASU Pre-Fill

```
compratio=1
sd=default,th=1
sd=sd1,lun=/dev/rdisk/c0t600144F0971F781900005325D1790001d0s0
sd=sd2,lun=/dev/rdisk/c0t600144F0971F781900005325D1880002d0s0
sd=sd3,lun=/dev/rdisk/c0t600144F0971F781900005325D1960003d0s0
sd=sd4,lun=/dev/rdisk/c0t600144F0971F781900005325D1A70004d0s0
sd=sd5,lun=/dev/rdisk/c0t600144F0971F781900005325D1B90005d0s0
sd=sd6,lun=/dev/rdisk/c0t600144F0971F781900005325D1CB0006d0s0
sd=sd7,lun=/dev/rdisk/c0t600144F0971F781900005325D1DE0007d0s0
sd=sd8,lun=/dev/rdisk/c0t600144F0971F781900005325D1F00008d0s0
sd=sd9,lun=/dev/rdisk/c0t600144F0971F781900005325D2060009d0s0
sd=sd10,lun=/dev/rdisk/c0t600144F0971F781900005325D21C000Ad0s0
sd=sd11,lun=/dev/rdisk/c0t600144F0971F781900005325D22D000Bd0s0
sd=sd12,lun=/dev/rdisk/c0t600144F0971F781900005325D23E000Cd0s0
sd=sd13,lun=/dev/rdisk/c0t600144F0971F781900005325D256000Dd0s0
sd=sd14,lun=/dev/rdisk/c0t600144F0971F781900005325D26F000Ed0s0
sd=sd15,lun=/dev/rdisk/c0t600144F0971F781900005325D282000Fd0s0
sd=sd16,lun=/dev/rdisk/c0t600144F0971F781900005325D2950010d0s0
sd=sd17,lun=/dev/rdisk/c0t600144F0971F781900005325D2A60011d0s0
sd=sd18,lun=/dev/rdisk/c0t600144F0971F781900005325D2BB0012d0s0
sd=sd19,lun=/dev/rdisk/c0t600144F0971F781900005325D2CD0013d0s0
sd=sd20,lun=/dev/rdisk/c0t600144F0971F781900005325D2DF0014d0s0
sd=sd21,lun=/dev/rdisk/c0t600144F0971F781900005325D2F10015d0s0
sd=sd22,lun=/dev/rdisk/c0t600144F0971F781900005325D3060016d0s0
sd=sd23,lun=/dev/rdisk/c0t600144F0971F781900005325D3170017d0s0
sd=sd24,lun=/dev/rdisk/c0t600144F0971F781900005325D32A0018d0s0
sd=sd25,lun=/dev/rdisk/c0t600144F0971F781900005325D3350019d0s0
sd=sd26,lun=/dev/rdisk/c0t600144F0971F781900005325D347001Ad0s0
sd=sd27,lun=/dev/rdisk/c0t600144F0971F781900005325D358001Bd0s0
sd=sd28,lun=/dev/rdisk/c0t600144F0971F781900005325D36B001Cd0s0
sd=sd29,lun=/dev/rdisk/c0t600144F0971F781900005325D37A001Dd0s0
sd=sd30,lun=/dev/rdisk/c0t600144F0971F781900005325D38B001Ed0s0
sd=sd31,lun=/dev/rdisk/c0t600144F0971F781900005325D39F001Fd0s0
sd=sd32,lun=/dev/rdisk/c0t600144F0971F781900005325D3B20020d0s0
sd=sd33,lun=/dev/rdisk/c0t600144F0971F781900005325D3C40021d0s0
sd=sd34,lun=/dev/rdisk/c0t600144F0971F781900005325D3D40022d0s0
sd=sd35,lun=/dev/rdisk/c0t600144F0971F781900005325D3E40023d0s0
sd=sd36,lun=/dev/rdisk/c0t600144F0971F781900005325D3F50024d0s0
sd=sd37,lun=/dev/rdisk/c0t600144F0971F781900005325D4090025d0s0
sd=sd38,lun=/dev/rdisk/c0t600144F0971F781900005325D41D0026d0s0
sd=sd39,lun=/dev/rdisk/c0t600144F0971F781900005325D4360027d0s0
sd=sd40,lun=/dev/rdisk/c0t600144F0971F781900005325D4470028d0s0
sd=sd41,lun=/dev/rdisk/c0t600144F0971F781900005325D4580029d0s0
sd=sd42,lun=/dev/rdisk/c0t600144F0971F781900005325D46B002Ad0s0
sd=sd43,lun=/dev/rdisk/c0t600144F0971F781900005325D47C002Bd0s0
sd=sd44,lun=/dev/rdisk/c0t600144F0971F781900005325D48D002Cd0s0
sd=sd45,lun=/dev/rdisk/c0t600144F0971F781900005325D49E002Dd0s0
sd=sd46,lun=/dev/rdisk/c0t600144F0971F781900005325D4AC002Ed0s0
sd=sd47,lun=/dev/rdisk/c0t600144F0971F781900005325D4BD002Fd0s0
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sd=sd53,lun=/dev/rdisk/c0t600144F0971F781900005325D5280035d0s0
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sd=sd242, lun=/dev/rdisk/c0t600144F0EE27827200005325D9C60072d0s0

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sd=sd245,lun=/dev/rdisk/c0t600144F0EE27827200005325D9CE0075d0s0
sd=sd246,lun=/dev/rdisk/c0t600144F0EE27827200005325D9D10076d0s0
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sd=sd250,lun=/dev/rdisk/c0t600144F0EE27827200005325D9DC007Ad0s0
sd=sd251,lun=/dev/rdisk/c0t600144F0EE27827200005325D9DF007Bd0s0
sd=sd252,lun=/dev/rdisk/c0t600144F0EE27827200005325D9E1007Cd0s0
sd=sd253,lun=/dev/rdisk/c0t600144F0EE27827200005325D9E4007Dd0s0
sd=sd254,lun=/dev/rdisk/c0t600144F0EE27827200005325D9E7007Ed0s0
sd=sd255,lun=/dev/rdisk/c0t600144F0EE27827200005325D9EA007Fd0s0
sd=sd256,lun=/dev/rdisk/c0t600144F0EE27827200005325D9EC0080d0s0
```

```
wd=wd1,sd=sd*,seekpct=eof,rdpct=0,xfersize=1m
rd=rd1,wd=wd*,elapsed=72h,interval=60,iorate=max
```

