SPC BENCHMARK 1™
EXECUTIVE SUMMARY

IBM CORPORATION
IBM FLEX SYSTEM V7000

SPC-1 V1.14

Submitted for Review: March 28, 2014
Submission Identifier: A00142

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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Revision Information and Key Dates

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SPC-1 Specification revision number	V1.14
SPC-1 Workload Generator revision number	V2.3.0
Date Results were first used publicly	March 28, 2014
Date the FDR was submitted to the SPC	March 28, 2014
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	March 27, 2014

Tested Storage Product (TSP) Description

The IBM Storwize V7000 is now available to support IBM PureFlex configurations. This method of configuring the V7000 product is indicated by including a PureFlex system order indicator *(feature code EFD1 or EFD4)* in the Storwize V7000 order. When configured in this way, the same numbers and types of disks, and the same methods of host attachment are available as for other types of Storwize V7000 orders. This SPC-1 Result is the first Storwize V7000 SPC-1 submission to use FCoE as the method of Host System attachment. Also, this SPC-1 Result uses an IBM PureFlex host processor.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: IBM Flex System V7000	
Metric	**Reported Result**
SPC-1 IOPS™	72,002.67
SPC-1 Price-Performance™	$5.94/SPC-1 IOPS™
Total ASU Capacity	24,433.592 GB
Data Protection Level	Protected 1 *(mirroring)*
Total Price	$427,796.52
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

