SPC BENCHMARK 2™

FULL DISCLOSURE REPORT

TELECOMMUNICATIONS TECHNOLOGY ASSOCIATION

GLUESYS ANYSTOR-700ED

SPC-2™ V1.8.0

SUBMISSION IDENTIFIER: B12007

SUBMITTED FOR REVIEW: DECEMBER 29, 2020

First Edition – December 2020

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Benchmark Specification and Glossary

The official SPC Benchmark 2™ (SPC-2™) specification is available on the website of the Storage Performance Council (SPC) at www.spcresults.org.

The SPC-2™ specification contains a glossary of the SPC-2™ terms used in this publication.

Table of Contents

AUDIT CERTIFICATION

InfoSizing
The Right Metric For Sizing IT

Storage Performance Council
Certified Auditor

Hyo-Sil Kim
Telecommunications Technology Association
47, Bundang-ro, Bundang-gu, Seongnam-city,
Gyeonggi-do, 13591, Republic of Korea

December 28, 2020

I verified the SPC Benchmark 2™ (SPC-2 ™ v1.8.0) test execution and performance results of the following Tested Storage Product:

Gluesys AnyStor-700ED

The results were:

SPC-2 MBPS™	**10,987.03**
SPC-2 Price-Performance	**$3.43/SPC-2 MBPS™**
SPC-2 Total System Price	$37,625.50
SPC-2 LFP Composite	9,817.57 MB/s
SPC-2 LDQ Composite	12,133.94 MB/s
SPC-2 VOD Data Rate	11,009.57 MB/s
SPC-2 ASU Capacity	17,592 GB
SPC-2 ASU Price	$2.14/GB

In my opinion, these performance results were produced in compliance with the SPC requirements for the benchmark.

The testing was executed using the SPC-2 Toolkit Version v1.3.4. The audit process was conducted in accordance with the SPC Policies and met the requirements for the benchmark.

A Letter of Good Faith was issued by Telecommunications Technology Association, stating the accuracy and completeness of the documentation and testing data provided in support of the audit of this result.

A Full Disclosure Report for this result was prepared by InfoSizing, reviewed and approved by Telecommunications Technology Association, and can be found at www.spcresults.org under the Submission Identifier B12007.

63 Lourdes Dr. | Leominster, MA 01453 | 978-343-6562 | www.sizing.com

The independent audit process conducted by InfoSizing included the verifications of the following items:

- The physical capacity of the data repository (46,089 GB).
- The total capacity of the Application Storage Unit (17,592 GB).
- The accuracy of the Benchmark Configuration diagram
- The tuning parameters used to configure the Benchmark Configuration
- The Workload Generator commands used to execute the testing.
- The validity and integrity of the test result files.
- The compliance of the results from each performance test.
- The compliance of the results from each persistence test.
- The compliance of the submitted pricing model.
- The differences between the tested and the priced configuration, if any.

The Full Disclosure Report for this result was prepared in accordance with the disclosure requirements set forth in the specification for the benchmark.

The following benchmark requirements, if any, were waived in accordance with the SPC Policies:

None.

Respectfully Yours,

Doug Johnson, Certified SPC Auditor

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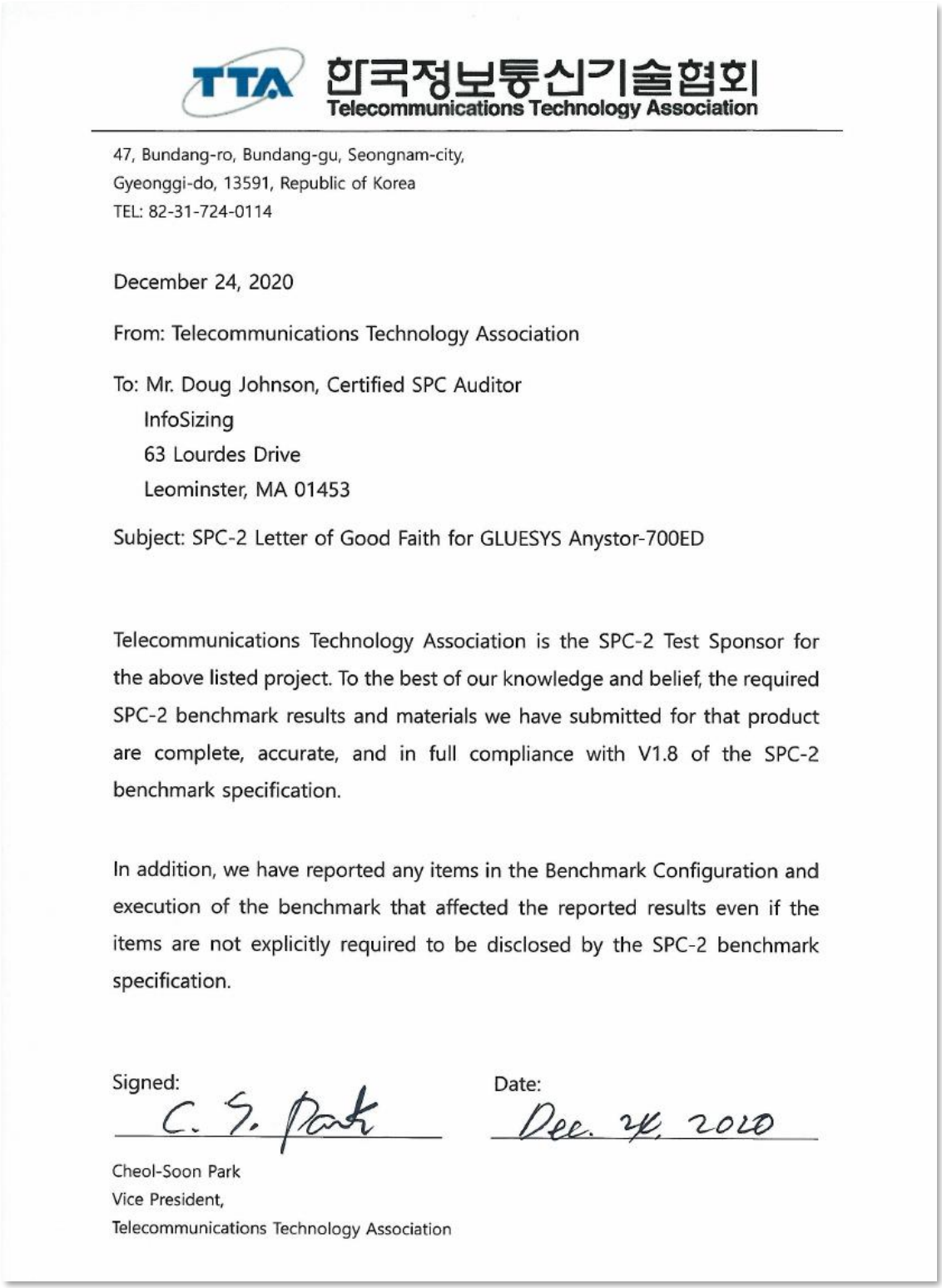
LETTER OF GOOD FAITH



TTA 한국정보통신기술협회
Telecommunications Technology Association

47, Bundang-ro, Bundang-gu, Seongnam-city,
Gyeonggi-do, 13591, Republic of Korea
TEL: 82-31-724-0114

December 24, 2020

From: Telecommunications Technology Association

To: Mr. Doug Johnson, Certified SPC Auditor
InfoSizing
63 Lourdes Drive
Leominster, MA 01453

Subject: SPC-2 Letter of Good Faith for GLUESYS Anystor-700ED

Telecommunications Technology Association is the SPC-2 Test Sponsor for the above listed project. To the best of our knowledge and belief, the required SPC-2 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V1.8 of the SPC-2 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-2 benchmark specification.

Signed: C. S. Park Date: Dec. 24, 2020

Cheol-Soon Park
Vice President,
Telecommunications Technology Association

SPC Benchmark 2™

Executive Summary

Gluesys AnyStor-700ED

SPC-2 MBPS™	**10,987.03**
SPC-2 LFP Composite	9,817.57 MB/s
SPC-2 LDQ Composite	12,133.94 MB/s
SPC-2 VOD Data Rate	11,009.57 MB/s

SPC-2 Price Performance	**$3.43/SPC-2 MBPS™**
SPC-2 LFP Price-Performance	$3.83/MBPS
SPC-2 LDQ Price-Performance	$3.10/MBPS
SPC-2 VOD Price-Performance	$3.42/MBPS

Storage Metrics

SPC-2 Data Protection Level	Protected 2
SPC-2 Physical Storage Capacity	46,089 GB
SPC-2 ASU Capacity	17,592 GB
SPC-2 ASU Price	$2.14/GB

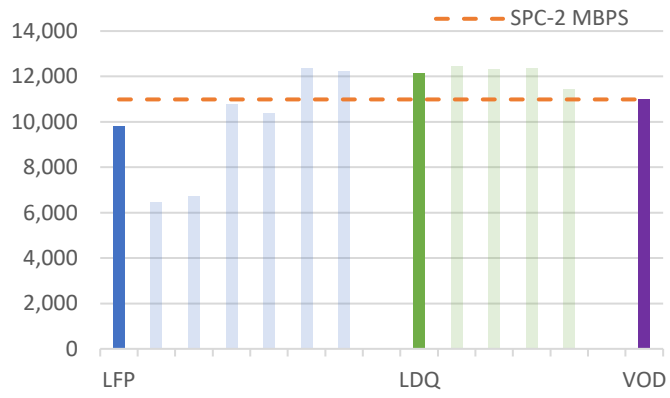
Pricing Summary

SPC-2 Total System Price	$37,625.50
SPC-2 Overall Discount	50.00%
Currency / Target Country	USD / Republic of Korea
Availability Date	Currently Available

