SPC BENCHMARK 2™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM SYSTEM STORAGE DS5300 *(8 Gb, RAID-6)*

SPC-2™ V1.3

Submitted for Review: October 21, 2009
Submission Identifier: B00046
Revised: March 8, 2010

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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Revision Information and Key Dates

Revision Information and Key Dates	
SPC-2 Specification revision number	V1.3
SPC-2 Workload Generator revision number	V1.0
Date Results were first used publicly	October 21, 2009
Date FDR was submitted to the SPC	October 21, 2009
Date revised FDR was submitted to the SPC Revised Total Price and SPC-2 Price-Performance *(highlighted in red, page 3)* Revised pricing *(highlighted in red, page 6)* Revised TSC and Priced Storage Configuration differences *(highlighted in red, page 6)*	March 8, 2010
Date the TSC will be available for shipment to customers	September 8, 2009
Date the TSC completed audit certification	October 20, 2009

Tested Storage Product (TSP) Description

The System Storage DS5000 series disk system is IBM's midrange disk offering, specifically designed to meet the needs of midrange/departmental storage requirements, delivering high performance, advanced function, high availability, modular and scalable storage capacity, with SAN-attached 8 Gbps Fibre Channel (FC) connectivity, and support for RAID 0, 1, 3, 5, 6, and 10, with up to 256 TB physical storage capacity.

The DS5000 series represents the seventh-generation architecture within the midrange disk family.

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 System Storage DS5300 *(8Gb, RAID-6)*				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
5,543.88	$75.33	14,042.731	$417,648	RAID-6
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	4,909.31			$85.07
Write Only:				
1024 KiB Transfer	3,436.08	48	71.58	
256 KiB Transfer	3,464.43	48	72.18	
Read-Write:				
1024 KiB Transfer	4,864.06	48	101.33	
256 KiB Transfer	4,936.59	48	102.85	
Read Only:				
1024 KiB Transfer	6,382.12	48	132.96	
256 KiB Transfer	6,372.58	48	132.76	
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	6,217.33			$67.17
1024 KiB Transfer Size				
4 I/Os Outstanding	6,316.67	48	131.60	
1 I/O Outstanding	6,358.23	48	132.46	
64 KiB Transfer Size				
4 I/Os Outstanding	6,203.20	48	129.23	
1 I/O Outstanding	5,991.20	48	124.82	
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**
	5,505.01	7,000	0.79	$75.87

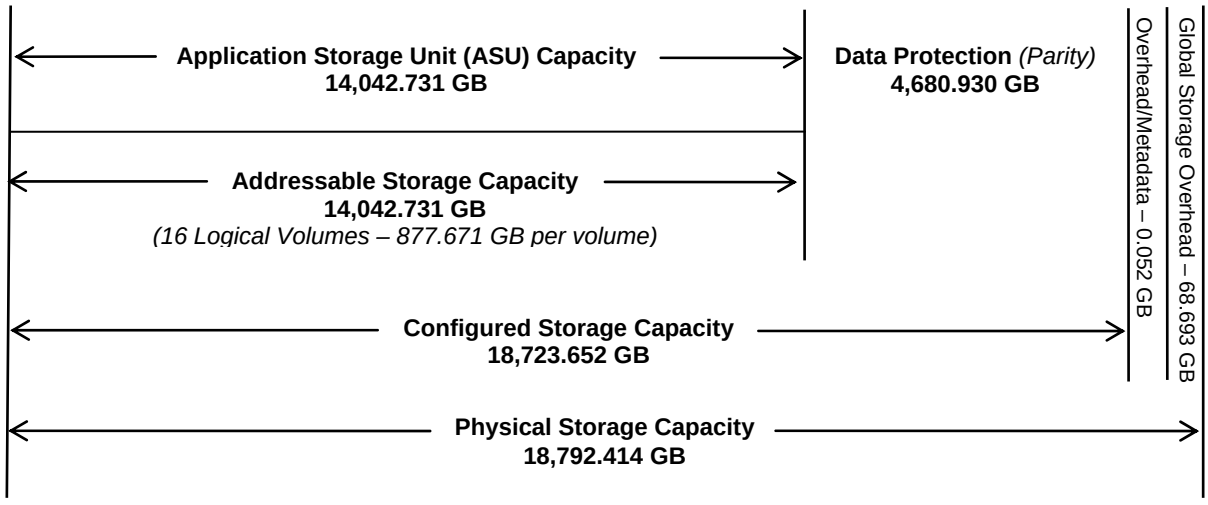
SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

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-6*** provides simultaneous drive failure protection. RAID 6 stripes both user data and redundancy data (parity) across the drives. RAID 6 uses the equivalent of the capacity of two drives (in a volume group) for redundancy data. RAID 6 protects against simultaneous failure of two volume group member drives by using two independent error-correction schemes.

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	74.73%
Protected Application Utilization	99.63%
Unused Storage Ratio	0.00%

Application Utilization: Total ASU Capacity *(14,042.731 GB)* divided by Physical Storage Capacity *(18,792.414 GB)*.

