SPC Benchmark 2™
Executive Summary

IBM Corporation
IBM System Storage DS5020 Express *(RAID-6)*

SPC-2™ V1.3

Submitted for Review: October 8, 2009
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EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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 8, 2009

Date revised FDR was submitted to the SPC
  Revised Total TSP Price and SPC-2 Price-Performance *(page 3)*
  Revised pricing *(page 6)*
  Revised TSC/Priced Storage Configuration differences *(page 6)*
  Revised TSC component table (*page 7)*
  (revisions highlighted in red on the above pages)
	March 11, 2010

Date FDR was submitted to the SPC	October 8, 2009
Date the TSC will be available for shipment to customers	September 4, 2009
Date the TSC completed audit certification	October 7, 2009

Tested Storage Product (TSP) Description

The IBM DS5020 storage system is designed to provide midrange customers with the performance, reliability, and robust functionality enterprise customers are accustomed to – at an affordable price. Its core features and dynamic flexibility make it a great fit for a wide range of requirements, providing peace of mind and exceptional return on investment. The System Storage DS5020 Express disk system includes an industry leading 8 Gbps Fibre Channel (FC) as well as iSCSI host capability that seamlessly integrates into existing and new infrastructures, while providing the balanced performance needed to satisfy the mixed workloads created by consolidation. Its modular architecture and efficiencies help lower acquisition and operational costs as performance and configuration requirements can be met with minimal raw capacity. And when it's time to expand, the DS5020 can add incremental capacity with no downtime.

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.

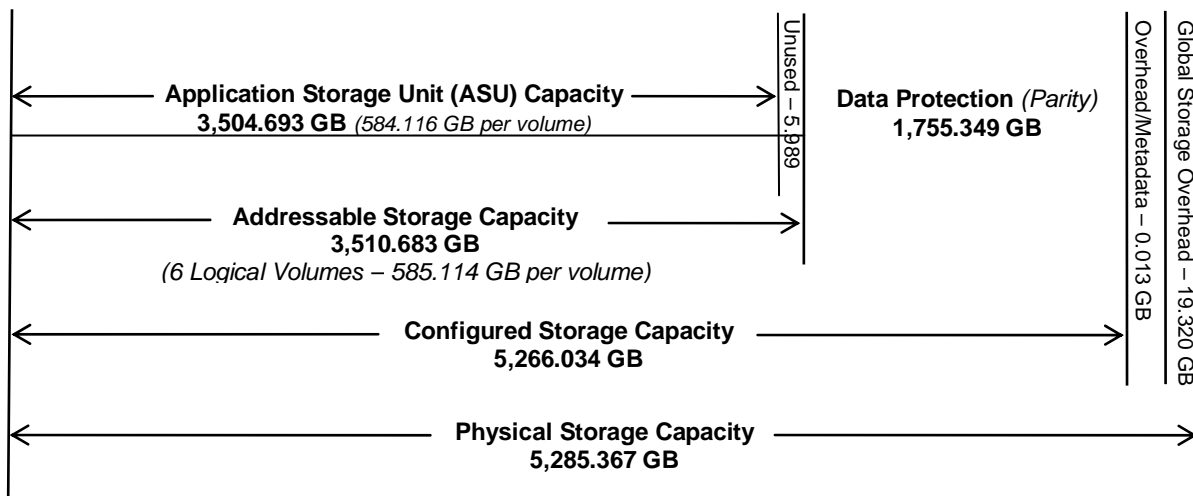| SPC-2 Reported Data				
IBM System Storage DS5020 Express *(RAID-6)*				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
1,286.74	$93.26	3,504.693	$120,002	RAID-6
The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 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	1,009.98			$118.82
Write Only:				
1024 KiB Transfer	864.81	32	27.03	
256 KiB Transfer	383.30	32	11.98	
Read-Write:				
1024 KiB Transfer	1,071.56	32	33.49	
256 KiB Transfer	574.05	32	17.94	
Read Only:				
1024 KiB Transfer	1,580.42	32	49.39	
256 KiB Transfer	1,585.74	32	49.55	
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	1,466.08			$81.85
1024 KiB Transfer Size				
4 I/Os Outstanding	1,541.69	32	48.18	
1 I/O Outstanding	1,532.52	32	47.89	
64 KiB Transfer Size				
4 I/Os Outstanding	1,405.70	32	43.93	
1 I/O Outstanding	1,384.43	32	43.26	
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**
	1,384.16	1,760	0.79	$86.70