Priced Storage Configuration Summary

4	QLogic QLE292 16 Gbps FC 2-port HBAs
1	Gluesys AnyStor-700D
2	Controllers
64	GB Total Cache
8	16Gbps FC Ports
24	1.92 TB SSDs
4	Total RUs

Data Rate Summary (MB/s)



Large File Processing (LFP) Summary

	MB/s	Streams	Per Stream
Write Only			
1,024 KiB Xfer	6,464.24	24	269.34
256 KiB Xfer	6,723.01	32	210.09
Read / Write			
1,024 KiB Xfer	10,763.45	48	224.24
256 KiB Xfer	10,369.08	72	144.02
Read Only			
1,024 KiB Xfer	12,350.36	48	257.30
256 KiB Xfer	12,235.29	96	127.45

Large Database Query (LDQ) Summary

	MB/s	Streams	Per Stream
1,024 KiB Xfer			
4 I/Os Outstanding	12,432.21	16	777.01
1 I/O Outstanding	12,306.58	36	341.85
64 KiB Xfer			
4 I/Os Outstanding	12,360.17	128	96.56
1 I/O Outstanding	11,436.81	160	71.48

Video on Demand (VOD) Summary

Streams	14,000	Per Stream	0.79 MB/s

SPC Benchmark 2™ Specification Revision	v1.8.0
SPC Benchmark 2™ Workload Generator Revision	v1.3.4

Submitted for Review	December 29, 2020
Submission Details	www.storageperformance.org/r/B12007

PRICING DETAILS

Part No.	Description	Source	Qty	Unit Price	Ext. Price	Disc.	Disc. Price
	Hardware & Software						
ASE-4024	Intel Xeon Silver 4210 (10C, 20T, 2.2GHz Processor) 2P (per node) 32GB ECC RDIMM Memory (per node) 1000 Gigabit Ethernet 2Port(UTP) (per node) Hot-Swappable 24 SAS or SATA Disk Bay Redundant Power Supply NAS O/S Mirroring AnyStor Enterprise dedicated O/S - Raid : 0, 1, 10, 5, 6, 50, 60 Support Support Manager - NFS, SMB, CIFS, FTP, iSCSI Active Directory, Open Directory AnyManager - Web-based NAS Manamement Tool - Cluster Management - Volume Managent & Monitoring - Auto / Manual recovery - Parallel & distributed recovery - Data Replication Management - Thin provisioning - Load Balancing (rebalance) - Monitoring Tool on WEB (WMS) - Data Distributed I/O - Up to16 nodes expansion support	1	1	32,042.00	32,042.00	50%	16,021.00
HD-SD19200T	SAMSUNG SAS SSD PM1643a 1.9TB	1	24	1,007.00	24,168.00	50%	12,084.00
HB-2016G01	2 Port 16G Fibre Channel Interface	1	8	1,373.00	10,984.00	50%	5,492.00
NC-2X00101	2 Port 1000Base-T Network Interface(UTP)	1	2	366.00	732.00	50%	366.00
					Hardware & Software Subtotal		**33,963.00**
	Support & Maintenance						
SV-WT524-3Y	Premium Package 3-Year Support & Maintenance and 24x7 w/ 4-hour response	1	1	7,325.00	7,325.00	50%	3,662.50
					Support & Maintenance Subtotal		**3,662.50**
	SPC-2 Total System Price						**37,625.50**

Prices used in SPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections of the SPC benchmark specifications. If you find that the stated prices or maintenance levels are not available according to these terms, please inform the SPC at spcadmin@spcresults.org.

Pricing Details: The price quotation from Gluesys (Source 1) can be found in Appendix B.

Discount Details: The discounts shown are based on the overall configuration purchased and are generally available.

Warranty: The priced warranty provides the required 24x7 with 4-hour response time coverage.

Differences Between Tested and Priced Storage Configurations

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

PUBLICATION DETAILS

This section provides contact information for the test sponsor and auditor, a revision history of this document, and a description of any exceptions or waivers associated with this publication.

Contact Information

Role	Name	Details
Test Sponsor Primary Contact	Telecommunications Technology Association Hyo-Sil Kim	tta.or.kr/eng/index.jsp hyosil.kim@tta.or.kr
SPC Auditor	InfoSizing Doug Johnson	www.sizing.com doug@sizing.com

Revision Information

Date	FDR Revision	Details
December 29, 2020	First Edition	Initial Publication

Component Changes in Revised Full Disclosure Report

The following table outlines component changes that were made in revisions to this Full Disclosure Report.

Original Component	Revised Component	Description of Change
n/a	n/a	Initial submission

Audit Notes

There were no anomalies, exceptions or waivers associated with the audit of the Gluesys AnyStor-700ED.

CONFIGURATION INFORMATION

Tested Storage Product Description

Gluesys AnyStor-700ED (AS700ED) is an all-flash storage system that is designed to deliver extreme response speed and performance at an exceptional price. It is optimized for running high-performance enterprise workloads such as big data, post-production, and research computing. AS700ED offers multiprotocol support as well as flexible storage management features to achieve the best performance and stability and eliminate barriers between heterogeneous IT environments.

Host System and Tested Storage Configuration Components

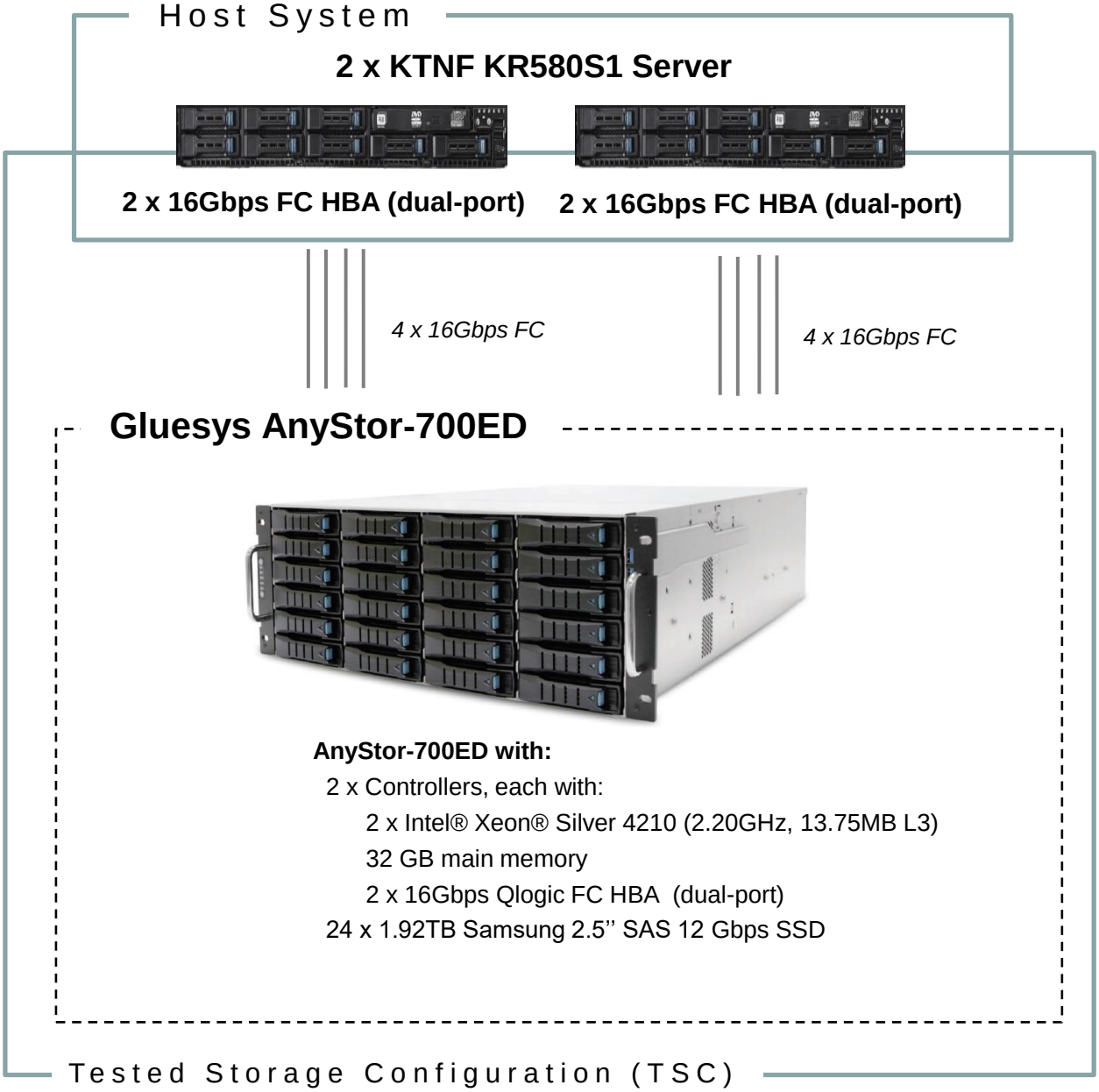
The following table lists the components of the Host System(s) and the TSC.