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

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

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

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

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

Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 8.
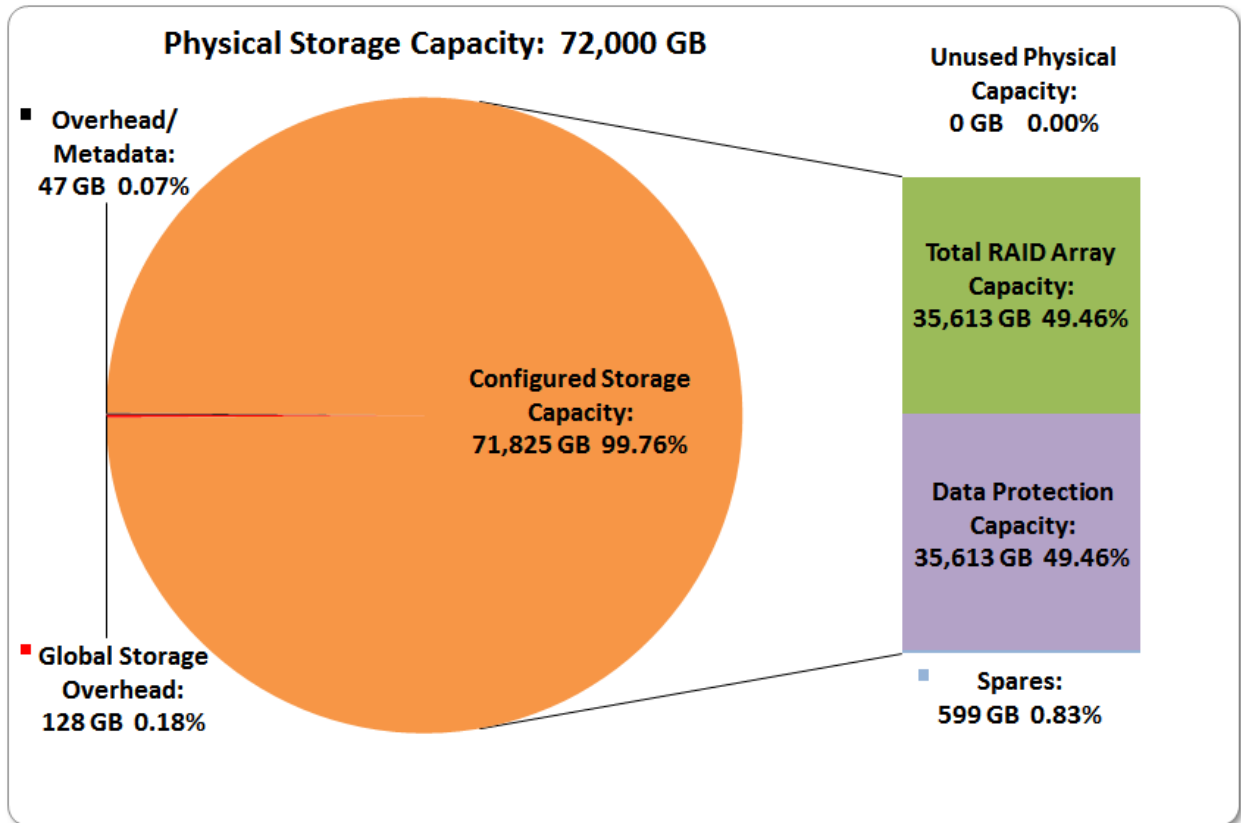
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.
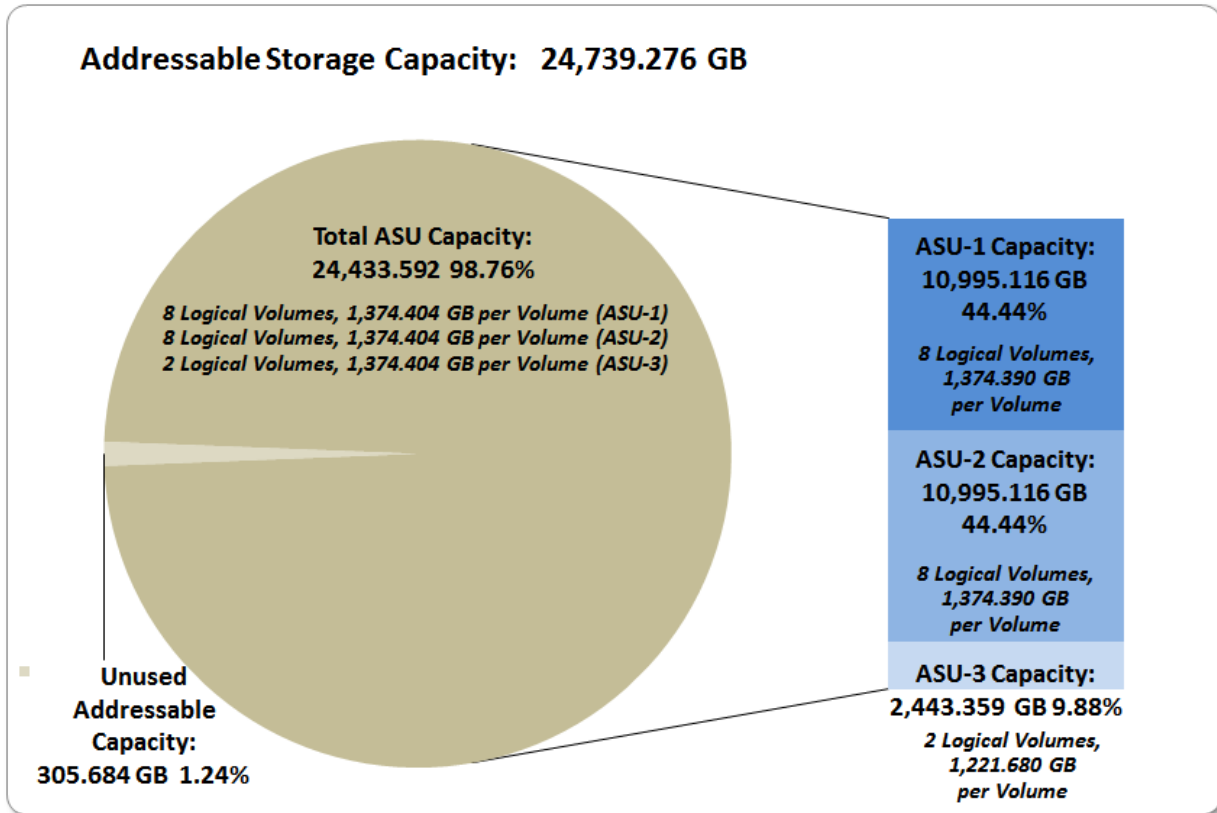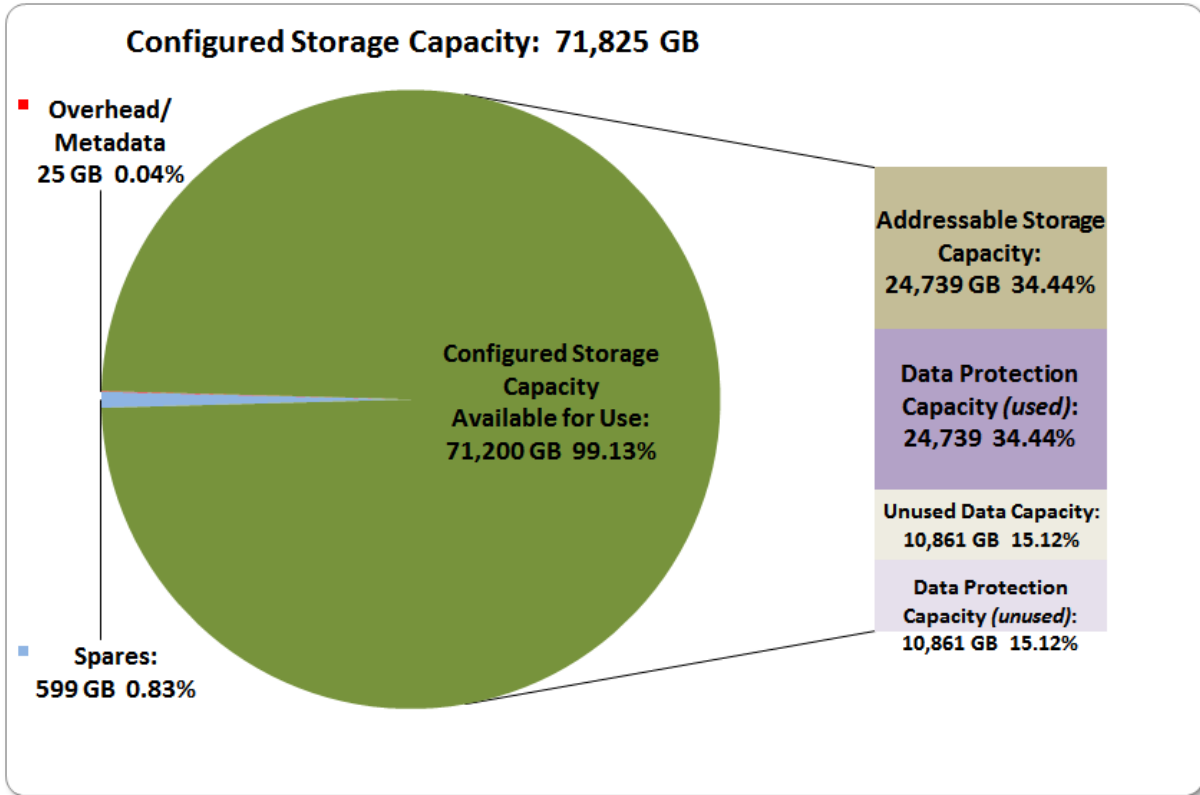
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