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

The following command/parameter lines appear in each of the command and parameter files for the Idle (Pre-Idle and Post-Idle Phases), 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.

```
host=localhost,jvms=1,java=(java,-d64,-Xmx2048m)
host=(sbm-4170m2h),jvms=1,java=(java,-d64,-Xmx2048m),shell=spc2
host=(sbm-4170m2e),jvms=1,java=(java,-d64,-Xmx2048m),shell=spc2
host=(sbm-4170m2f),jvms=1,java=(java,-d64,-Xmx2048m),shell=spc2
host=(sbm-4170m2g),jvms=1,java=(java,-d64,-Xmx2048m),shell=spc2
host=(sbm-4170m2b),jvms=1,java=(java,-d64,-Xmx2048m),shell=spc2
sd=default,size=94479826432
```

```
sd=sd1,host=localhost,lun=/dev/rdisk/c0t600144F0971F781900005325D1790001d0s0
sd=sd2,host=localhost,lun=/dev/rdisk/c0t600144F0971F781900005325D1880002d0s0
sd=sd3,host=localhost,lun=/dev/rdisk/c0t600144F0971F781900005325D1960003d0s0
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sd=sd156,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D8F4001Cd0s0
sd=sd157,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D8F7001Dd0s0
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sd=sd243,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9C90073d0s0
sd=sd244,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9CC0074d0s0
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sd=sd246,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9D10076d0s0
sd=sd247,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9D40077d0s0
sd=sd248,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9D70078d0s0
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sd=sd250,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9DC007Ad0s0
sd=sd251,host=sbm-4170m2b,lun=/dev/rdsk/c0t600144F0EE27827200005325D9DF007Bd0s0
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```
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sd=sd255,host=sbm-4170m2b,lun=/dev/rdisk/c0t600144F0EE27827200005325D9EA007Fd0s0
sd=sd256,host=sbm-4170m2b,lun=/dev/rdisk/c0t600144F0EE27827200005325D9EC0080d0s0
```

Pre-Idle Phase

```
# Pre_idle
```

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

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

```
rd=default,rampup=180,measurement=600,runout=45,rampdown=15,buffers=1,periods=90
rd=default,rdpct=50,xfersize=1024k
rd=TR11-s2048_SPC-2-FP,streams=2048
```