Host Systems
2x KTNF KR580S1, each with : 2x Intel® Xeon® Gold 6140 CPU (@ 2.30 GHz, 18-Core, 24.75 MB L3) 768 GB Main Memory Red Hat Enterprise Linux 8.2
Tested Storage Configuration
4x QLogic QLE2692 16 Gbps FC 2-port HBAs
1x Gluesys AnyStor-700ED 2x Storage Controllers, each with: 2x Intel® Xeon® Silver 4210 CPU @2.20 GHz, 10-Core, 13.75 MB L3) 32 GB cache (64 GB total) 4 x 16 Gbps FC Front End Ports (8 ports total) 24x 1.92 TB SSDs

Configuration Diagrams

BC/TSC Configuration Diagram

The following diagram illustrates the Benchmark Configuration (BC), including the Tested Storage Configuration (TSC) and the Host System(s).



Storage Network Configuration

The Benchmark Configuration utilized direct-attached storage.

Benchmark Configuration Creation Process

Customer Tunable Parameters and Options

All the customer tuning parameters and options that have been altered from their default values for this benchmark are included in Appendix C and in the Supporting Files (see Appendix A).

Tested Storage Configuration Creation

A detailed description of how the logical representation of the TSC was created is included in Appendix D and in the Supporting Files (see Appendix A).

Tested Storage Configuration Inventory

An inventory of the components in the TSC, as seen by the Benchmark Configuration, is included in Appendix E and in the Supporting Files (see Appendix A).

Workload Generator Storage Configuration

The SPC-2 Workload Generator storage configuration commands are included in Appendix F and in the Supporting Files (see Appendix A).

Logical Volume and ASU Capacities

The following table shows the capacities of the logical volume(s) and the ASU.

Logical Volumes	Capacity (GB)	Used (GB)	Unused (GB)
4	4,398	4,398	0
SPC-2 ASU Capacity		**17,592**	

Please see the Storage Definition (sd) entries in Appendix F for more detailed configuration information.

Physical Storage Capacity and Utilization

The following table details the Physical Capacity of the storage devices and the Physical Capacity Utilization (percentage of Total Physical Capacity used) in support of hosting the ASU. All capacities are reported in GB.

Devices	Count	Physical Capacity	Total Capacity
SSD	24	1,920.4	46,089
	Total Physical Capacity		**46,089**
	Physical Capacity Utilization		**38.17%**

Data Protection

The data protection level used for all LVs was **Protected 2** (***RAID-10)***, which was accomplished by configuring dual controllers and redundancy of all pathways.

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.

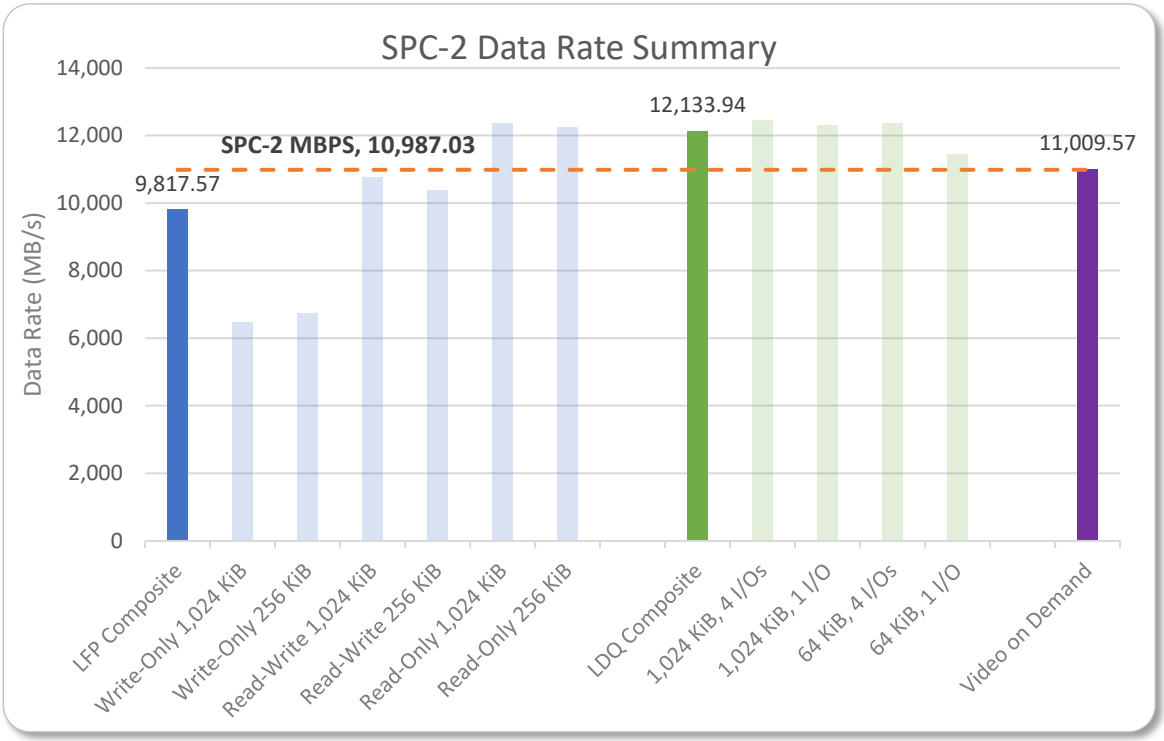
Benchmark Execution Overview

Workload Generator Input Parameters

The SPC-2 Workload Generator commands and parameters used to invoke the execution of the tests are included in Appendix F and in the Supporting Files (see Appendix A).

Data Rate Summary Graph

The following graph presents the data rates for the test runs contributing to the SPC-2 MBPS performance metric.



ASU Pre-Fill

The following table provides a summary of the Pre-Fill performed on the ASU prior to testing.

ASU Pre-Fill Summary			
Start Time	21-Dec-20 23:36:57	**Requested IOP Level**	Uncontrolled MAX MB/sec
End Time	22-Dec-20 01:06:11	**Observed IOP Level**	3,286 MB/sec
Duration	1:29:14	For additional details see the Supporting Files.	

Large File Processing Test

Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Large File Processing Test Runs are documented in Appendix F.

Test Results File

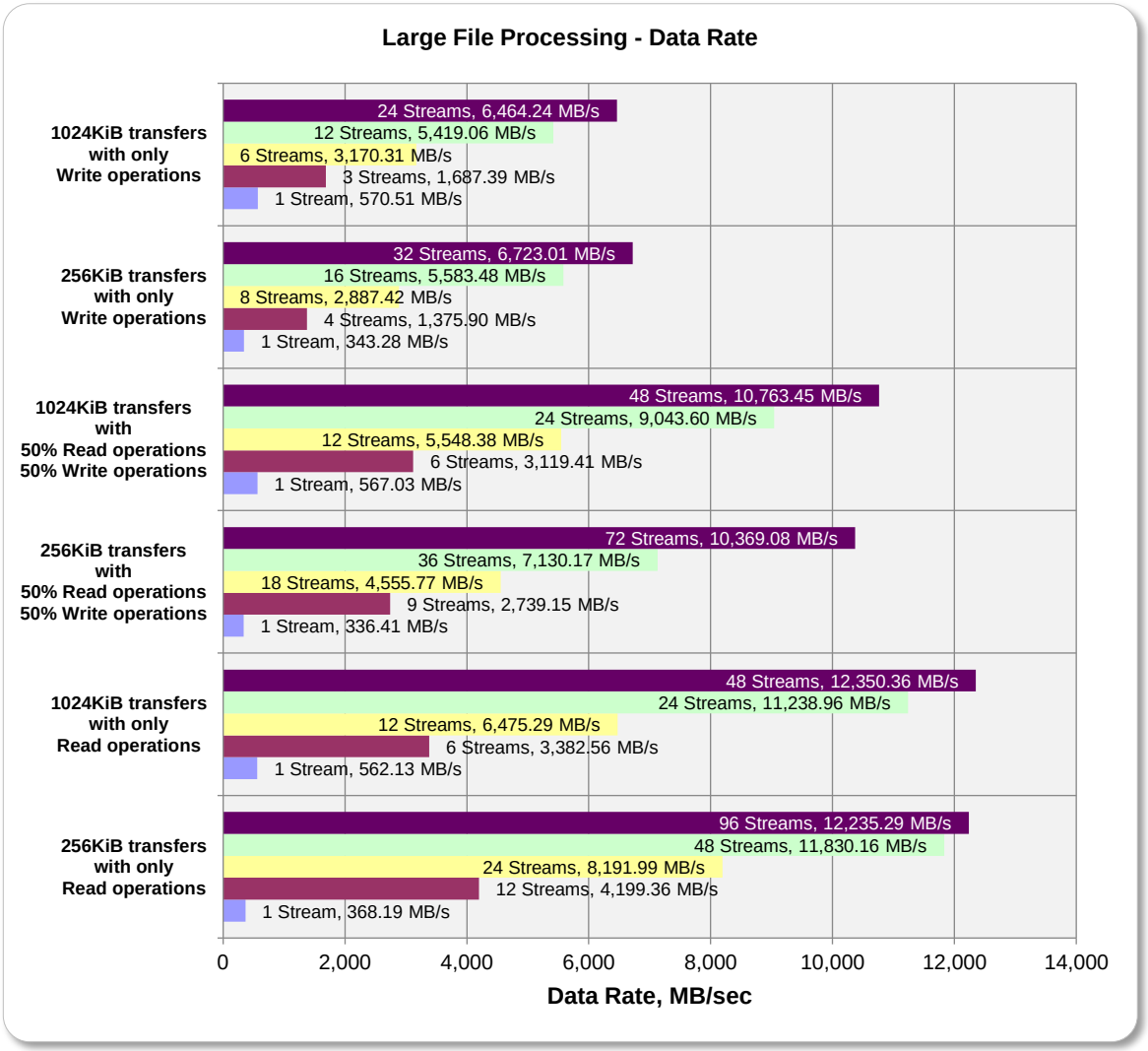
The SPC-2 Test Results file generated from the Large File Processing Test Runs is included in the Supporting Files (see Appendix A).

