SPC BENCHMARK 2™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM STORWIZE® V7000

SPC-2™ V1.3

Submitted for Review: December 13, 2010
Submission Identifier: B00052

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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Revision Information and Key Dates

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SPC-2 Specification revision number	V1.3
SPC-2 Workload Generator revision number	V1.0
Date Results were first used publicly	December 13, 2010
Date FDR was submitted to the SPC	December 13, 2010
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	December 10, 2010

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

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
- Reported Data for each SPC Test: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand Delivery (VOD) Test.

SPC-2 Reported Data				
IBM Storwize V7000				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
3,132.87	$71.32	29,914.447	$ 223,422.08	Protected *(RAID-5)*
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)				
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LFP Composite	2,992.67			$74.66
Write Only:				
1024 KiB Transfer	2,089.54	20	104.48	
256 KiB Transfer	1,898.74	20	94.94	
Read-Write:				
1024 KiB Transfer	2,935.55	20	146.78	
256 KiB Transfer	2,728.91	20	136.45	
Read Only:				
1024 KiB Transfer	4,141.33	20	207.07	
256 KiB Transfer	4,161.93	20	208.10	
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	4,046.64			$55.21
1024 KiB Transfer Size				
4 I/Os Outstanding	3,918.33	20	195.92	
1 I/O Outstanding	4,150.02	20	207.50	
64 KiB Transfer Size				
4 I/Os Outstanding	4,115.84	20	205.79	
1 I/O Outstanding	4,002.37	20	200.12	
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**
	2,359.30	3,000	0.79	$94.70

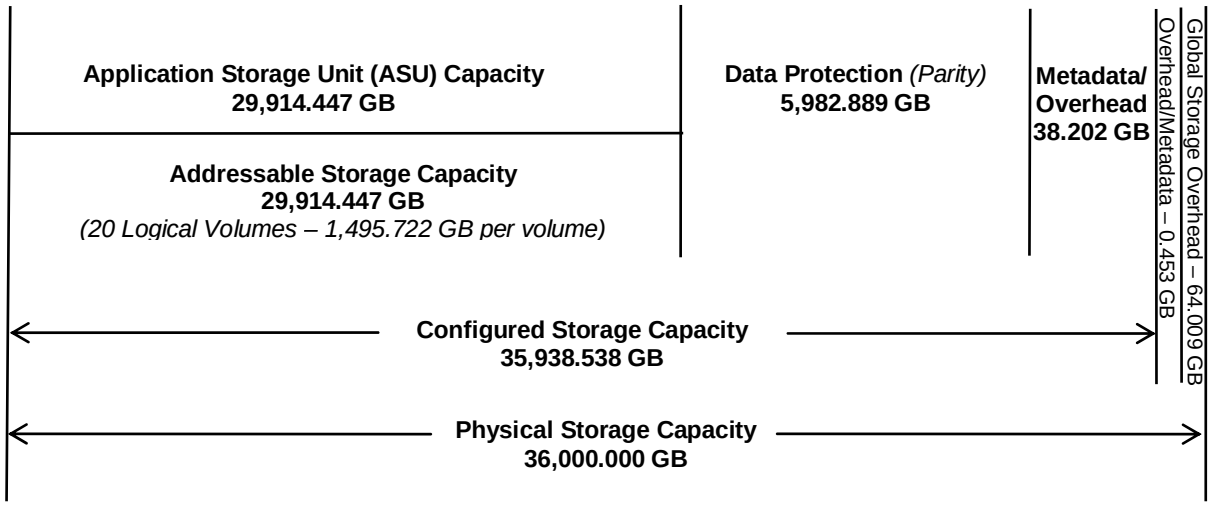
SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

ASU (Application Storage Unit) **Capacity** represents the total storage capacity read and written in the course of executing the SPC-2 benchmark.

A **Data Protection Level** of **Protected** using ***RAID-5*** provides data protection by distributing check data corresponding to user data across multiple disks in the form of bit-by-bit parity.

Storage Capacities and Relationships

The following diagram *(not to scale)* 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	83.10%
Protected Application Utilization	99.71%
Unused Storage Ratio	0.00%

Application Utilization: Total ASU Capacity *(29,914.447 GB)* divided by Physical Storage Capacity *(36,000.000 GB)*

Protected Application Utilization: (Total ASU Capacity *(29,914.447 GB)* plus total Data Protection Capacity *(5,982.889 GB)* minus unused Data Protection Capacity *(0.000 GB)* divided by Physical Storage Capacity *(29,914.447 GB)*.

Unused Storage Ratio: Total Unused Capacity *(0.000 GB)* divided by Physical Storage Capacity *(29,914.447 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.

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.