Post-Idle Phase

```
# Post_idle
```

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

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

```
rd=default,rampup=180,measurement=600,runout=45,rampdown=15,buffers=1,periods=90
rd=default,rdpct=50,xfersize=1024k
rd=TR13-s512_SPC-2-FP,streams=512
```

Large File Processing Test (LFP)

```
# * Large File Processing Test (LFP)
```

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

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

```
rd=default,rampup=180,periods=90,measurement=600,runout=45,rampdown=15,buffers=1
```

```
* LFP, "write" Test Phase
```

```
* Test Run Sequence 1
```

```
rd=default,rdpct=0,xfersize=1024k
rd=TR1-s512_SPC-2-FP,streams=512
rd=TR2-s256_SPC-2-FP,streams=256
rd=TR3-s128_SPC-2-FP,streams=128
rd=TR4-s64_SPC-2-FP,streams=64
rd=TR5-s1_SPC-2-FP,streams=1
```

```
* Test Run Sequence 2
```

```
rd=default,xfersize=256k
rd=TR6-s1024_SPC-2-FP,streams=1024
rd=TR7-s512_SPC-2-FP,streams=512
```

```
rd=TR8-s256_SPC-2-FP,streams=256
rd=TR9-s128_SPC-2-FP,streams=128
rd=TR10-s1_SPC-2-FP,streams=1

* LFP, "read-write" Test Phase

* Test Run Sequence 3
rd=default,rdpct=50,xfersize=1024k
rd=TR11-s2048_SPC-2-FP,streams=2048
rd=TR12-s1024_SPC-2-FP,streams=1024
rd=TR13-s512_SPC-2-FP,streams=512
rd=TR14-s256_SPC-2-FP,streams=256
rd=TR15-s1_SPC-2-FP,streams=1

* Test Run Sequence 4
rd=default,xfersize=256k
rd=TR16-s1024_SPC-2-FP,streams=1024
rd=TR17-s512_SPC-2-FP,streams=512
rd=TR18-s256_SPC-2-FP,streams=256
rd=TR19-s128_SPC-2-FP,streams=128
rd=TR20-s1_SPC-2-FP,streams=1

* LFP, "read" Test Phase

* Test Run Sequence 5
rd=default,rdpct=100,xfersize=1024k
rd=TR21-s256_SPC-2-FP,streams=256
rd=TR22-s128_SPC-2-FP,streams=128
rd=TR23-s64_SPC-2-FP,streams=64
rd=TR24-s32_SPC-2-FP,streams=32
rd=TR25-s1_SPC-2-FP,streams=1

* Test Run Sequence 6
rd=default,xfersize=256k
rd=TR26-s1025_SPC-2-FP,streams=1024
rd=TR27-s512_SPC-2-FP,streams=512
rd=TR28-s256_SPC-2-FP,streams=256
rd=TR29-s128_SPC-2-FP,streams=128
rd=TR30-s1_SPC-2-FP,streams=1
```

Large Database Query Test (LDQ)

* Large Database Query Test (LDQ)

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

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

rd=default,rdpct=99,rampup=180,periods=90,measurement=600,runout=45,rampdown=15
* LDQ, 1024 KiB Test Phase
* Test Run Sequence 1
rd=default,xfersize=1024k,buffers=4
rd=TR1-s256_SPC-2-DQ,streams=256
rd=TR2-s128_SPC-2-DQ,streams=128
rd=TR3-s64_SPC-2-DQ,streams=64
rd=TR4-s32_SPC-2-DQ,streams=32
rd=TR5-s1_SPC-2-DQ,streams=1

* Test Run Sequence 2
rd=default,buffers=1
```

```
rd=TR6-s256_SPC-2-DQ,streams=256
rd=TR7-s128_SPC-2-DQ,streams=128
rd=TR8-s64_SPC-2-DQ,streams=64
rd=TR9-s32_SPC-2-DQ,streams=32
rd=TR10-s1_SPC-2-DQ,streams=1
```

* LDQ, 64 KiB Test Phase

```
* Test Run Sequence 3
rd=default,xfersize=64k,buffers=4
rd=TR11-s512_SPC-2-DQ,streams=512
rd=TR12-s256_SPC-2-DQ,streams=256
rd=TR13-s128_SPC-2-DQ,streams=128
rd=TR14-s64_SPC-2-DQ,streams=64
rd=TR15-s1_SPC-2-DQ,streams=1
```