A summary of the Large File Processing Test Runs is included on the following pages.

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.

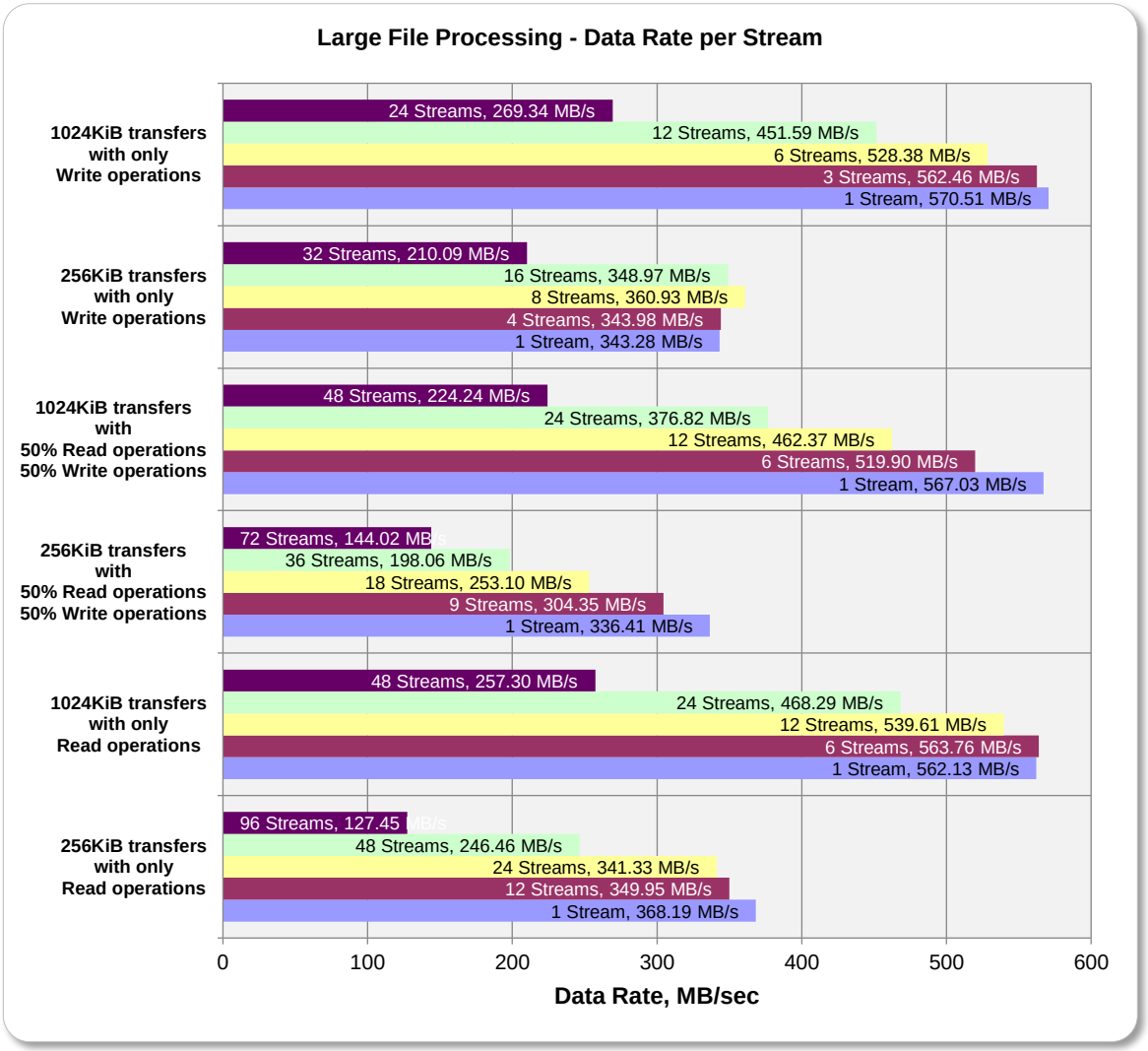
Test Run Sequence	1 Stream	12.5% of Max Streams	25% of Max Streams	50% of Max Streams	Variable Max Streams
Write 1024KiB	570.51	1,687.39	3,170.31	5,419.06	6,464.24
Write 256KiB	343.28	1,375.90	2,887.42	5,583.48	6,723.01
Read/Write 1024KiB	567.03	3,119.41	5,548.38	9,043.60	10,763.45
Read/Write 256KiB	336.41	2,739.15	4,555.77	7,130.17	10,369.08
Read 1024KiB	562.13	3,382.56	6,475.29	11,238.96	12,350.36
Read 256KiB	368.19	4,199.36	8,191.99	11,830.16	12,235.29



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.

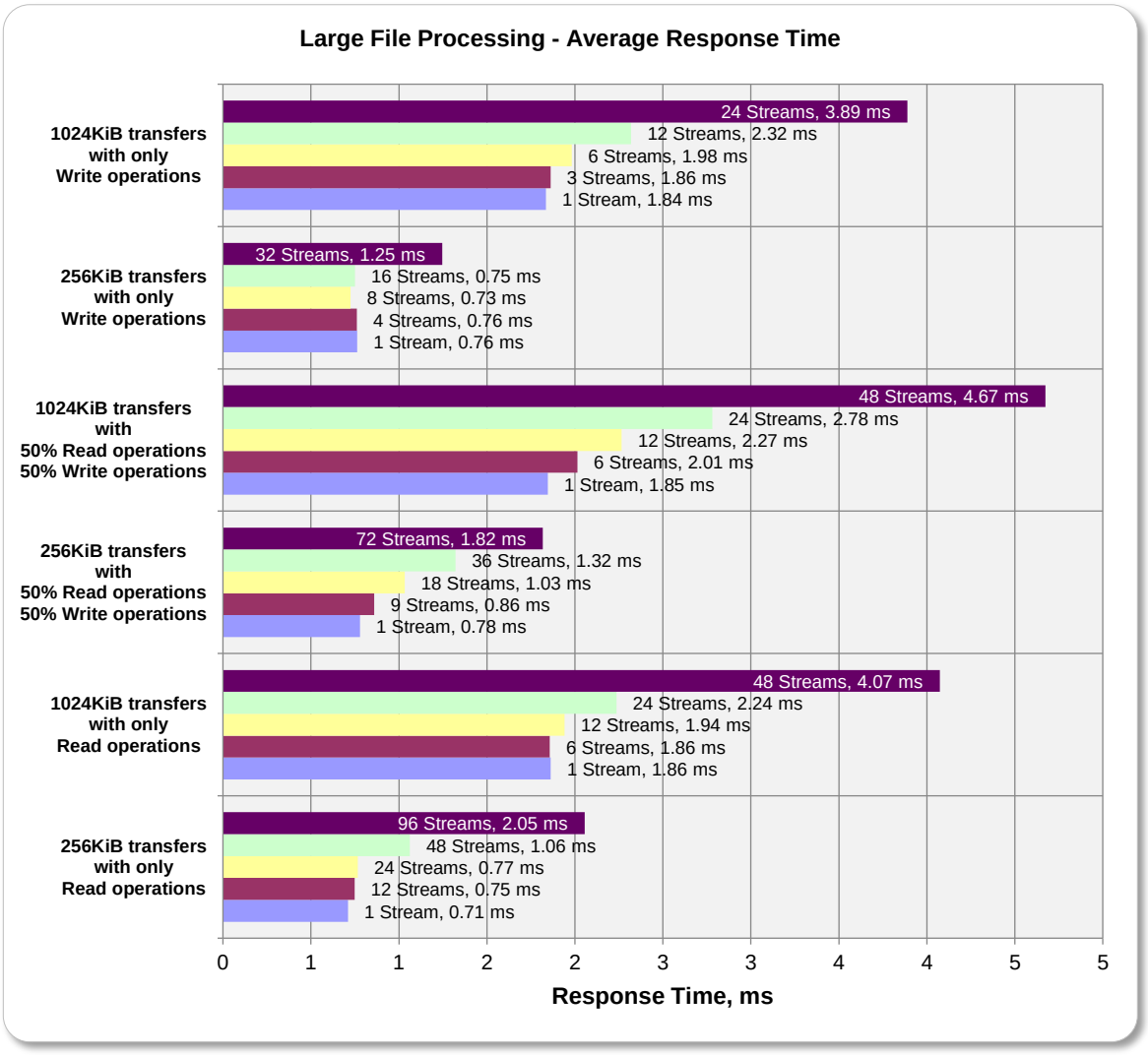
Test Run Sequence	1 Stream	12.5% of Max Streams	25% of Max Streams	50% of Max Streams	Variable Max Streams
Write 1024KiB	570.51	562.46	528.38	451.59	269.34
Write 256KiB	343.28	343.98	360.93	348.97	210.09
Read/Write 1024KiB	567.03	519.90	462.37	376.82	224.24
Read/Write 256KiB	336.41	304.35	253.10	198.06	144.02
Read 1024KiB	562.13	563.76	539.61	468.29	257.30
Read 256KiB	368.19	349.95	341.33	246.46	127.45