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-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)* documents the various storage capacities, used in this benchmark, and their relationships.

Application Storage Unit (ASU) Capacity
3,504.693 GB *(584.116 GB per volume)*

Unused – 5.989

Data Protection *(Parity)*
1,755.349 GB

Overhead/Metadata – 0.013 GB

Global Storage Overhead – 19.320 GB

Addressable Storage Capacity
3,510.683 GB
(6 Logical Volumes – 585.114 GB per volume)

Configured Storage Capacity
5,266.034 GB

Physical Storage Capacity
5,285.367 GB

SPC-1 Storage Capacity Utilization	
Application Utilization	66.31%
Protected Application Utilization	99.52%
Unused Storage Ratio	0.11%

Application Utilization: Total ASU Capacity *(3,504.693 GB)* divided by Physical Storage Capacity *(5,285.367 GB)*

Protected Application Utilization: (Total ASU Capacity *(3,504.693 GB)* plus total Data Protection Capacity *(1,755.349 GB)* minus unused Data Protection Capacity *(0.000 GB)*) divided by Physical Storage Capacity *(5,285.367 GB)*

Unused Storage Ratio: Total Unused Capacity *(5.989 GB)* divided by Physical Storage Capacity *(5,285.367 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 23-24 in the Full Disclosure Report.

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Description	Unit Price	Quantity	Extended Price
IBM DS5020 storage system			
DS5020 disk storage array (MTM 1814-20A) Note- this includes 1 GB RAM per controller, four 8 Gb FC host connections with SFPs four 4 Gb FC drive connections with SFPs	$ 22,500.00	1	$ 22,500.00
Feature #2080 -DS5020 two dual 8 Gbps host cards with SFPs	$ 8,000.00	1	$ 8,000.00
Feature #7393 -DS5020 33-64 Disk Drive Att	$ 4,000.00	1	$ 4,000.00
Feature #2070 - DS5020 Additional 2GB Cache Memory	$ 4,000.00	1	$ 4,000.00
Feature #7801 - DS5020 - Windows Host Kit	$ 1,250.00	1	$ 1,250.00
Feature #8700 - DS5020 - 2 Storage Partitions - Plant	$ 1,500.00	1	$ 1,500.00
Feature #3605 - 5m FC cable	$ 129.00	8	$ 1,032.00
EXP520 expansion units (MTM 1814-52A) incl 2 x 4 Gb SFPs	$ 6,000.00	2	$ 12,000.00
Feature #4200 - DS5020 146.8GB/15K 4GB/S FC DDM	$ 1,605.00	36	$ 57,780.00
HBA model 42D0485	$ 1,299.00	4	$ 5,196.00
Maintenance (3 years, 24x7 with 4 hour response)	$ 2,744.00	1	$ 2,744.00
			$ 120,002.00