Storage Capacities, Relationships, and Utilization

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

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.

Physical Storage Capacity: 72,000 GB

- Overhead/Metadata: 47 GB 0.07%
- Configured Storage Capacity: 71,825 GB 99.76%
- Global Storage Overhead: 128 GB 0.18%

Unused Physical Capacity: 0 GB 0.00%

- Total RAID Array Capacity: 35,613 GB 49.46%
- Data Protection Capacity: 35,613 GB 49.46%
- Spares: 599 GB 0.83%

Configured Storage Capacity: 71,825 GB

■ **Overhead/ Metadata**
25 GB 0.04%

Configured Storage Capacity Available for Use: 71,200 GB 99.13%

Addressable Storage Capacity: 24,739 GB 34.44%

Data Protection Capacity (used): 24,739 34.44%

Unused Data Capacity: 10,861 GB 15.12%

Data Protection Capacity (unused): 10,861 GB 15.12%

■ **Spares: 599 GB 0.83%**

Addressable Storage Capacity: 24,739.276 GB

Total ASU Capacity: 24,433.592 98.76%

8 Logical Volumes, 1,374.404 GB per Volume (ASU-1)
8 Logical Volumes, 1,374.404 GB per Volume (ASU-2)
2 Logical Volumes, 1,374.404 GB per Volume (ASU-3)

ASU-1 Capacity: 10,995.116 GB 44.44%

8 Logical Volumes, 1,374.390 GB per Volume

ASU-2 Capacity: 10,995.116 GB 44.44%

8 Logical Volumes, 1,374.390 GB per Volume

ASU-3 Capacity: 2,443.359 GB 9.88%

2 Logical Volumes, 1,221.680 GB per Volume

■ **Unused Addressable Capacity: 305.684 GB 1.24%**

Total Unused Storage Capacity Ratio and Details

Physical Storage Capacity:
72,000 GB

Unused Physical Capacity: 0 GB

Physical Storage Capacity Used:
49,667 GB 68.98%

Total Unused Storage Capacity:
2,2333 GB 31.02%

Unused Configured Capacity: 21,722 GB

includes 11,667 GB of unused Data Protection

■ **Unused Addressable Capacity:**
306 GB

■ **Unused Data Protection:**
306 GB

SPC-1 Storage Capacity Utilization	
Application Utilization	33.94%
Protected Application Utilization	67.89%
Unused Storage Ratio	31.02%

Application Utilization: Total ASU Capacity *(24,433.592 GB)* divided by Physical Storage Capacity *(72,000.000 GB)*.