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	12.5% of Max Streams	25% of Max Streams	50% of Max Streams	Variable Max Streams
Write 1024KiB	1.84	1.86	1.98	2.32	3.89
Write 256KiB	0.76	0.76	0.73	0.75	1.25
Read/Write 1024KiB	1.85	2.01	2.27	2.78	4.67
Read/Write 256KiB	0.78	0.86	1.03	1.32	1.82
Read 1024KiB	1.86	1.86	1.94	2.24	4.07
Read 256KiB	0.71	0.75	0.77	1.06	2.05



Large Database Query Test

Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Large Database Query Test Runs are documented in Appendix F.

Test Results File

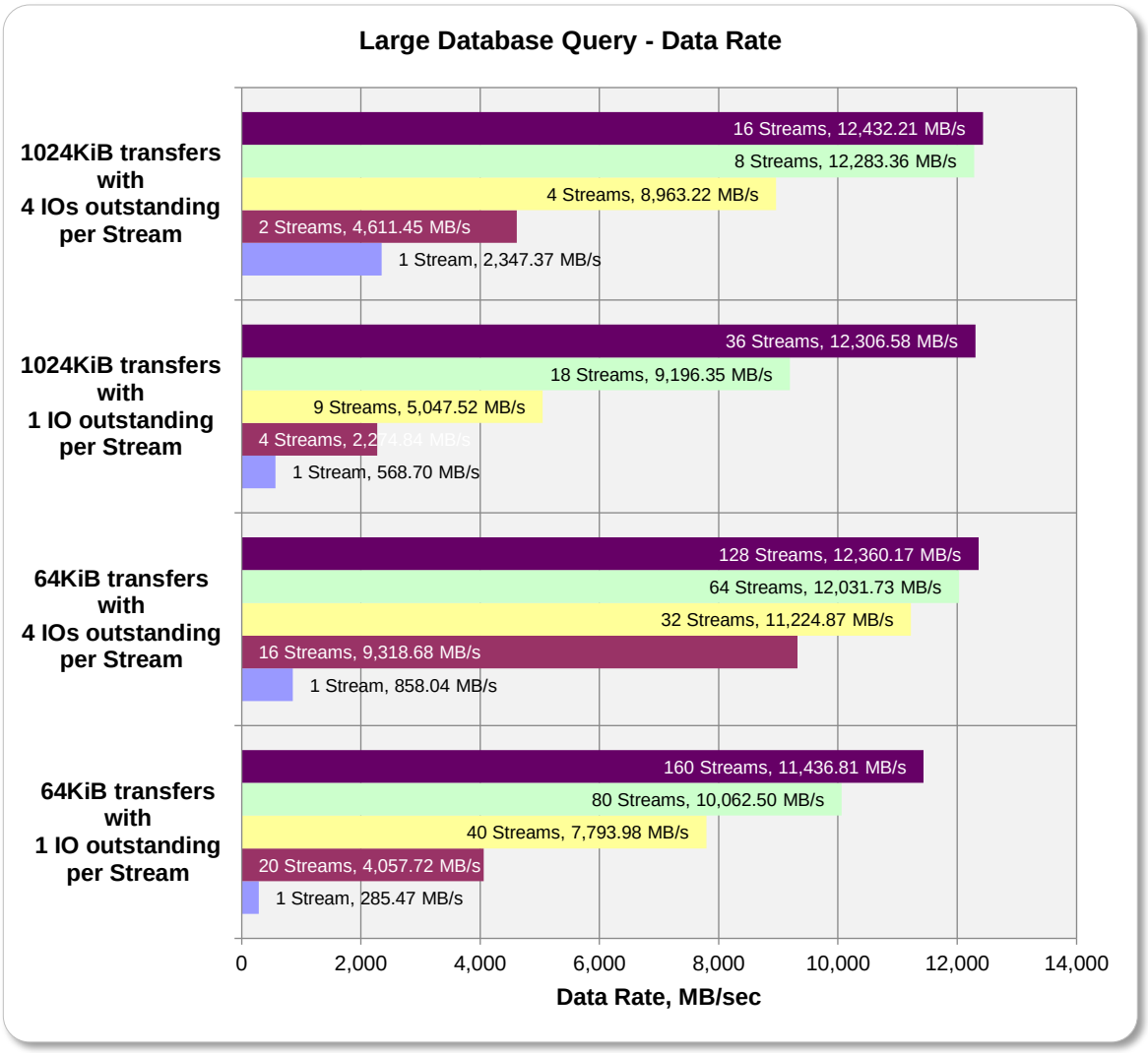
The SPC-2 Test Results file generated from the Large Database Query Test Runs is included in the Supporting Files (see Appendix A).

A summary of the Large Database Query Test Runs is included on the following pages.

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.

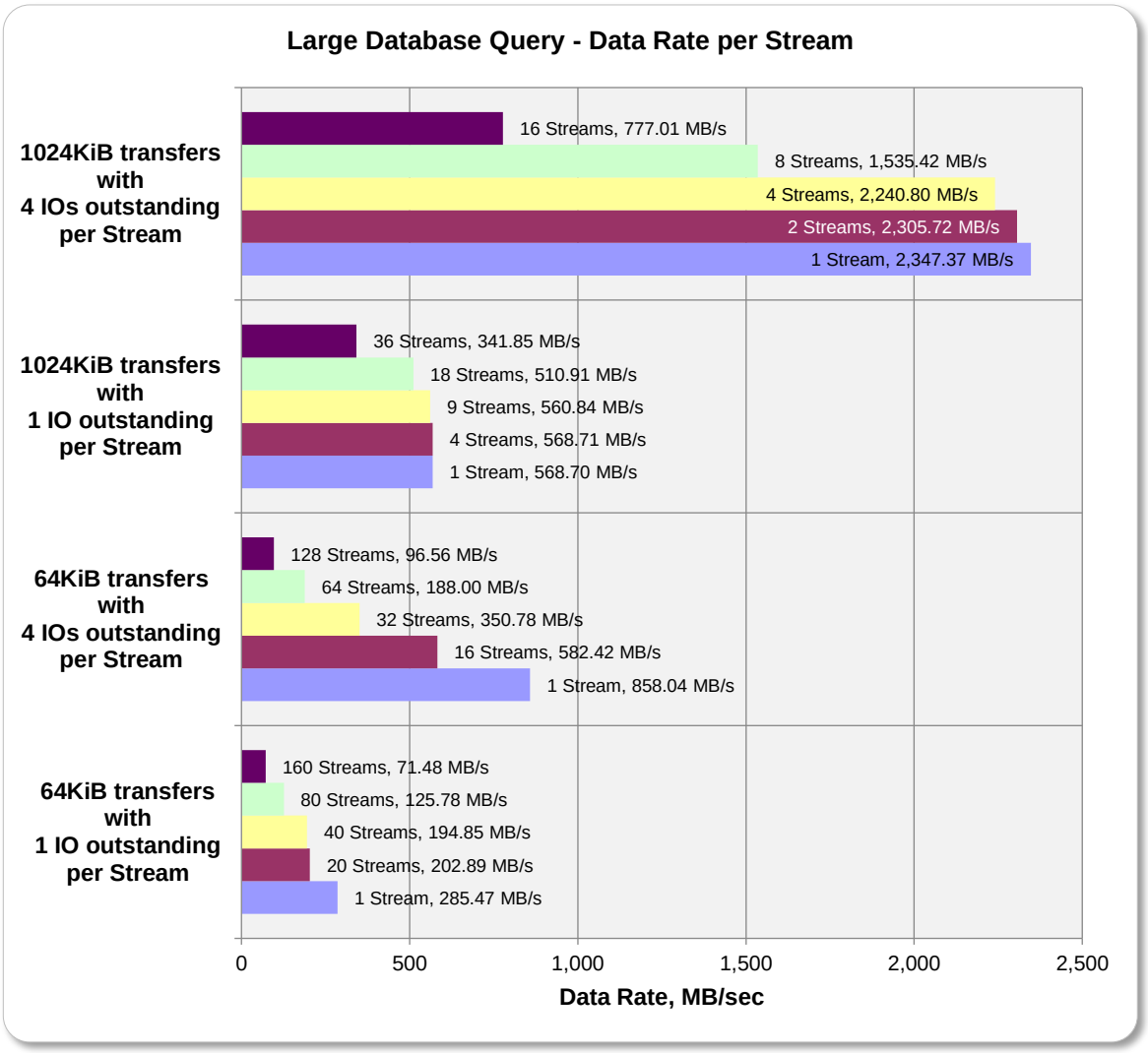
Test Run Sequence	1 Stream	12.5% of Max Streams	25% of Max Streams	50% of Max Streams	Variable Max Streams
1024KiB w/ 4 IOs/Stream	2,347.37	4,611.45	8,963.22	12,283.36	12,432.21
1024KiB w/ 1 IO/Stream	568.70	2,274.84	5,047.52	9,196.35	12,306.58
64KiB w/ 4 IOs/Stream	858.04	9,318.68	11,224.87	12,031.73	12,360.17
64KiB w/ 1 IO/Stream	285.47	4,057.72	7,793.98	10,062.50	11,436.81



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.

