SPC BENCHMARK 1™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM STORWIZE® V7000

SPC-1 V1.12

Submitted for Review: March 14, 2011
Submission Identifier: A00103

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	V1.12
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	March 14, 2011
Date the FDR was submitted to the SPC	March 14, 2011
Date the priced storage configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	March 11, 2011

Tested Storage Product (TSP) Description

The IBM Storwize V7000 disk system, IBM's newest midrange disk storage offering, uses IBM System Storage SAN Volume Controller technology to deliver high performance, advanced function, high availability, and modular and scalable storage capacity.

- Supports RAID 0, 1, 5, 6, and 10

- Provides SAN-attached 8 Gbps Fibre Channel (FC) host connectivity and 1 GbE iSCSI host connectivity

- Supports intermix of SAS drives, Nearline SAS drives, and Solid-state drives within the IBM Storwize V7000 Control Enclosure and IBM Storwize V7000 Expansion Enclosures (up to twenty-four 2.5-inch disk drives or twelve 3.5 inch disk drives in each Enclosure).

- Includes IBM Easy Tier technology for automatically moving heavily used data extents onto high-performance storage

- Supports attachment of other storage devices via the Fibre Channel interface, just as the SAN Volume Controller

- Supports a complete set of SAN Volume Controller functions including FlashCopy, RemoteCopy, VDisk Mirroring, thin provisioning, and a revised web-based user interface for both products new with this release

Summary of Results

| SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM Storwize® V7000	
Metric	**Reported Result**
SPC-1 IOPS™	53,014.29
SPC-1 Price-Performance	$7.52/SPC-1 IOPS™
Total ASU Capacity	24,433.592 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$389,425.11

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

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

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

Storage Capacities and Relationships

The following diagram and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.
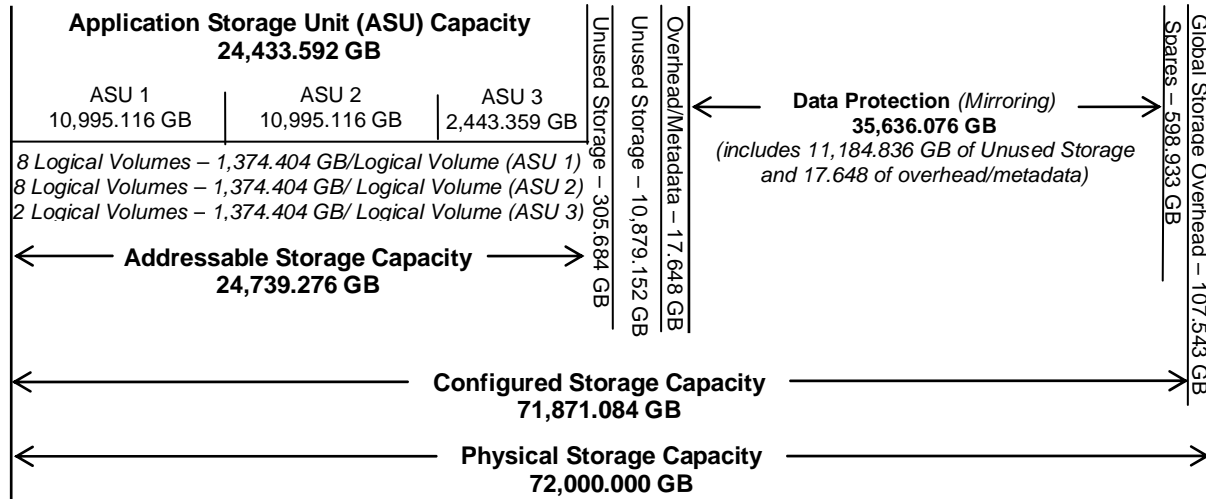
SPC-1 Storage Capacity Utilization	
Application Utilization	33.94%
Protected Application Utilization	68.32%
Unused Storage Ratio	30.64%

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 *(35,636.076 GB)* minus unused Data Protection Capacity *(10,879.152 GB)* divided by Physical Storage Capacity *(72,000.000 GB)*