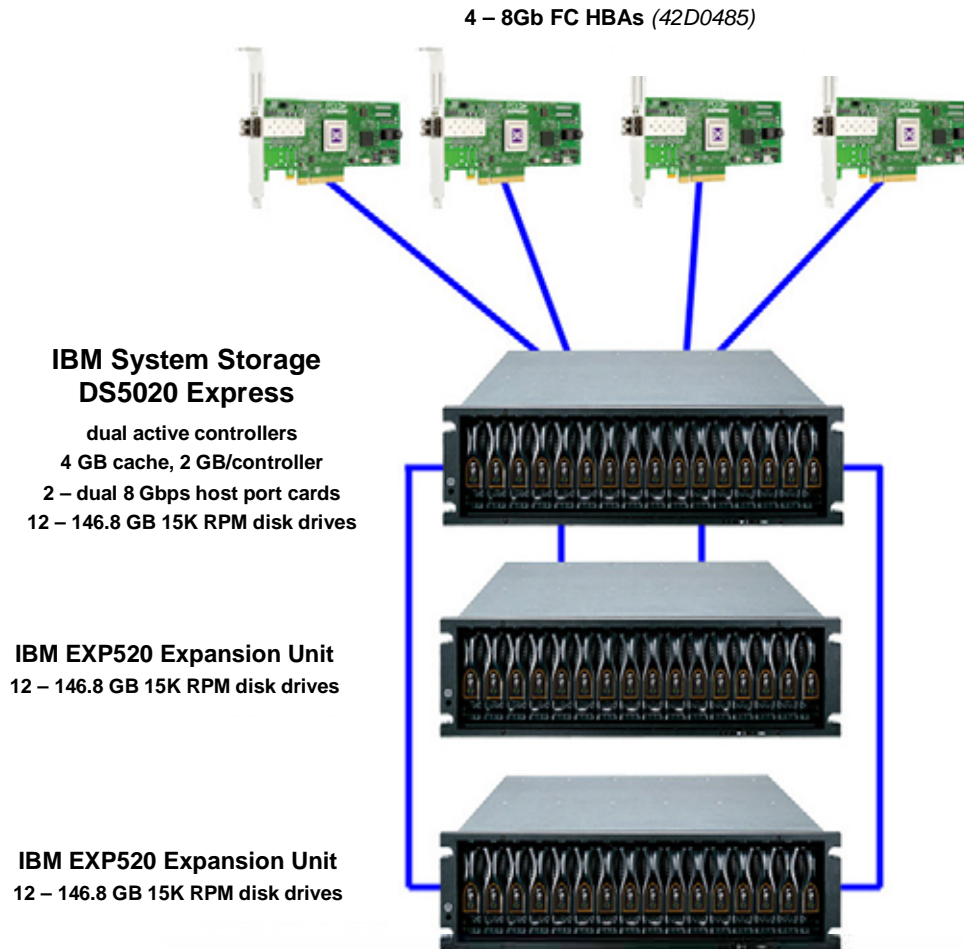## Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The difference between the Tested Storage Configuration and Priced Storage Configuration is that the priced disk drives are mounted in an IBM drive carrier and each disk drive is configured to self-identify as a DS5020 brand.

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 DS5020 brand.

- The TSC was configured with 12 4Gbps SFPs, of which 8 were used. The Priced Storage Configuration only included the required 8 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

4 – 8Gb FC HBAs *(42D0485)*

**IBM System Storage
DS5020 Express**

dual active controllers
4 GB cache, 2 GB/controller
2 – dual 8 Gbps host port cards
12 – 146.8 GB 15K RPM disk drives

IBM EXP520 Expansion Unit
12 – 146.8 GB 15K RPM disk drives

IBM EXP520 Expansion Unit
12 – 146.8 GB 15K RPM disk drives

Priced Storage Configuration Components

Priced Storage Configuration:
4 – 8Gb FC HBAs *(42D0485)*

SC-1/SC-2: IBM System Storage DS5020 Express
2 – dual-active controllers with:
    4 GB cache, 2 GB per controller
    2 – dual 8 Gbps host cards with 4 SFPs
    4 – 8 Gb Fibre Channel front-end connections
        per controller *(8 total, 4 used – 2 per controller)*
    4 – 4 Gb Fibre Channel backend connection
        (4 used)

2 – IBM EXP520 expansion units   with 2 SFPs *(4 Gbps)* per unit
36 – 146.8 GB 15K RPM FC disk drives