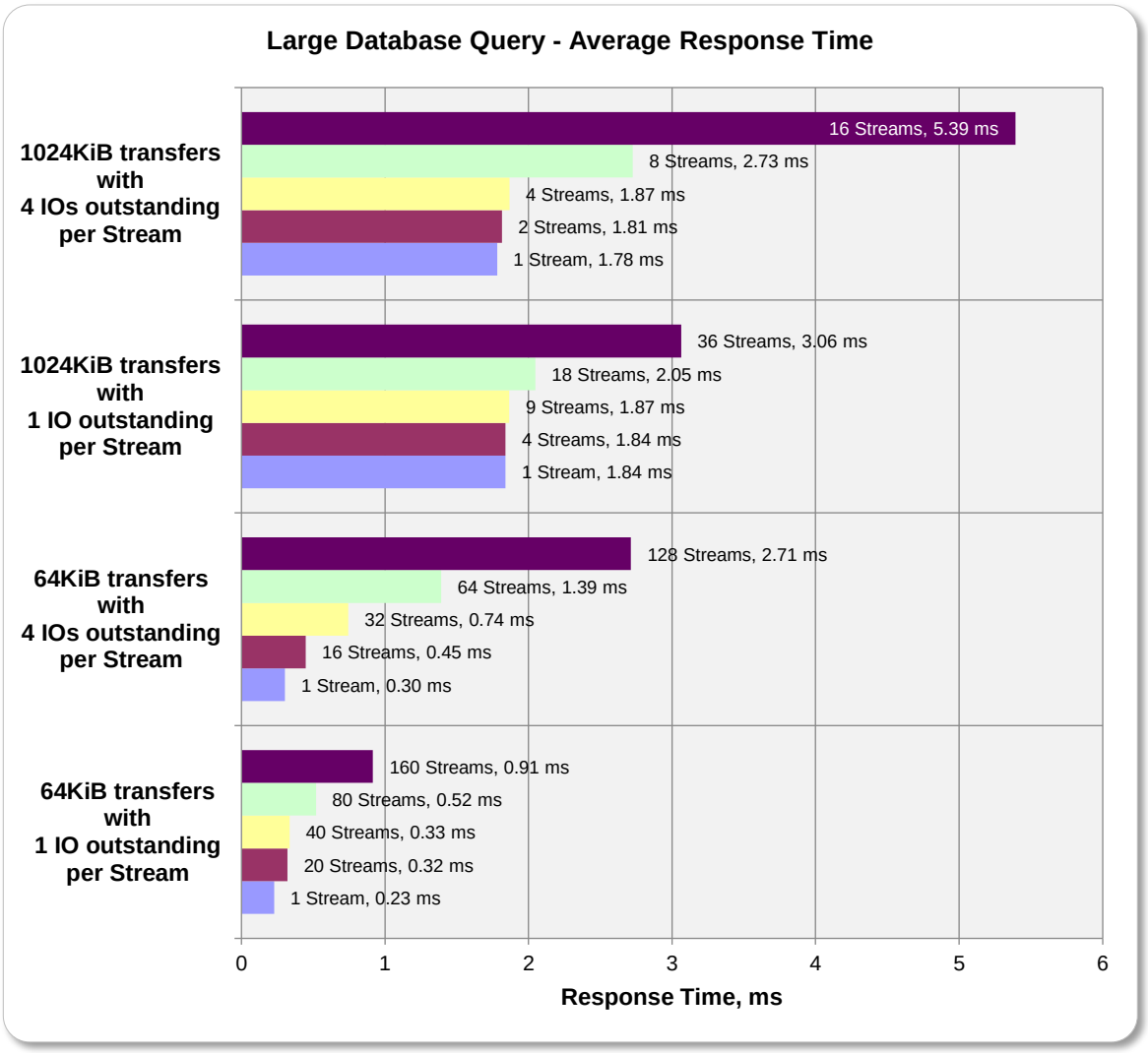
Test Run Sequence	1 Stream	12.5% of Max Streams	25% of Max Streams	50% of Max Streams	Variable Max Streams
1024KiB w/ 4 IOs/Stream	2,347.37	2,305.72	2,240.80	1,535.42	777.01
1024KiB w/ 1 IO/Stream	568.70	568.71	560.84	510.91	341.85
64KiB w/ 4 IOs/Stream	858.04	582.42	350.78	188.00	96.56
64KiB w/ 1 IO/Stream	285.47	202.89	194.85	125.78	71.48



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	12.5% of Max Streams	25% of Max Streams	50% of Max Streams	Variable Max Streams
1024KiB w/ 4 IOs/Stream	1.78	1.81	1.87	2.73	5.39
1024KiB w/ 1 IO/Stream	1.84	1.84	1.87	2.05	3.06
64KiB w/ 4 IOs/Stream	0.30	0.45	0.74	1.39	2.71
64KiB w/ 1 IO/Stream	0.23	0.32	0.33	0.52	0.91



Video on Demand Delivery Test

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 F.

Test Results File

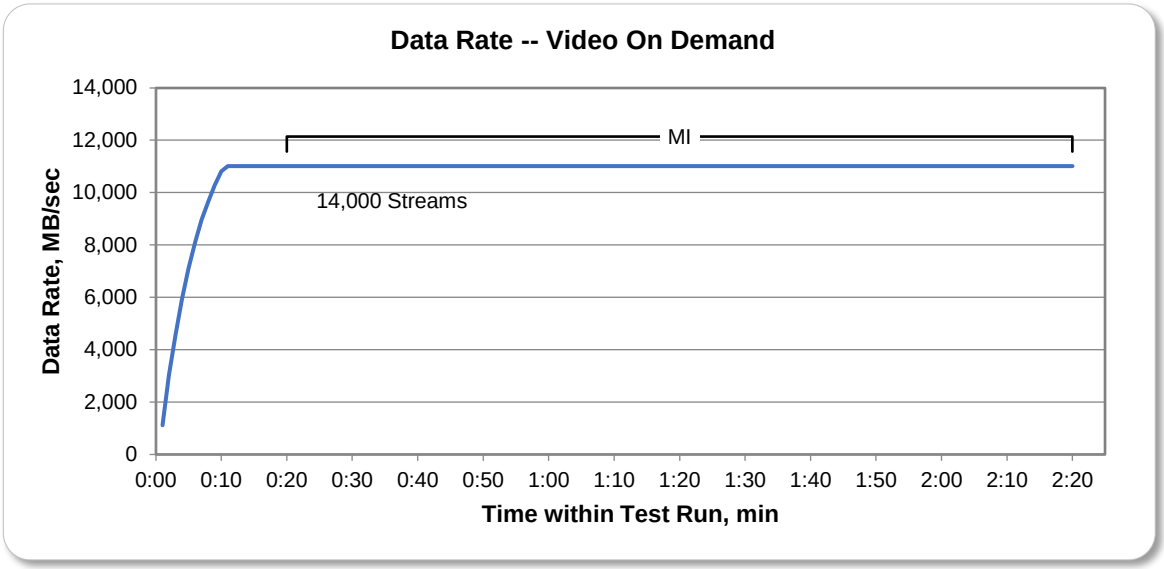
The SPC-2 Test Results file generated from the Video on Demand Delivery Test Run is included in the Supporting Files (see Appendix A).