Unused Storage Ratio: Total Unused Capacity *(22,063.988 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 21-22 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.
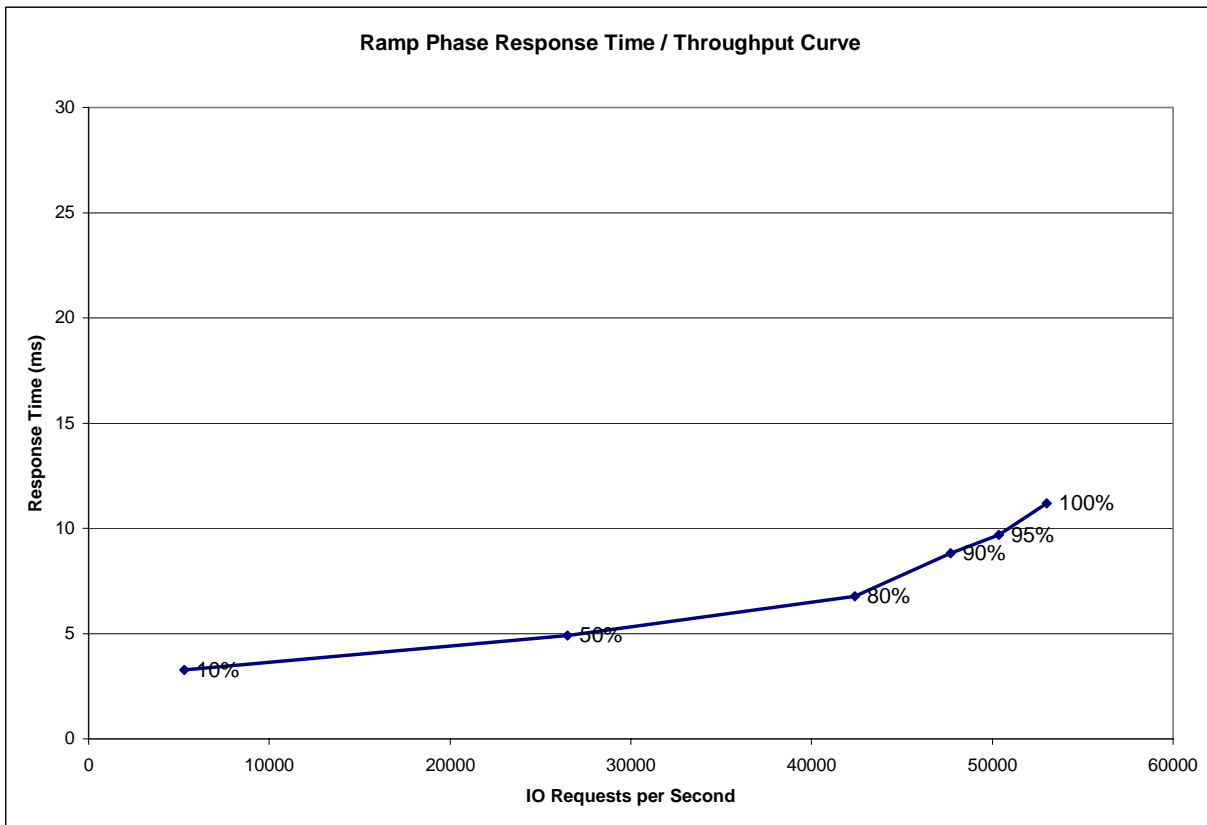
Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	5,302.17	26,505.06	42,396.22	47,688.07	50,357.56	53,014.29
Average Response Time (ms):						
All ASUs	3.27	4.91	6.77	8.82	9.70	11.19
ASU-1	4.04	6.05	8.41	10.53	11.50	13.03
ASU-2	3.80	6.28	9.59	12.51	13.94	16.02
ASU-3	1.40	1.90	2.04	3.56	4.02	5.16
Reads	6.19	9.62	14.16	17.20	18.81	20.97
Writes	1.36	1.84	1.95	3.35	3.76	4.82

Priced Storage Configuration Pricing

		Qty	Unit Price .	extended	% discount	discounted price
Storwize V7000 base storage enclosure (2076-124)	8 SFP (8 Gb)	1	$25,000	$25,000	39	$ 15,250.00
Storwize V7000 Base SW		1	$18,000	$18,000	39	$ 10,980.00
Storwize V7000 expansion enclosure (2076-224)		9	$6,000	$54,000	39	$ 32,940.00
Storwize V7000 Base SW		9	$18,000	$162,000	39	$ 98,820.00
SAS 1M Cables to attach Control Enclosures to Expansion Enclosures		18	$59	$1,062	39	$ 647.82
2.5" 10K 300GB SAS HDD's		240	$1,099	$263,760	39	$ 160,893.60
24 port fibre channel switch (2498-B24)	w/ 8 port actv, 8 SFP (8 Gb)	2	$7,890	$15,780	20	$ 12,624.00
Short wave 5m fibre channel cable (1814-20A 5605)		8	$129	$1,032	20	$ 825.60
Short wave 25 m fibre channel cable (1814-20A 5625)		4	$189	$756	20	$ 604.80
19 inch rack (7014-T42)		1	$2,970	$2,970	50	$ 1,485.00
Dual port 8 Gbps FC HBA (42D0510)		2	$1,299	$2,598	0	$ 2,598.00
	HW/SW Total					$ 337,668.82
Maintenance for Software						
Base SW		10	$7,200	$72,000	39	$ 43,920.00
WSU for Hardware						
Storwize V7000 Controller Enclosure		1	$4,200	$4,200	39	$ 2,562.00
Storwize V7000 Expansion Enclosure		9	$1,921	$17,289	39	$ 10,546.29
Warranty/Maintenance Upgrade to 3 year 24x7x4 for Switch		2	$2,330	$4,660	20	$ 3,728.00
	Total Warranty/Maintenance					$ 60,756.29
	Grand Total					**$ 398,425.11**

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 present 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 Price 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

Each of the two 2498 B24 switches in the TSC was enabled for 24 ports and configured with 20 SFPs. The benchmark measurements utilized 8 ports and 8 SFPs in each switch.

