SPC BENCHMARK 1™
EXECUTIVE SUMMARY

IBM CORPORATION
IBM STORWIZE® V7000 *(SSDS)*

SPC-1 V1.12

Submitted for Review: June 4, 2012
Submission Identifier: A00116

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	V2.2.0
Date Results were first used publicly	June 4, 2012
Date the FDR was submitted to the SPC	June 4, 2012
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	June 1, 2012

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
- Accommodates up to twenty-four 2.5-inch disk drives or twelve 3.5-inch disk drives installed within the IBM Storwize V7000 Control Enclosure with attachment support for up to nine IBM Storwize V7000 Expansion Enclosures, providing modular and highly scalable storage solutions that range up to 360 TB physical storage capacity.
- 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.
- 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 Reported Data	
Tested Storage Product (TSP) Name: IBM Storwize® V7000 *(SSDs)*	
Metric	**Reported Result**
SPC-1 IOPS™	120,492.34
SPC-1 Price-Performance	$1.50/SPC-1 IOPS™
Total ASU Capacity	1,527.100 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$181,029.02

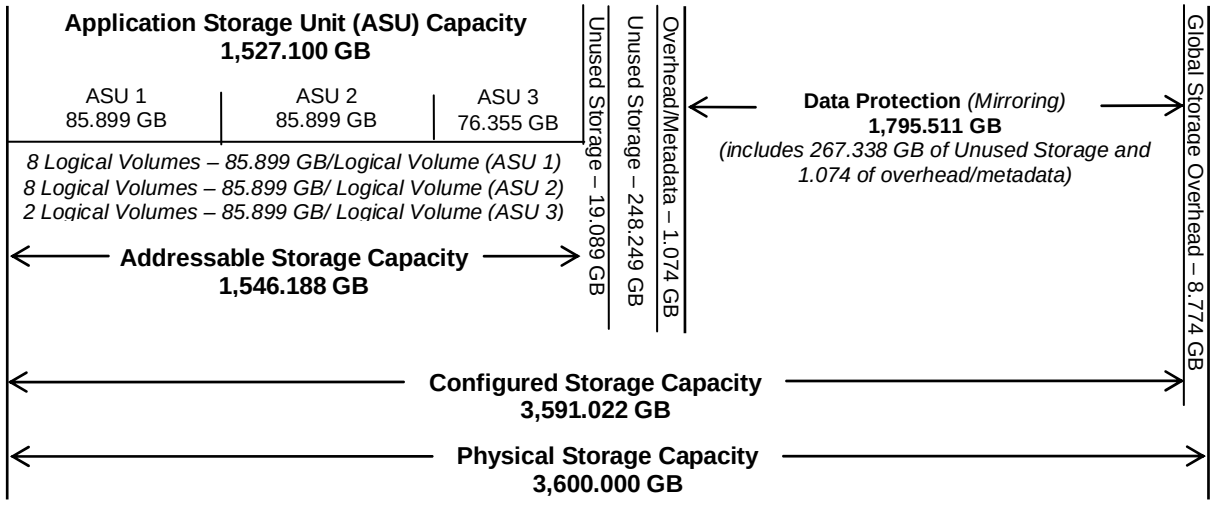
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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 *(Mirroring)*** configures two or more identical copies of user data.

Storage Capacities, Relationships, and Utilization

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	42.42%
Protected Application Utilization	84.87%
Unused Storage Ratio	14.85%

Application Utilization: Total ASU Capacity *(1,527.100 GB)* divided by Physical Storage Capacity *(3,600.000 GB)*

Protected Application Utilization: Total ASU Capacity *(1,527.100 GB)* plus total Data Protection Capacity *(1,795.511 GB)* minus unused Data Protection Capacity *(214.963 GB)* divided by Physical Storage Capacity *(3,600.000 GB)*

