



**SPC BENCHMARK 2™
EXECUTIVE SUMMARY**

**IBM CORPORATION
IBM SYSTEM STORAGE DS5020 EXPRESS (RAID-6)**

SPC-2™ V1.3

**Submitted for Review: October 8, 2009
Submission Identifier: B00042**

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	IBM Corporation – http://www.ibm.com Bruce McNutt – bmcnutt@us.ibm.com 650 Harry Road San Jose, CA 9120 Phone: (408) 927-2717
Test Sponsor Alternate Contact	IBM Corporation – http://www.ibm.com Vernon Miller – millerv@us.ibm.com KBV/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-4849 FAX: (520) 799-2009
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

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 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	\$87.04	3,504.693	\$112,002	RAID-6
<i>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)</i>				
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			\$110.90
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	
<i>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).</i>				
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			\$76.40
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	
<i>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).</i>				
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	\$80.92

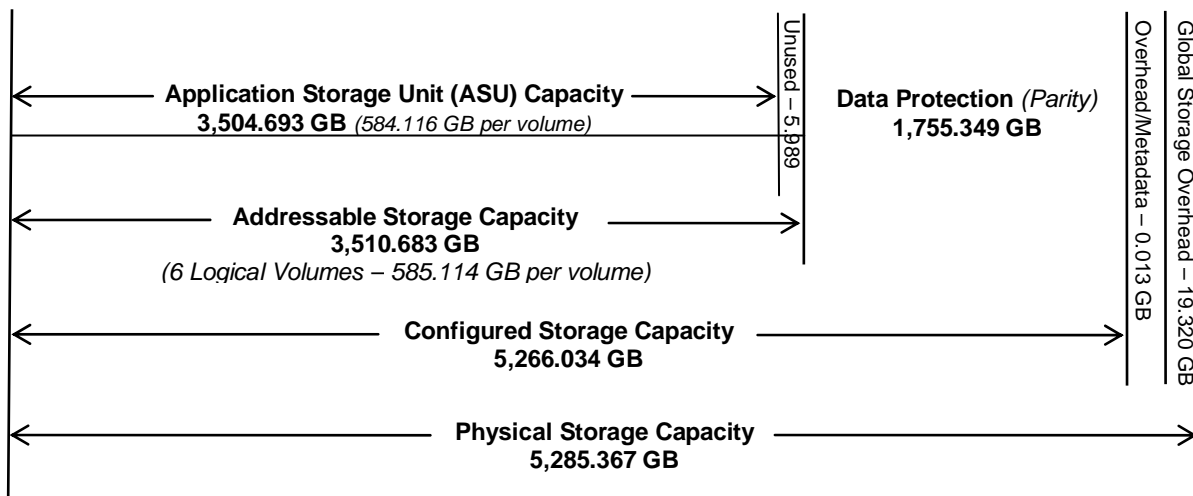
SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

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.



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.

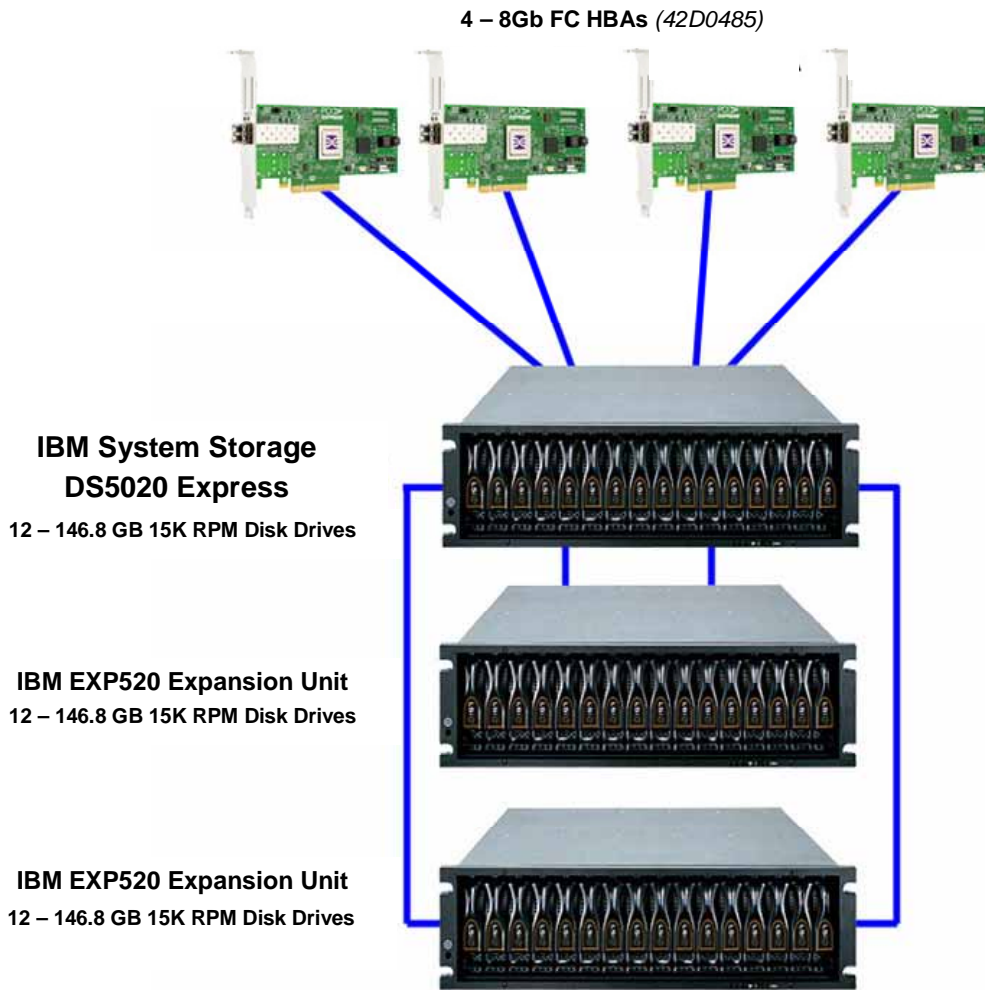
Tested Storage Configuration Pricing (*Priced Storage Configuration*)

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, and four 8Gb Fibre Channel host connections (4 used), and four – 4Gb FC drive connections	\$ 22,500.00	1	\$ 22,500.00
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)	\$ 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
			\$ 112,002.00

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.

Priced Storage Configuration Diagram



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: 2 GB cache per controller 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 unit
36 – 146.8 GB 15K RPM FC disk drives