```
* Test Run Sequence 4
rd=default,buffers=1
rd=TR16-s1024_SPC-2-DQ,streams=1024
rd=TR17-s512_SPC-2-DQ,streams=512
rd=TR18-s256_SPC-2-DQ,streams=256
rd=TR19-s128_SPC-2-DQ,streams=128
rd=TR20-s1_SPC-2-DQ,streams=1
```

Logical Volume Initialization and Video on Demand Delivery (VOD)

Video on Demand Test (VOD)

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

```
maxlatestart=0
videosegmentduration=1200
maxlatevod=0
#reportinginterval=15
reportinginterval=5

rd=default,rampup=1200,periods=600,measurement=7200,runout=45,rampdown=15,buffers=8
rd=TR1-24000s_SPC-2-VOD,streams=24000

# To start slaves, run:
# nohup java -d64 -cp . RemoteStart > nohup.sbm-4170m2h.out 2>&1 &
# nohup java -d64 -cp . RemoteStart > nohup.sbm-4170m2e.out 2>&1 &
# nohup java -d64 -cp . RemoteStart > nohup.sbm-4170m2f.out 2>&1 &
# nohup java -d64 -cp . RemoteStart > nohup.sbm-4170m2g.out 2>&1 &
# nohup java -d64 -cp . RemoteStart > nohup.sbm-4170m2b.out 2>&1 &
#Or nohup java -d64 -cp . RemoteStart > nohup.`hostname`.out 2>&1 &
# On each Client
```

SPC-2 Persistence Test Run 1 (*write phase*)

Persist 1

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

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

rd=default,rampup=180,periods=90,measurement=300,runout=0,rampdown=0,buffers=1
rd=default,rdpct=0,xfersize=1024k
rd=TR1-1024s_SPC-2-persist-w,streams=1024
```

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

Persistence Test Run 2

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

```
maxlatestart=1
reportinginterval=5
segmentlength=512m
maxpersistenceerrors=10

*corruptstreams=3
rd=default,buffers=1,rdpct=100,xfersize=1024k
rd=TR1-1024s_SPC-2-persist-r
```

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

ASU Pre-Fill, Idle Test, Large File Processing Test, Large Database Query Test, Video on Demand Delivery Test, and SPC-2 Persistence Test Run 1

The following script, **run-spc2-7330b.sh**, executes the following:

- The required ASU pre-fill
- The SPC-1/E Idle Test
- The SPC-2 Tests:
 - Large File Processing (LPF)
 - Video on Demand (VOD)
 - Large Database Query (LDQ)
 - SPC-2 Persistence – Test Run 1 (*write phase*)
- Various ‘housekeeping’ in support of the test execution

run-spc2-7330b.sh

```
#!/usr/bin/ksh
#
set -x
#
Controller_C=sbm-7330c
Controller_B=sbm-7330b
#####
# SPC2 execution
RUN=AUDIT-1 # 4-20-2014      Full run Testing SPC2e scripts with pre idle and post

#####
#
precond="yes"   # set to "yes" or "no"
runspc="yes"   # set to "yes" or "no"
Persist2="no"  # set to "yes" or "no"

# Set SPC2 Output options
#
script=run-spc2-7330b.sh
output=$RUN
basedir=/spc/output/spc2/7330b/12T/
outdir=$basedir/$output
config=/spc/config/spc2/sbm-7330c
mkdir -p $outdir

# Optional preconditioning:
if [[ $precond = "yes" ]]; then

echo "Preconditioning will now start "

# Run pre conditioning:

##### Pre-Fill via vdbench
/vdbench/vdbench503rc11/vdbench -f $config/pre.txt -o $outdir/pre-1/
cp $config/pre.txt $outdir/pre-1/
fi # 'fi' for the above 'if [[ $precond = "yes" ]]'

if [[ $runspc = "yes" ]]; then
```

```
#### Gather Master client info and tunables
cp $script $outdir
hostdir=$outdir/HostP1
mkdir -p $hostdir
cp /etc/system $hostdir

#### Get config files and prtvtoc
cp -r /spc/spc2-2013/SPC2/Config-ZS3-2-Cluster $outdir/
####
#### Run- INIT LFP VOD LDQ

#### INIT All Volumes via VOD parameter file
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-vod.txt -o$outdir/init -
init

##### Pre Idle
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-pre.txt -o $outdir/pre-MH/

##### Sleep for 2400
sleep 2400

##### Post Idle
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-post.txt -o $outdir/post-
MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-lfp.txt -o $outdir/lfp-MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-vod.txt -o $outdir/vod-MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-ldq.txt -o $outdir/ldq-MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-persist1.txt -o
$outdir/persist1/
cp $config/spc2-persist1.txt $outdir
cp $config/spc2-lfp.txt $outdir
cp $config/spc2-post.txt $outdir
cp $config/spc2-ldq.txt $outdir
cp $config/spc2-vod.txt $outdir
cp $config/spc2-pre.txt $outdir
fi
##### Persist 2
if [[ $Persist2 = "yes" ]]; then
cp $script $outdir/$script-P2
java -d64 -Xmx8192m -cp . vdbench -wSPC2 -f $config/spc2-persist2.txt -o
$outdir/persist2/
sleep 5
cp $config/spc2-persist2.txt $outdir
sleep 5
fi
#### Create Archive

cd $basedir ;/bin/chmod -R 777 $output ;mv $output.zip $output.zip-P1 ;/usr/bin/zip
-r $output.zip $output
#
####nohup java -d64 -cp . RemoteStart > nohup.`hostname`.out 2>&1 &
```

