SPC BENCHMARK 2™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM SYSTEM STORAGE
DS4700 EXPRESS MODEL 70 *(RAID-5)*

SPC-2™ V1.2.1

Submitted for Review: April 1, 2008
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EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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Revision Information and Key Dates

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SPC-2 Specification revision number	V1.2.1
SPC-2 Workload Generator revision number	spc2rc9g
Date Results were first used publicly	April 1, 2008
Date FDR was submitted to the SPC	April 1, 2008
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	March 27, 2008

Tested Storage Product (TSP) Description

IBM System Storage DS4700 Express models 70 and 72 are members of the DS4000 series storage products that address the needs of midrange and departmental storage requirements. They are designed to deliver high performance with advanced function and high availability. These models employ sixth-generation architecture that delivers 4 Gbps FC connectivity directly to host servers, SAN fabric, and disk drive expansion enclosures.

DS4700 Express models provides end-to-end 4 Gbps support when using the new System p5 single-and dual-port 4 Gbps Fibre Channel HBAs available in both AIX 5L and Linux on POWER. The combination of System p5 and DS4700 Express can help maximize your infrastructure investment.

DS4700 Express models come in compact, 3U rack-mountable enclosures that contain dual intelligent, high-performance RAID controllers. They can accommodate up to 16 E-DDMs for up to 12 TB internal physical storage capacity. Model 70 comes with 2 GB of cache memory (1 GB per controller), while model 72 comes with 4 GB cache (2 GB per controller).

DS4700 Express models support disk arrays organized as RAID-10 (mirrored+striped), RAID-5 and RAID-6. Disk arrays with RAID-6 provide 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.

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.

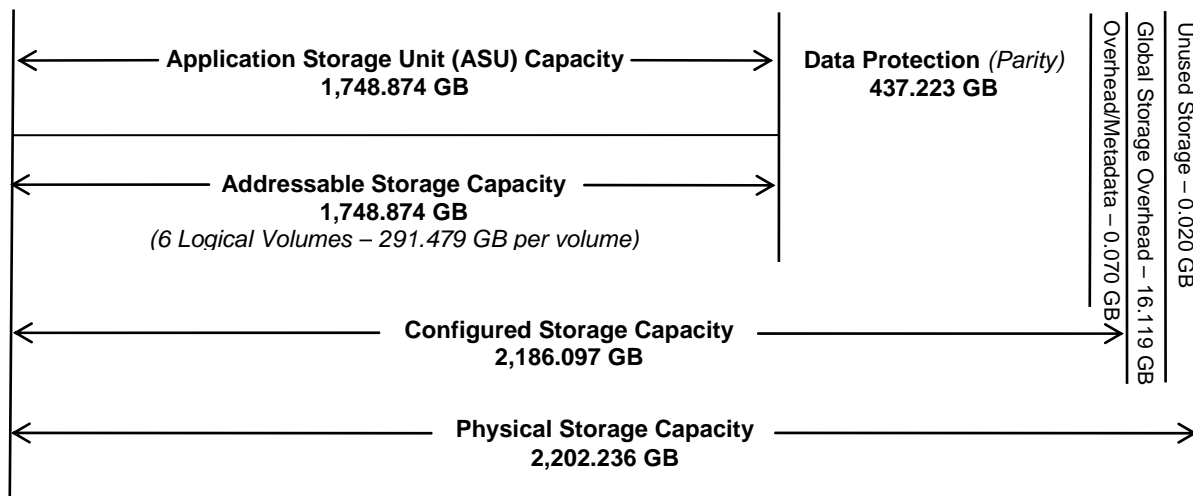| SPC-2 Reported Data				
IBM System Storage DS4700 Express Model 70 *(RAID-5)*				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
823.62	$106.73	1,748.874	$87,903	RAID-5
The above SPC-2 MBPS™ value represents the aggregate data rate of all three 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	697.66			$126.00
Write Only:				
1024 KiB Transfer	727.08	32	22.72	
256 KiB Transfer	283.12	32	8.85	
Read-Write:				
1024 KiB Transfer	830.44	32	25.95	
256 KiB Transfer	406.23	32	12.69	
Read Only:				
1024 KiB Transfer	973.26	32	30.41	
256 KiB Transfer	965.81	32	30.18	
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	884.51			$99.38
1024 KiB Transfer Size				
4 I/Os Outstanding	931.87	32	29.12	
1 I/O Outstanding	948.73	32	29.65	
64 KiB Transfer Size				
4 I/Os Outstanding	927.36	32	28.98	
1 I/O Outstanding	730.08	32	22.82	
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**
	888.68	1,130	0.79	$98.91

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-1 benchmark.

A **Data Protection Level** of **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 documents the various storage capacities, used in this benchmark, and their relationships.

Application Storage Unit (ASU) Capacity
1,748.874 GB

Data Protection *(Parity)*
437.223 GB

Addressable Storage Capacity
1,748.874 GB
(6 Logical Volumes – 291.479 GB per volume)

Configured Storage Capacity
2,186.097 GB

Physical Storage Capacity
2,202.236 GB

Unused Storage – 0.020 GB
Global Storage Overhead – 16.119 GB
Overhead/Metadata – 0.070 GB

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Product	Quantity	List Price each	extended list price
IBM DS4700 Express Model 70 (equiv to 3992)	1	$19,449 (2 GB cache, 1 GB per Cntrler.+Windows Host Kit and 2 Storage Partitions)	$19,449
EXP810 (equiv to FC4600)	1	$6,000	$6,000
Expansion license 1-3 EXP810's	1	$7,600	$7,600
39M5894 HBA's (equiv to QLA 2462)	2	$2,485	$4,970
73.4 GB x15K RPM disk drives	30	$1,301	$39,030
1m Fiber Optic Cable LC-LC	6	$79	$474
annoual 24x7x4hr upgrade	3	$3,460	$10,380
total			**$87,903**

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

The difference between the Tested Storage Configuration and Priced Storage Configuration is that each priced disk drive is mounted in an IBM drive carrier and is configured to self-identify as a DS4000 brand. That difference, if applied to the TSC, would not have a negative impact on the reported SPC-1 performance.

Benchmark Configuration/Tested Storage Configuration Diagram

_HS-1_

IBM xSeries 346 Server

**dual-ported
IBM DS4000
FAStT 4GB HBAs**

_SC-1/SC-2_

IBM System Storage DS4700 Express Model 70
(dual-active controllers, 15 FC disk drives)

EXP810 with 15 FC disk drives

Host System(s) and Tested Storage Configuration Components

Host System:	Tested Storage Configuration (TSC):
HS-1: IBM xSeries 346 Server	2 – IBM DS4000/FAStT 4Gb Dual HBAs

2 – 3.4 GHz Xeon CPUs with 1 MB L2 cache per CPU	**SC-1/SC-2: IBM System Storage DS4700**
	2 – dual-active controllers each with:
	    1 GB cache
	    2 – 4 Gb Fibre Channel host connections
	      (4 total, 4 used)
	    2 – 4 Gb Fibre Channel drive connections
	      (4 total, 2 used)

2 GB main memory	
Windows Server 2003 Enterprise Edition with SP1	
PCI-X	
WG:	1 – EXP810 expansion unit
	30 – 73 GB 15K RPM disk drives