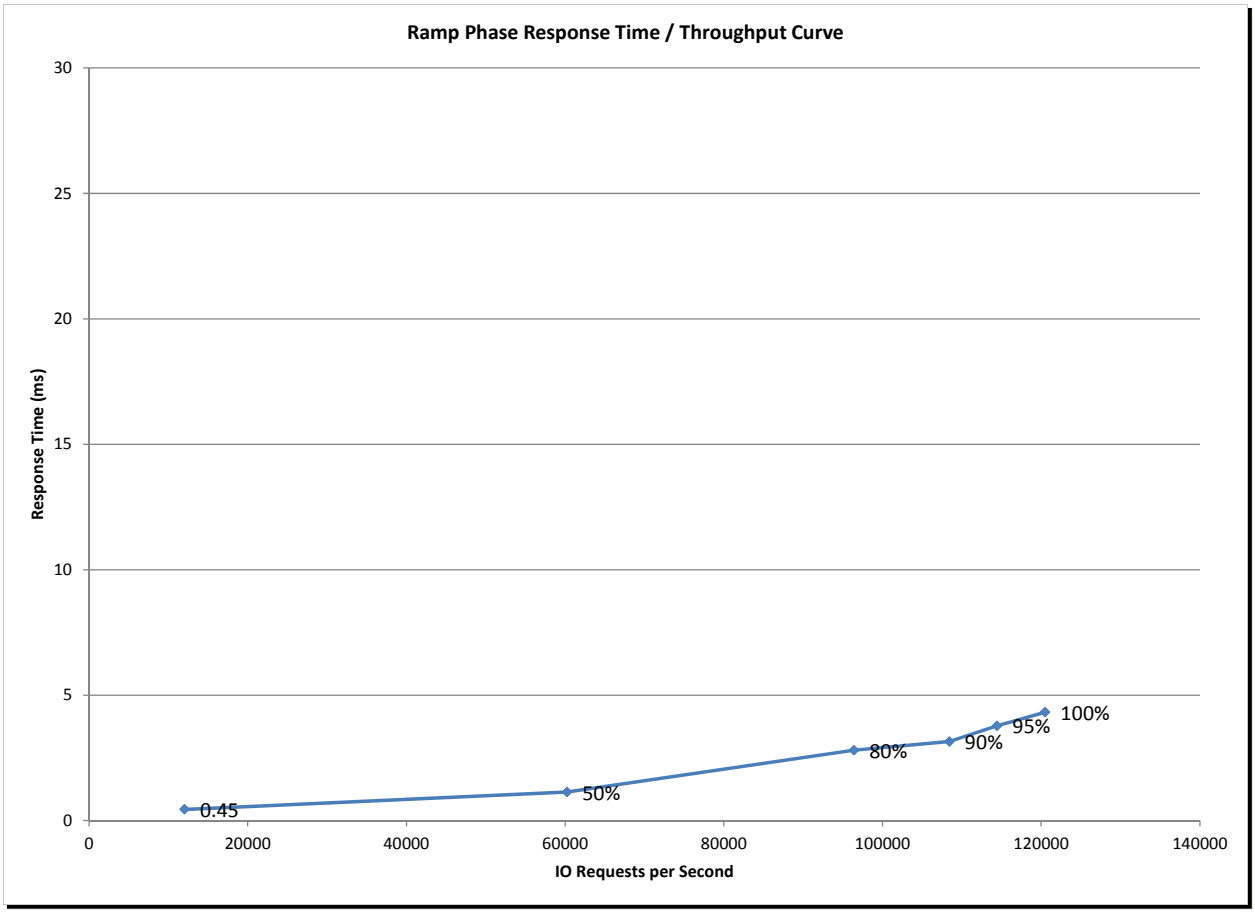
Unused Storage Ratio: Total Unused Capacity *(515.587 GB)* divided by Physical Storage Capacity *(3,600.000 GB)* and may not exceed 45%.

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	12,048.96	60,240.56	96,406.36	108,442.25	114,430.47	120,492.34
Average Response Time (ms):						
All ASUs	0.45	1.14	2.80	3.15	3.78	4.32
ASU-1	0.42	1.03	2.44	2.78	3.32	3.80
ASU-2	0.46	1.09	2.59	2.92	3.49	3.99
ASU-3	0.50	1.39	3.68	4.05	4.87	5.55
Reads	0.41	0.87	1.73	2.05	2.41	2.79
Writes	0.47	1.32	3.51	3.87	4.67	5.31

Priced Storage Configuration Pricing

Component	Quantity	Unit Price	Unit Maint	List w/ Maint	% discount	Total Price
V7000 controller (2076-124) w/8 SFPs, 18 - 200GB SSDs	1	186,982.00	4,200.00	191,182.00	39	116,621.02
V7000 base software	1	18,000.00	7,200.00	25,200.00	39	15,372.00
24 port fibre channel switch (2498-B24) w/8 ports enabled, 8 SFPs	2	7,120.00	10,800.00	35,840.00	20	28,672.00
5m fibre channel cable (2076-124 5305)	8	129.00	0.00	1,032.00	20	825.60
25m fibre channel cable (2076-124 5625)	8	189.00	0.00	1,512.00	20	1,209.60
4 Gbps dual port FC adapter (9117-5774)	8	3,273.00	0.00	26,184.00	30	18,328.80
Total Price						**181,029.02**