Protected Application Utilization: (Total ASU Capacity *(24,433.592 GB)* plus total Data Protection Capacity *(35,612.795 GB)* minus unused Data Protection Capacity *(11,166.583 GB)*) divided by Physical Storage Capacity *(72,000.000 GB)*.

Unused Storage Ratio: Total Unused Capacity *(22,333.165 GB)* divided by Physical Storage Capacity *(72,000.000 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 24-25 in the Full Disclosure Report.

Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPS™ metric.

The Average Response Time measured at the any of the above load points cannot exceed 30 milliseconds or the benchmark measurement is invalid.
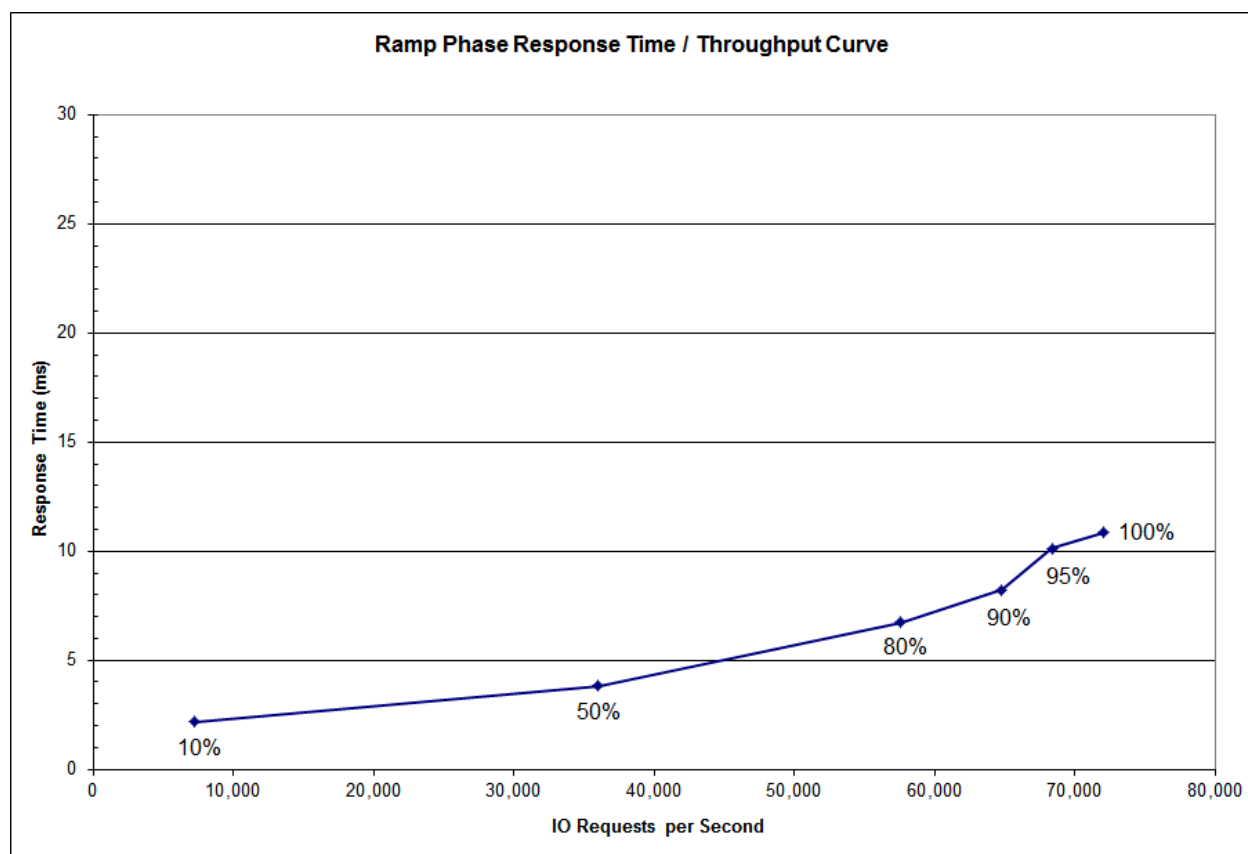
Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	7,202.67	35,990.49	57,595.74	64,802.16	68,391.82	72,002.67
Average Response Time (ms):						
All ASUs	2.19	3.84	6.74	8.22	10.12	10.86
ASU-1	2.72	4.57	7.69	9.44	11.66	12.57
ASU-2	2.50	4.68	8.70	11.21	13.89	15.13
ASU-3	0.92	1.92	3.88	4.32	5.20	5.37
Reads	4.19	6.88	11.40	14.48	18.03	19.70
Writes	0.88	1.85	3.71	4.14	4.97	5.11