SPC-2 Persistence Test Run 2

The following script, **run-spc2-7330b.sh-P2**, was invoked to execute SPC-2 Persistence Test Run 2 (*read phase*) after the required TSC power off/power on cycle.

run-spc2-7330b.sh-P2

```
#!/usr/bin/ksh
#
set -x
#
Controller_C=sbm-7330c
Controller_B=sbm-7330b
#####
# SPC2 execution
RUN=AUDIT-1 # 4-20-2014      Full run Testing SPC2e scripts with pre idle and post

#####
#
precond="no" # set to "yes" or "no"
runspc="no" # set to "yes" or "no"
Persist2="yes" # set to "yes" or "no"

# Set SPC2 Output options
#
script=run-spc2-7330b.sh
output=$RUN
basedir=/spc/output/spc2/7330b/12T/
outdir=$basedir/$output
config=/spc/config/spc2/sbm-7330c
mkdir -p $outdir

# Optional preconditioning:
if [[ $precond = "yes" ]]; then

echo "Preconditioning will now start "

# Run pre conditioning:

##### Pre-Fill via vdbench
/vdbench/vdbench503rc11/vdbench -f $config/pre.txt -o $outdir/pre-1/
cp $config/pre.txt $outdir/pre-1/
fi # 'fi' for the above 'if [[ $precond = "yes" ]]'

if [[ $runspc = "yes" ]]; then

#### Gather Master client info and tunables
cp $script $outdir
hostdir=$outdir/HostP1
mkdir -p $hostdir
cp /etc/system $hostdir

#### Get config files and prtvtoc
cp -r /spc/spc2-2013/SPC2/Config-ZS3-2-Cluster $outdir/
####
#### Run- INIT LFP VOD LDQ

#### INIT All Volumes via VOD parameter file
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-vod.txt -o$outdir/init -
init
```

```
##### Pre Idle
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-pre.txt -o $outdir/pre-MH/

##### Sleep for 2400
sleep 2400

##### Post Idle
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-post.txt -o $outdir/post-
MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-lfp.txt -o $outdir/lfp-MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-vod.txt -o $outdir/vod-MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-ldq.txt -o $outdir/ldq-MH/
java -d64 -Xmx2024m -cp . vdbench -wSPC2 -f $config/spc2-persist1.txt -o
$outdir/persist1/
cp $config/spc2-persist1.txt $outdir
cp $config/spc2-lfp.txt $outdir
cp $config/spc2-post.txt $outdir
cp $config/spc2-ldq.txt $outdir
cp $config/spc2-vod.txt $outdir
cp $config/spc2-pre.txt $outdir
fi
##### Persist 2
if [[ $Persist2 = "yes" ]]; then
cp $script $outdir/$script-P2
java -d64 -Xmx8192m -cp . vdbench -wSPC2 -f $config/spc2-persist2.txt -o
$outdir/persist2/
sleep 5
cp $config/spc2-persist2.txt $outdir
sleep 5
fi
#### Create Archive

cd $basedir ;/bin/chmod -R 777 $output ;mv $output.zip $output.zip-P1 ;/usr/bin/zip
-r $output.zip $output
#
###nohup java -d64 -cp . RemoteStart > nohup.`hostname`.out 2>&1 &
```