Test Run Data

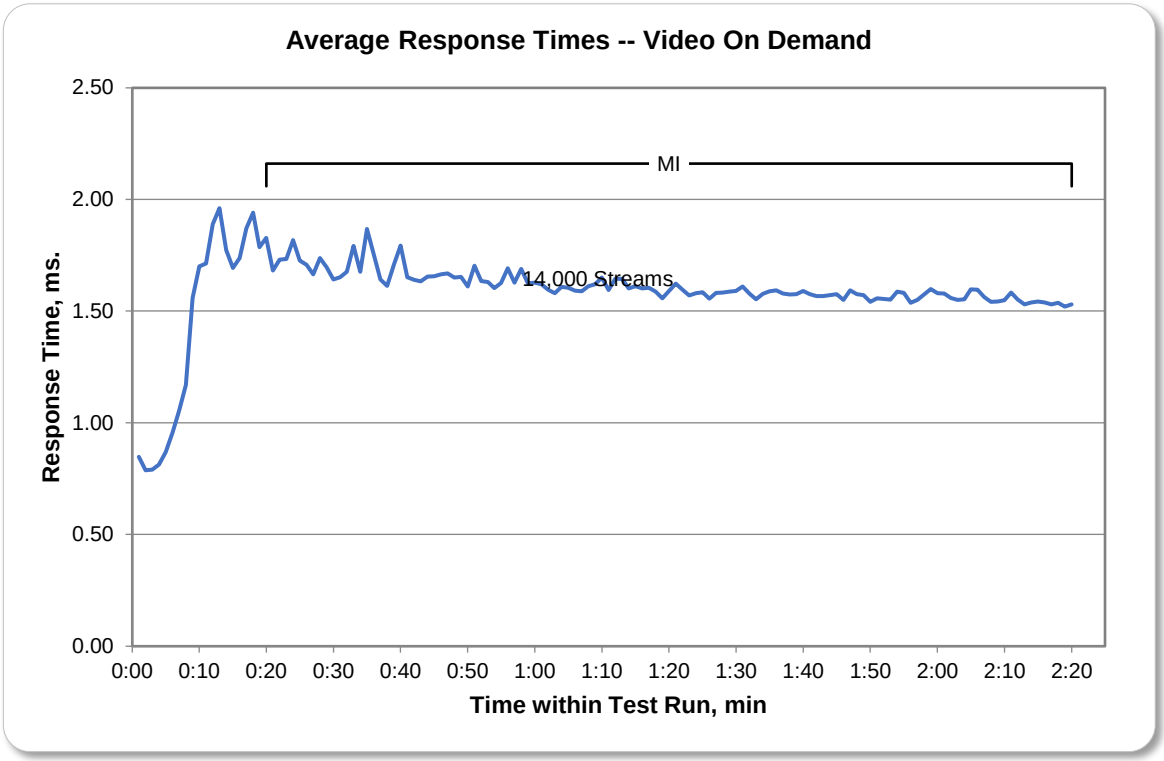
The number of Streams specified, Ramp-Up duration in seconds, Measurement Interval duration in seconds, average Data Rate for the Measurement Interval, and average Data Rate per Stream for the Measurement Interval are listed in the following table.

SPC-2 VOD	TR1
Number of Streams	14,000
Ramp-up Time, sec	1,200
Measurement Interval, sec	7,200
Average Data Rate, MB/sec	11,009.57
Per Stream Data Rate, MB/sec	0.79
Average Response Time, ms	1.61
Average Max Response Time, ms	31.59

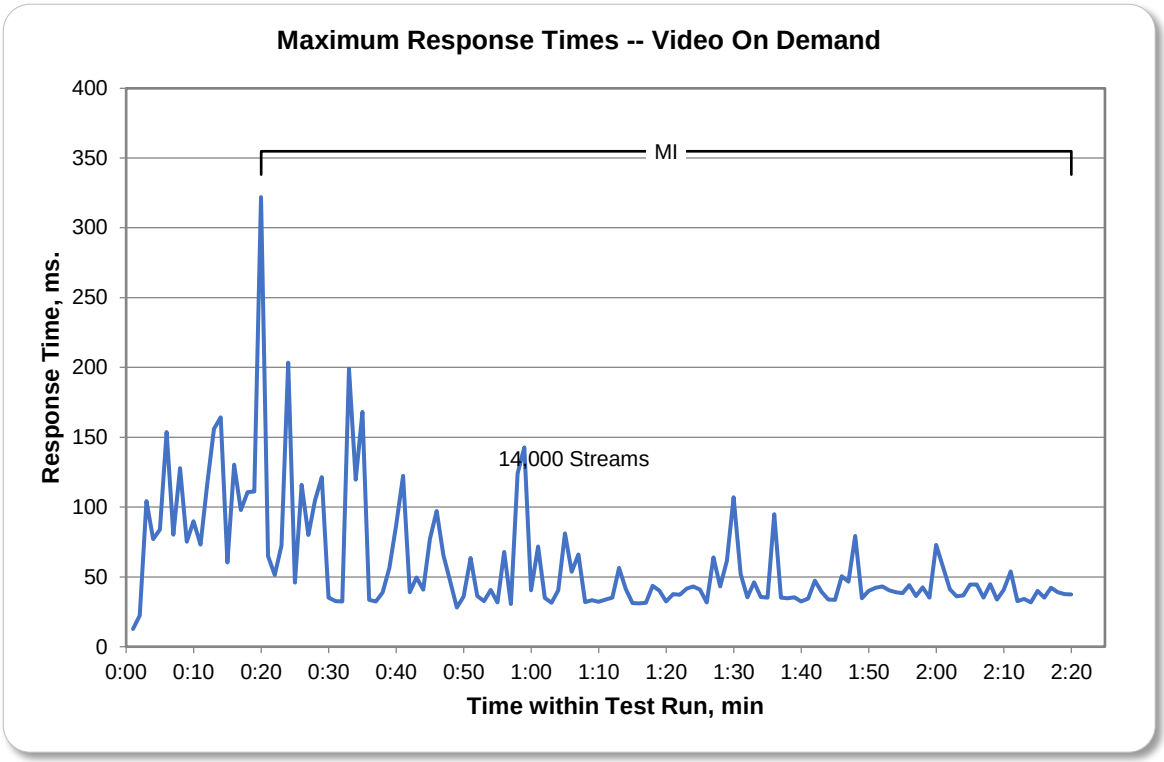
Average Data Rate Graph



Average Response Time Graph



Maximum Response Time Graph



Data Persistence Test

Workload Generator Commands and Parameters

The SPC-2 Workload Generator commands and parameters for the Persistence Test Runs are documented in Appendix F.

Test Results File

The SPC-2 Test Results file generated from the Data Persistence Test Runs is included in the Supporting Files (see Appendix A).

Test Results

Data Persistence Test Results	
Data Persistence Test Number	1
Total Number of Logical Blocks Written	1,458,679
Total Number of Logical Blocks Re-referenced	61,863
Total Number of Logical Blocks Verified	1,396,816
Total Number of Logical Blocks that Failed Verification	0
Number of Failed I/O Requests in the process of the Test	0

APPENDIX A: SUPPORTING FILES

The following table details the content of the Supporting Files provided as part of this Full Disclosure Report.

File Name	Description	Location
/SPC2_RESULTS	**Result Workbooks and PDFs**	**root**
LDQ.xlsx	LDQ results workbook	/SPC2_RESULTS
LFP.xlsx	LFP results workbook	/SPC2_RESULTS
VOD.xlsx	VOD results workbook	/SPC2_RESULTS
Persist.xlsx	Persist 1 & 2 results workbook	/SPC2_RESULTS
/C_Tuning	**Tuning parameters and options**	**root**
set_kernel_parameters_glue.sh	OS tuning commands	/C_Tuning
/D_Creation	**Storage configuration creation**	**root**
login.sh	Probe FC	/D_Creation
mklun.sh	Create target LUNs	/D_Creation
mkraid.sh	Configure storage devices	/D_Creation
/E_Inventory	**Configuration inventory**	**root**
1.prefill.out	Configuration before PreFill	/E_Inventory
2.init.out	Configuration before Init	/E_Inventory
3.lfp.out	Configuration before LFP	/E_Inventory
4.ldq.out	Configuration before LDQ	/E_Inventory
5.vod.out	Configuration before VOD	/E_Inventory
6.persist1.out	Configuration before Persist1	/E_Inventory
7.persist2.out	Configuration before Persist2	/E_Inventory
8.test_end.out	Configuration after Persist2	/E_Inventory
/F_Generator	**Workload generator**	**root**
config_capture.sh	Capture configuration inventory	/F_Generator
LDQ.par	LDQ test parameters	/F_Generator
LFP.par	LFP test parameters	/F_Generator
Persistence_1.par	Persist1 test parameters	/F_Generator
Persistence_2.par	Persist2 test parameters	/F_Generator
Pre-fill.par	Prefill test parameters	/F_Generator
run.sh	Script to run PreFill – Persist1	/F_Generator
run_persistence2.sh	Script to run Persist2	/F_Generator
VOD.par	VOD test parameters	/F_Generator

APPENDIX B: THIRD PARTY QUOTATION

Gluesys

견 적 서

수 신 : 김효실 책임님 (hyosil.kim@tta.or.kr)
참 조 :

gluesys

경기도 안양시 동안구 시민대로327번길 11-31
파낙스 R&D센터 5F ㈜글루시스
대 표 이 사 : 박 성 순

1. 납품일자(Delivery Date) : 협의 후 지정(negotiated)
2. 결제조건(Payment Condition) : 협의(negotiated)
3. 견적일자(Date) : 2020년 12월 24일
4. 견적유효일자(Effective Date) : 견적일로부터 90일(3개월) (in 90 days)

담 당 자(Contact): 김유상 과장
연 락 처 ☎: 010-2353-2325
이 메 일(E-mail): yskim@gluesys.com

견적 금액 (Total Price) : **37625.50 $**
품 명 (Product Name) : AnyStor700ED-24

귀사의 무궁한 발전을 기원하오며, 아래와 같이 견적합니다.