Priced Storage Configuration Pricing

Description (part number)	Qty	Unit Price .	extended	% discount	discounted price
Flex System V7000 base storage enclosure w/ 24 slots (4939-A49)	1	14,500.00	14,500.00	39	8,845.00
Storwize V7000 Base SW (5639-NZ7)	1	11,000.00	11,000.00	39	6,710.00
Storwize V7000 expansion enclosure (2076-224)	9	6,000.00	54,000.00	39	32,940.00
Storwize V7000 Base SW (5639-SM3)	9	11,000.00	99,000.00	39	60,390.00
SAS 1M Cables (2076-5401)	18	358.00	6,444.00	39	3,930.84
2.5" 15K 300GB SAS HDD's (2076-3253)	240	1,099.00	263,760.00	39	160,893.60
V7000 2 port 10Gb-E adapter card (4939-ADB1)	4	699.00	2,796.00	39	1,705.56
IBM RackSwitch (G8124ER)	1	14,999.00	14,999.00	20	11,999.20
10 Gb-E SFP	12	665.00	7,980.00	20	6,384.00
10 Gb-E 1 M cable	12	79.00	948.00	20	758.40
Flex System chassis (8721-A1X)	1	43,000.00	43,000.00	20	34,400.00
19" Rack (7014-T42)	1	6,700.00	6,700.00	50	3,350.00
IBM Flex System CN4054 10 Gb-E Adapter (2 ports)	2	1,099.00	2,198.00	0	2,198.00
IBM Flex System EN4091 10 Gb-E Pass-thru (2 ports)	2	4,999.00	9,998.00	0	9,998.00
HW/SW Total					*344,502.60*
Maintenance for Software					
Base SW	10	7,200.00	72,000.00	39	43,920.00
WSU for Hardware					
Flex V7000 Controller Enclosure	1	5,040.00	5,040.00	39	3,074.40
Storwize V7000 Expansion Enclosure	9	6,048.00	54,432.00	39	33,203.52
Warranty/Maintenance Upgrade to 3 year 24x7x4 for Switch	1	3,870.00	3,870.00	20	3,096.00
Total Warranty/Maintenance					*83,293.92*
Grand Total					**427,796.52**