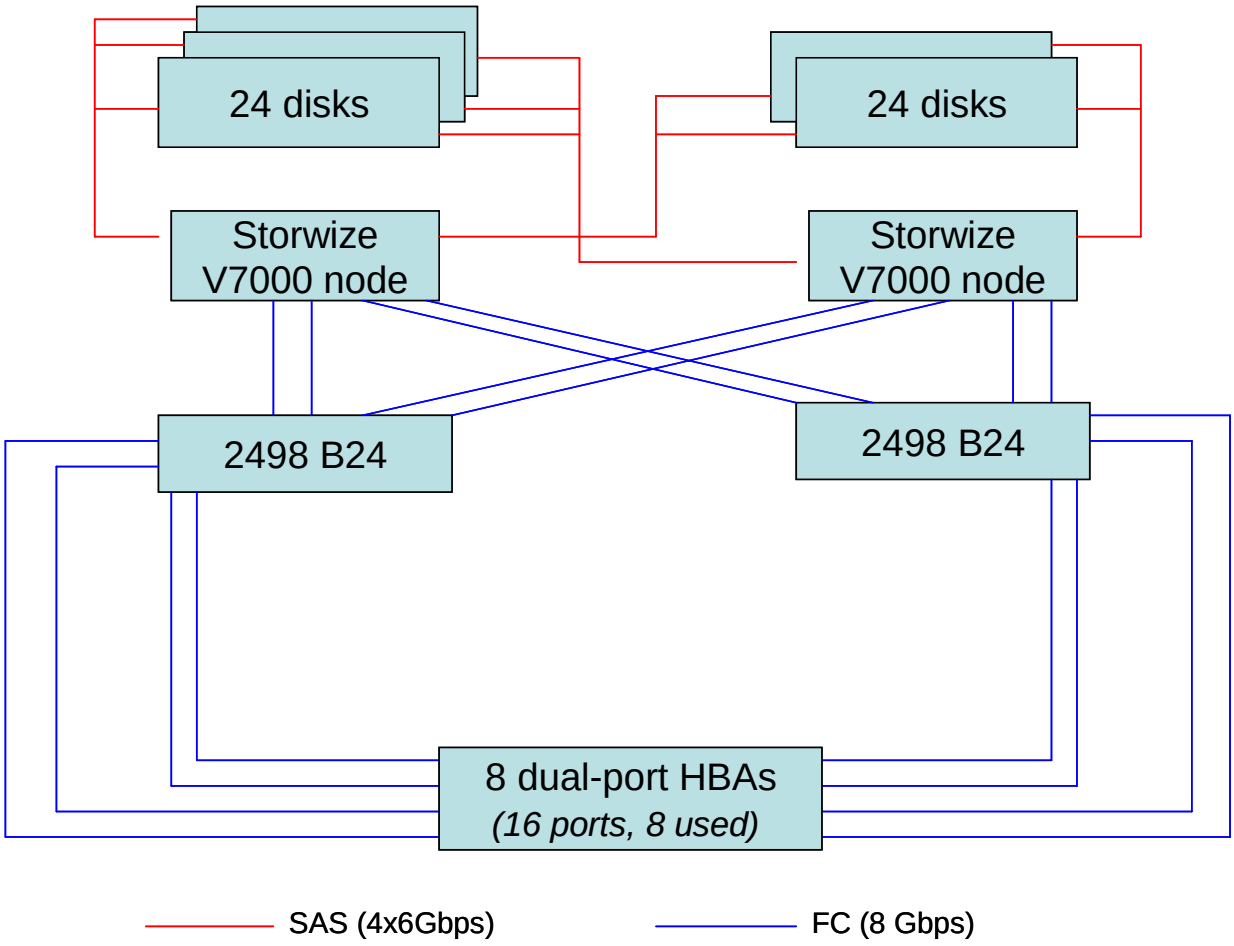
Priced Storage Configuration Pricing

Description		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)		4	$6,000	$24,000	39	14,640.00
Storwize V7000 Base SW		4	$18,000	$72,000	39	43,920.00
SAS 1M Cables to attach Control Enclosures to Expansion Enclosures		16	$59	$944	39	575.84
2.5" 10K 300GB SAS HDD's		120	$1,099	$131,880	39	80,446.80
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)		8	$189	$1,512	20	1,209.60
19 inch rack (7014-T42)		1	$2,970	$2,970	50	1,485.00
Dual port 8 Gbps FC HBA (42D0510)		8	$1,299	$10,392	0	10,392.00
	HW/SW Total					*192,348.84*
Maintenance for Software						
Base SW		5	$7,200	$36,000	39	21,960.00
WSU for Hardware						
Storwize V7000 Controller Enclosure		1	$4,200	$4,200	39	2,562.00
Storwize V7000 Expansion Enclosure		4	$1,921	$7,684	39	4,687.24
Warranty/Maintenance Upgrade to 3 year 24x7x4 for Switch		1	$2,330	$2,330	20	1,864.00
	Total Warranty/Maintenance					*31,073.24*
	Grand Total					**223,422.08**

The following 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.
- Standard IBM field delegation discounts.

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 300 GB disk drives.

Priced Configuration Components

Priced Storage Configuration:
8 – 8 Gb dual port FC HBAs *(model 42D0510)*
IBM Storwize® V7000 ***(2-node cluster)*** 8 GB memory/cache per node *(16 GB total)* 8 – 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 4 – Storwize® V7000 Expansion Enclosures 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*) with 4 SFPs per switch *(8 total)* and 4 ports enabled per switch *(8 total)*
8 – short wave 5m fibre channel cables
8 – 25m fibre channel cables