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:

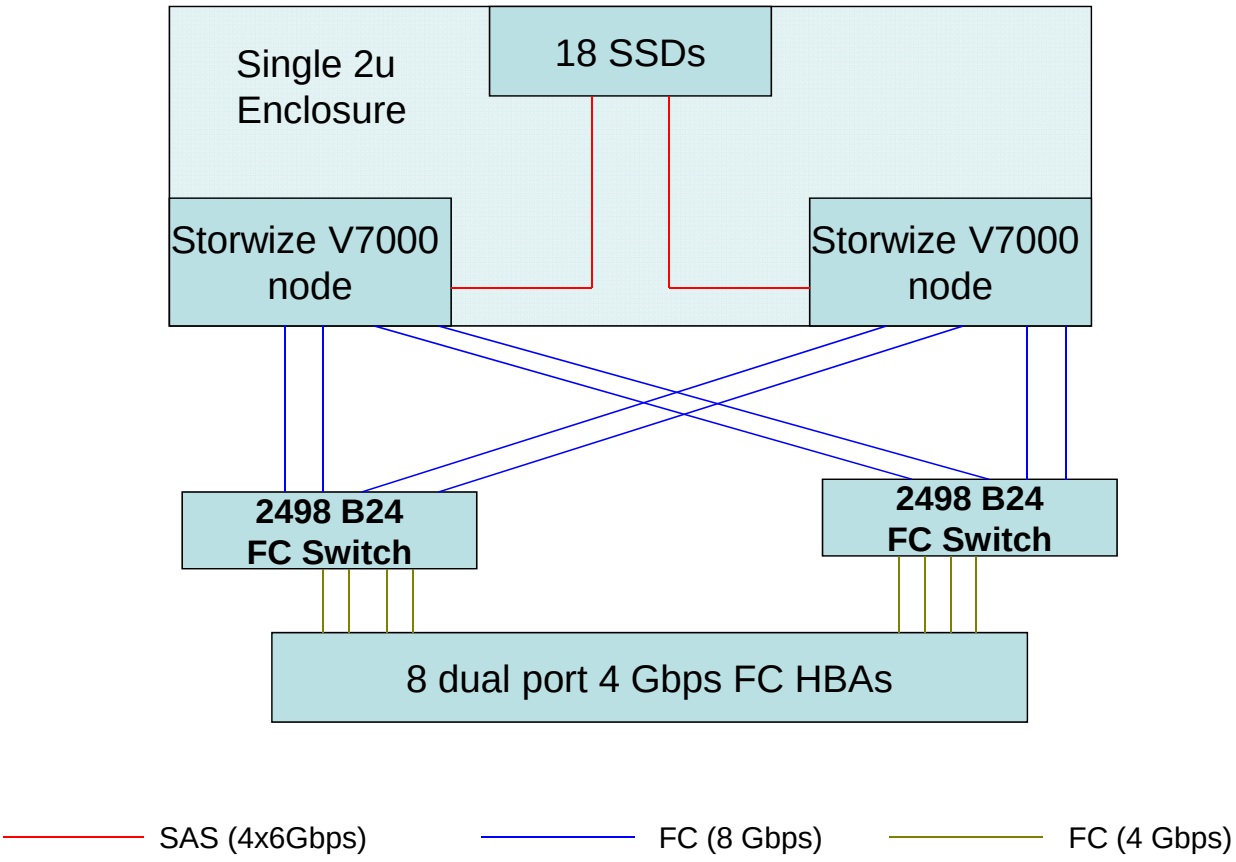
- Acknowledgement of new and existing problems with four (4) hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration 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 two 2498 B4 switches used in the TSC was configured with all 24 ports enabled and with 24 SFPs. Only eight of the ports, in each switch, were used in the SPC-1 measurements. Each of the two switches in the priced storage configuration was priced with eight ports enabled and eight SFPs.

This difference, if applied to the TSC, would not have had any impact on the SPC-1 measurements.

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration:
8 – 4 Gbps dual port FC HBAs
IBM Storwize® V7000 *(2 nodes)* Each V7000 node includes: 8 GB cache *(16 GB total)* 4 – 8 Gbps FC front-end connections *(8 total, 8 used)* 2 – 4x6 Gbps SAS backend connections *(4 total, 2 used – 1 per node)*
2 – 24 port Fibre Channel Brocade switches each with 8 ports enabled and 8 SFPs
1 – V7000 Expansion Enclosure
18 – 200 GB Solid State Devices (SSDs)