단위. $(V.A.T 별도)

No.	P/N	설명	수량	소비자가	공급단가	할인	공급금액
A		**AnyStor700ED-24**	**1**		**75,251.00**	**50%**	**37,625.50**
1	ASE-4024	Intel Xeon Silver 4210 (10C, 20T, 2.2GHz Processor) 2P (per node) 32GB ECC RDIMM Memory (per node) 1000 Gigabit Ethernet 2Port(UTP) (per node) Hot-Swappable 24 SAS or SATA Disk Bay Redundant Power Supply NAS O/S Mirroring AnyStor Enterprise dedicated O/S - Raid : 0, 1, 10, 5, 6, 50, 60 Support Support Manager - NFS, SMB, CIFS, FTP, iSCSI Active Directory, Open Directory AnyManager - Web-based NAS Manamement Tool - Cluster Management - Volume Managent & Monitoring - Auto / Manual recovery - Parallel & distributed recovery - Data Replication Management - Thin provisioning - Load Balancing (rebalance) - Monitoring Tool on WEB (WMS) - Data Distributed I/O - Up to16 nodes expansion support	1	**32,042**	**32,042.00**	**50%**	**16,021.00**
2	SV-WT524-3Y	Premium Package 3-Year Support & Maintenance and 24x7 w/ 4-hour response	1	**7,325**	**7,325.00**	**50%**	**3,662.50**
3	HD-SD19200T	SAMSUNG SAS SSD PM1643a 1.9TB	24	**1,007**	**24,168.00**	**50%**	**12,084.00**
4	HB-2016G01	2 Port 16G Fibre Channel Interface	8	**1,373**	**10,984.00**	**50%**	**5,492.00**
5	NC-2X00101	2 Port 1000Base-T Network Interface(UTP)	2	**366**	**732.00**	**50%**	**366.00**
					공급가		**37,625.50**
					부가가치세		**별 도**
					총합계		**37,625.50**

비고
. Discount based on full-package.
. Shipping and handling is not included in quotation.
. Pricing is in U.S. dollars for product availability, sales, and support in Republic of Korea.

APPENDIX C: TUNING PARAMETERS AND OPTIONS

The following scripts were used to set tuning parameters and options:

- set_kernel_parameters_glue.sh

The scripts listed above are included in the Supporting Files (see Appendix A).

APPENDIX D: STORAGE CONFIGURATION CREATION

Step 1 – Create RAID volumes

The **mkraid.sh** scripts includes all the CLI commands to perform the following actions:

- Create a disk partition for each disk.
- Create a software RAID 1+0 volume.
- Create one physical volume and one volume group on the RAID volume, and create four logical volumes.

mkraid.sh

```
#!/bin/sh

DISKS="/dev/disk/by-id/scsi-35002538b106a21c0 /dev/disk/by-id/scsi-35002538b106a21d0
/dev/disk/by-id/scsi-35002538b106a21f0 /dev/disk/by-id/scsi-35002538b106a2200 /dev/disk/by-
id/scsi-35002538b106a2220 /dev/disk/by-id/scsi-35002538b106a2230 /dev/disk/by-id/scsi-
35002538b106a2240 /dev/disk/by-id/scsi-35002538b106a2250 /dev/disk/by-id/scsi-
35002538b106a2260 /dev/disk/by-id/scsi-35002538b106a2270 /dev/disk/by-id/scsi-
35002538b106a22d0 /dev/disk/by-id/scsi-35002538b106a22e0 /dev/disk/by-id/scsi-
35002538b106a22f0 /dev/disk/by-id/scsi-35002538b106a2300 /dev/disk/by-id/scsi-
35002538b106a2310 /dev/disk/by-id/scsi-35002538b106a2320 /dev/disk/by-id/scsi-
35002538b106a2340 /dev/disk/by-id/scsi-35002538b106a2350 /dev/disk/by-id/scsi-
35002538b106a23a0 /dev/disk/by-id/scsi-35002538b106a23c0 /dev/disk/by-id/scsi-
35002538b106a23e0 /dev/disk/by-id/scsi-35002538b106a2400 /dev/disk/by-id/scsi-
35002538b106a2410 /dev/disk/by-id/scsi-35002538b106a2420"
create_fdisk (){
# create partion for Overprovisioning
    for disk in $DISKS
    do
        echo $disk
        fdisk $disk << EOF
n
p
1
+1400G
wq
EOF
    done
}
create_raid () {
# create clustered raid10
mdadm --create /dev/md0 --bitmap=clustered --level=10 --raid-devices=24 \
    /dev/disk/by-id/scsi-35002538b106a21c0-part1 \
    /dev/disk/by-id/scsi-35002538b106a21d0-part1 \
    /dev/disk/by-id/scsi-35002538b106a21f0-part1 \
    /dev/disk/by-id/scsi-35002538b106a2200-part1 \
    /dev/disk/by-id/scsi-35002538b106a2220-part1 \
    /dev/disk/by-id/scsi-35002538b106a2230-part1 \
    /dev/disk/by-id/scsi-35002538b106a2240-part1 \
    /dev/disk/by-id/scsi-35002538b106a2250-part1 \
```

```
        /dev/disk/by-id/scsi-35002538b106a2260-part1 \
        /dev/disk/by-id/scsi-35002538b106a2270-part1 \
        /dev/disk/by-id/scsi-35002538b106a22d0-part1 \
        /dev/disk/by-id/scsi-35002538b106a22e0-part1 \
                /dev/disk/by-id/scsi-35002538b106a22f0-part1 \
        /dev/disk/by-id/scsi-35002538b106a2300-part1 \
        /dev/disk/by-id/scsi-35002538b106a2310-part1 \
        /dev/disk/by-id/scsi-35002538b106a2320-part1 \
        /dev/disk/by-id/scsi-35002538b106a2340-part1 \
        /dev/disk/by-id/scsi-35002538b106a2350-part1 \
        /dev/disk/by-id/scsi-35002538b106a23a0-part1 \
        /dev/disk/by-id/scsi-35002538b106a23c0-part1 \
        /dev/disk/by-id/scsi-35002538b106a23e0-part1 \
        /dev/disk/by-id/scsi-35002538b106a2400-part1 \
        /dev/disk/by-id/scsi-35002538b106a2410-part1 \
        /dev/disk/by-id/scsi-35002538b106a2420-part1
}
create_lvm () {
        pvcreate /dev/md0
        vgcreate LD /dev/md0
        lvcreate -L4T -nvol1 LD
        lvcreate -L4T -nvol2 LD
        lvcreate -L4T -nvol3 LD
        lvcreate -L4T -nvol4 LD
}
create_fdisk
create_raid
create_lvm
```

Step 2 – Set-Up FC (Fibre Channel) Target on the Storage Subsystem

The **mklun.sh** script creates Target LUNs (using targetcli)

mklun.sh

```
#!/bin/bash

# clear target
echo "clearconfig confirm=true" | targetcli
sleep 3
# create backing store

luns=$(ls /dev/LD)
ports=$(cat /sys/class/fc_host/host*/port_name | cut -dx -f2-)
host_ports="21000024ff17481b 21000024ff17ed20 21000024ff17ed21
21000024ff17481a 21000024ff17edcc 21000024ff17edcd 21000024ff17490a
21000024ff17490b"

for lun in $luns
do
        echo "/backstores/block create name=$lun dev=/dev/LD/$lun" | targetcli
```

```
    sleep 3
done

# create qla2xxx binding interface

for port_name in $ports
do
    echo "/qla2xxx create wwn=$port_name" | targetcli
    sleep 3
    for lun in $luns
    do
        echo "/qla2xxx/naa.$port_name/luns create /backstores/block/$lun" | targetcli
        sleep 3
    done
done

# create port to lun binding

for port_name in $ports
do
    for host_port in $host_ports
    do
        echo "/qla2xxx/naa.$port_name/acls create wwn=$host_port" | targetcli
        sleep 3
    done

done

# starting target server
systemctl restart target
```

Step 3 – Set the multipath and Log in to FC Target on the Host system.

Set the multipath by editing "/etc/multipath.conf" on the Host system and probe the FC module "qla2xxx".

Edit /etc/multipath.conf

```
defaults {
    user_friendly_names     yes
    find_multipaths         yes
    path_selector           "service-time 0"
    rr_weight               priorities
    path_grouping_policy    multibus
    rr_min_io_rq            1
}
multipaths {
    multipath {
```

```
        wwid            3600140527b5bacec9de4c8e96ee06473
        alias           disk1
    }
    multipath {
        wwid            360014052cc1cc84d9f945bb9de4ee199
        alias           disk2
    }
    multipath {
        wwid            360014058890764426bc4d8fafdde0979
        alias           disk3
    }
    multipath {
        wwid            3600140537b7068928c94d17a19894a9b
        alias           disk4
    }
}
```

Login.sh

```
#!/bin/sh
modprobe qla2xxx
systemctl restart multipathd
```

APPENDIX E: CONFIGURATION INVENTORY

An inventory of the TSC was collected during the execution of the benchmark. The following log files were generated.

- 1.prefill.out
- 2.init.out
- 3.lfp.out
- 4.ldq.out
- 5.vod.out
- 6.persist1.out
- 7.persist2.out
- 8.test_end.out

The above log files are included in the Supporting Files (see Appendix A).

APPENDIX F: WORKLOAD GENERATOR

The following parameter files and scripts were used to execute the benchmark:

- config_capture.sh
- LDQ.par
- LFP.par
- Persistence_1.par
- Peristence_2.par
- Pre-fill.par
- run.sh
- run_persistenc2.sh
- VOD.par

The files listed above are included in the Supporting Files (see Appendix A).