Each of the two 2498 B24 switches included in the Priced Storage Configuration was enabled for 8 ports and configured with 8 SFPs. This difference, if applied to the TSC, would not affect the reported benchmark measurements.

Priced Storage Configuration Diagram
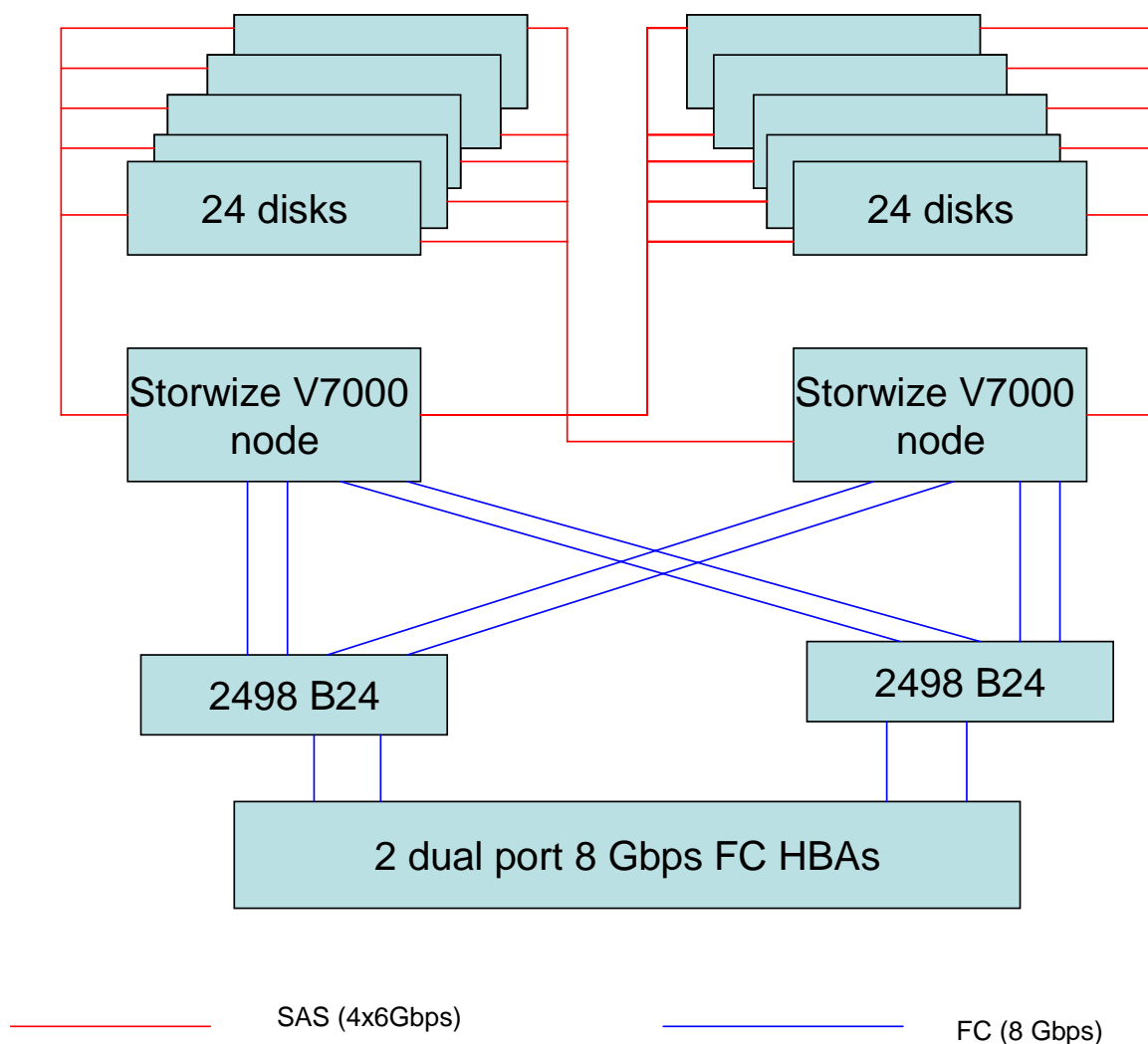
2498 B24: 24-port fibre channel switch

24 disks: One Storwize® V7000 base storage enclosure and four Storwize® V7000 Expansion Enclosures, each with 24 10K RPM 146GB disk drives.

Priced Storage Configuration Components

Priced Storage Configuration Components:
2 – 8 Gb PCIe dual port FC HBAs

IBM Storwize® V7000 *(2-node cluster)*
 	
  8 GB memory/cache per node *(16 GB total)*
 	
  4 – 8 Gbps switch-to-host FC connections
        shared by both nodes
 	
  2 – 4x6Gbps SAS connections per node
 	
  8 – 8 Gb SFPs
 	
24 – 10K RPM 300 GB disk drives
 	
  9 – Storwize® V7000 expansion enclosures each
        with 24 10K RPM 300 GB disk drives

1 – 19 inch rack with 2 12-plug PDUs
2 – 24-port fibre channel switches *(2498-B24)*
8 – short wave 5m fibre channel cables
4 – 25m fibre channel cables