Protected Application Utilization: (Total ASU Capacity *(14,042.731 GB)* plus total Data Protection Capacity *(4,680.930 GB)* minus unused Data Protection Capacity *(0.000 GB)* divided by Physical Storage Capacity *(18,792.414 GB)*.

Unused Storage Ratio: Total Unused Capacity *(0.000 GB)* divided by Physical Storage Capacity *(18,792.414 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 22-23 in the Full Disclosure Report.

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Model Type / Feature		Description	List Price	QTY	Extended Price
1818-53A		DS5300 Dual Controller Disk System	$80,000	1	$80,000
1818-D1A		EXP5000 16 slot Expansion unit (incl. 2 x 4 Gb SFPs)	$6,000	8	$48,000
	2030	8 GB Cache Memory	$16,000	1	$16,000
	2052	Two Quad 8 Gbps FC Host Port Cards (each port includes SFP)	$15,000	2	$30,000
	2412	Short Wave 4Gbps SFP Transceiver Pair	$998	8	$7,984
	5605	5M LC-LC FIBER OPTIC CABLE	$129	32	$4,128
	7720	DS5000 WINDOWS HOST KIT	$1,250	1	$1,250
	8900	DS5000 8 STG PARTITION-IP0	$10,000	1	$10,000
	5530	16-Pak 146.8 GB/15K DDM	$20,290	8	$162,320
42D0501		single port PCI-X 8 Gbps HBA	$1,299	8	$10,392
45W0501		SW SFP for HBA- 8 pack	$2,310	1	$2,310
			Total List		$372,384
		Std warranty 1 year 24x7x4hr response		incl	
		addtl 2 years 24x7x4			$45,264
			Grand Total		**$417,648**

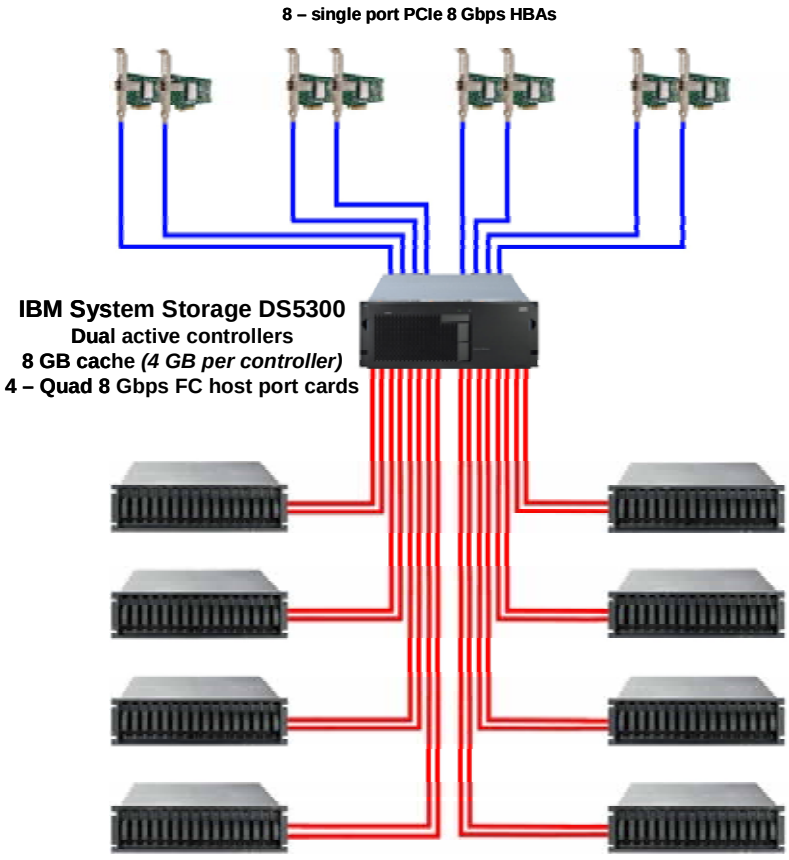
Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The differences between the TSC and Priced Storage Configuration consisted of the following:

- The priced disk drives are mounted in an IBM drive carrier and each disk drive is configured to self-identify as a DS5300 brand.
- The TSC was configured with 8 8Gbps SFPs, which were all used. The Priced Storage Configuration included an additional 8 SFPs.
- The TSC was configured with 48 4Gbps SFPs, of which 32 were used. The Priced Storage Configuration included only the required 32 SFPs.

The above differences, if applied to the TSC, would not have a negative impact on the reported SPC-1 performance.

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration:
8 – 8Gb PCIe FC HBAs *(42D0501)*
SC-1/SC-2: IBM System Storage DS5300 **dual-active controllers with:** 4 GB cache per controller *(8 GB total)* 4 – Quad 8 Gbps FC Host Port cards with 16 SFPs *(8 Gbps)* 8 – 8 Gb Fibre Channel front-end connections per controller *(16 total, 8 used – 4 per controller)* 8 – 4 Gb Fibre Channel backend connection per controller*(16 total, 16 used)*
8 – 4 Gbps SFP pairs
8 – IBM EXP5000 expansion unit with 2 SFPs *(4 Gbps)* per unit
128 – 146.8 GB 15K RPM disk drives *(16 disk drives per expansion unit)*