The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:
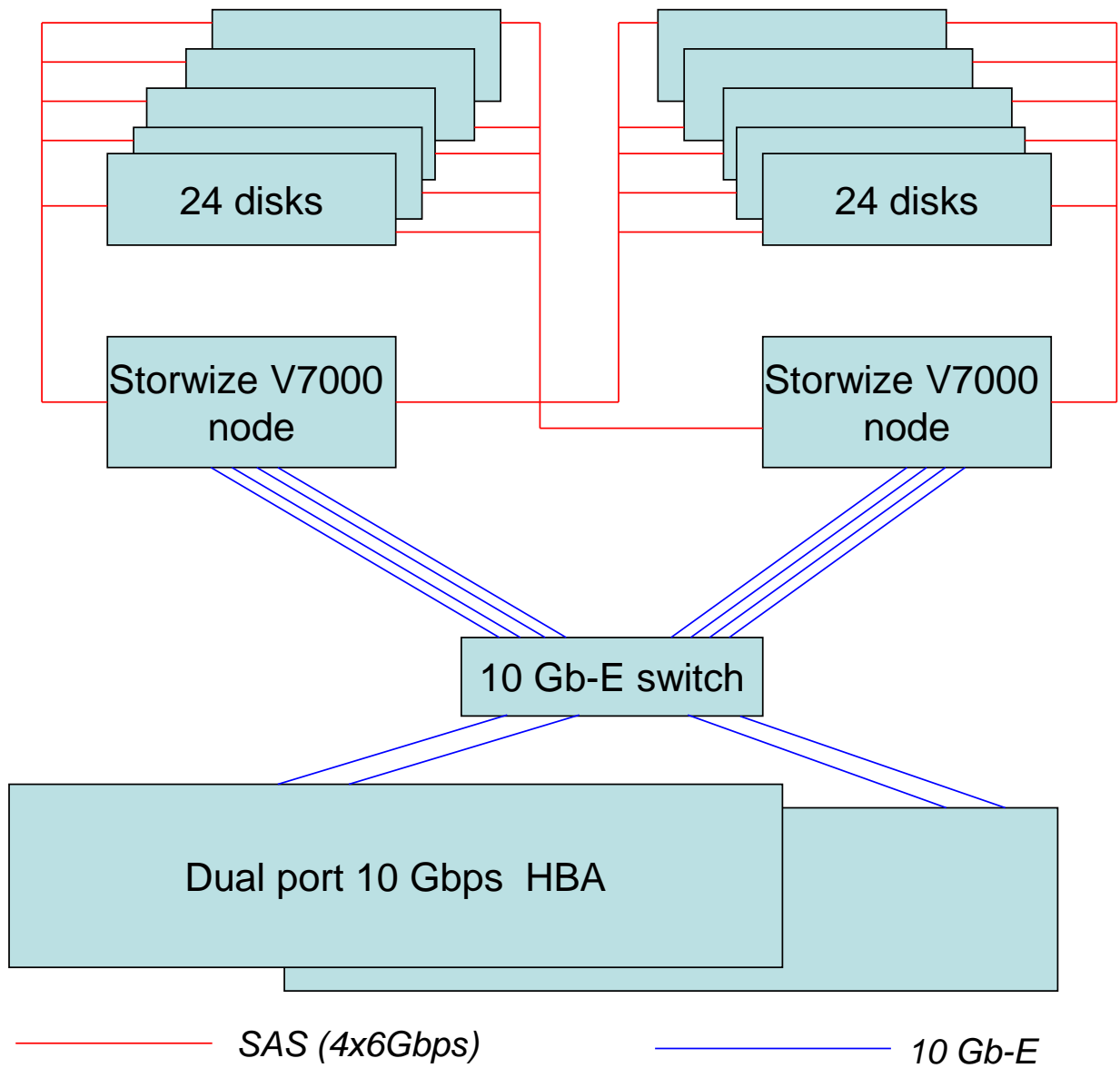
- Acknowledgement of new and existing problems with four (4) hours.

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

Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The TSC used a Cisco Nexus 5010, which has gone "end of life" (EOL). The Priced Storage Configuration substituted an IBM RackSwitch G8124ER *(part # 7309-BR6)* for the Cisco switch. Documentation supplied by the Test Sponsor was the basis for determining that the use of the IBM switch in the TSC would not affect the performance reported in this SPC-1 Result.

Priced Storage Configuration Diagram

24 disks

24 disks

Storwize V7000 node

Storwize V7000 node

10 Gb-E switch

Dual port 10 Gbps HBA

———— *SAS (4x6Gbps)*   ———— *10 Gb-E*

Priced Storage Configuration Components

Priced Storage Configuration
2 – IBM Flex System 10 Gb-E 2-port adapters   *(used in pass-thru mode)*
2 – IBM Flex System 10 Gb-E Pass-thru *(2 ports each)*

1 – IBM 24-port RackSwitch G8124ER
    12 – 10 Gb-E SFPs
    12 – Gb-E cables

IBM Flex System V7000
 	
Flex System V7000 base storage enclosure w/24 slots
 	
2 – V7000 Cannister Nodes, each with
 	
    8 GiB memory/cache *(16 GiB total)*
 	
    2 – V7000 2-port 10Gb-E adapter cards
        (4 adapter cards total)
 	
    4 – 10Gb E front-end connections
        (8 connections total and used)
 	
    8 – 6 Gb SAS connections *(8 PHYs)*
        (16 connections total and used)

1 – Flex System chassis
9 – Storwize V700 expansion enclosures
240 – 2.5",15K, 300 GB SAS HDDs   *(24 disk drives per enclosure, base and expansion)*
1 – 19" rack