SPC BENCHMARK 1™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM SYSTEM STORAGE SAN VOLUME CONTROLLER 4.2

SPC-1 V1.10.1

Submitted for Review: July 12, 2007
Submission Identifier: A00052

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	IBM Corporation – http://www.ibm.com Peter Leung – leungp@us.ibm.com 65S/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-2853 FAX: (520) 799-5530
Test Sponsor Alternate Contact	IBM Corporation – http://www.ibm.com Bruce McNutt – bmcnutt@us.ibm.com KBV/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-2460 FAX: (520) 799-5530
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-1 Specification revision number	V1.10.1
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	July 12, 2007
Date the FDR was submitted to the SPC	July 12, 2007
Date the TSC is available for shipment to customers	currently available
Date the TSC completed audit certification	July 11, 2007

Tested Storage Product (TSP) Description

The IBM System Storage SAN Volume Controller (SVC) enables a single point of control for disparate, heterogeneous storage resources to help support improved business application availability and greater resource utilization. SAN Volume Controller is designed to pool storage volumes from IBM and non-IBM storage systems into a single reservoir of capacity for centralized management.

SAN Volume Controller combines hardware and software into an integrated, modular solution. Using IBM System x™ server technology in clustered pairs, SAN Volume Controller is designed to avoid potential single points of failure. SAN Volume Controller software is designed to operate as a highly available cluster supporting high performance and ease of use.

SAN Volume Controller is highly scalable. An "I/O Group" is formed by combining a redundant pair of System x servers. Each server includes a four-port 4 Gbps-capable host bus adapter (HBA), designed to allow the SAN Volume Controller to connect and operate at up to 4 Gbps SAN fabric speed. Each I/O Group contains 8 GB of mirrored cache memory. Highly available I/O Groups are the basic configuration element of a SAN Volume Controller cluster. Adding I/O Groups to the cluster is designed to increase cluster performance and bandwidth.

SAN Volume Controller can scale out to support four I/O Groups, and it can scale up to support 1024 host servers. For every cluster, SAN Volume Controller support up to 4096 virtual disks.

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM System Storage SAN Volume Controller 4.2	
Metric	**Reported Result**
SPC-1 IOPS™	272,505.19
SPC-1 Price-Performance	$12.05/SPC-1 IOPS™
Total ASU Capacity	24,433.589 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$3,284,767

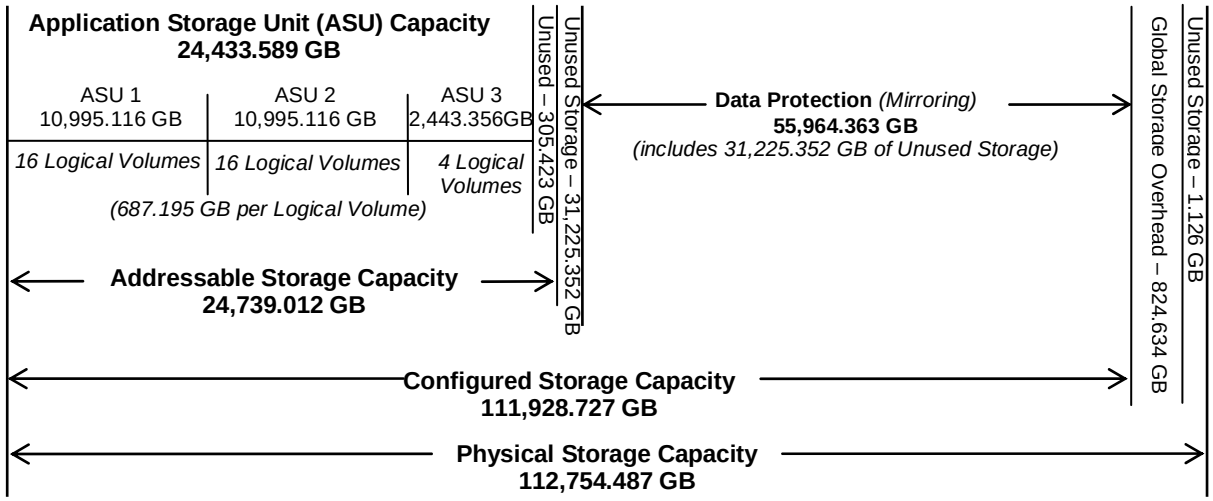
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

Total 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 Mirroring configures two or more identical copies of user data.

Storage Capacities and Relationships

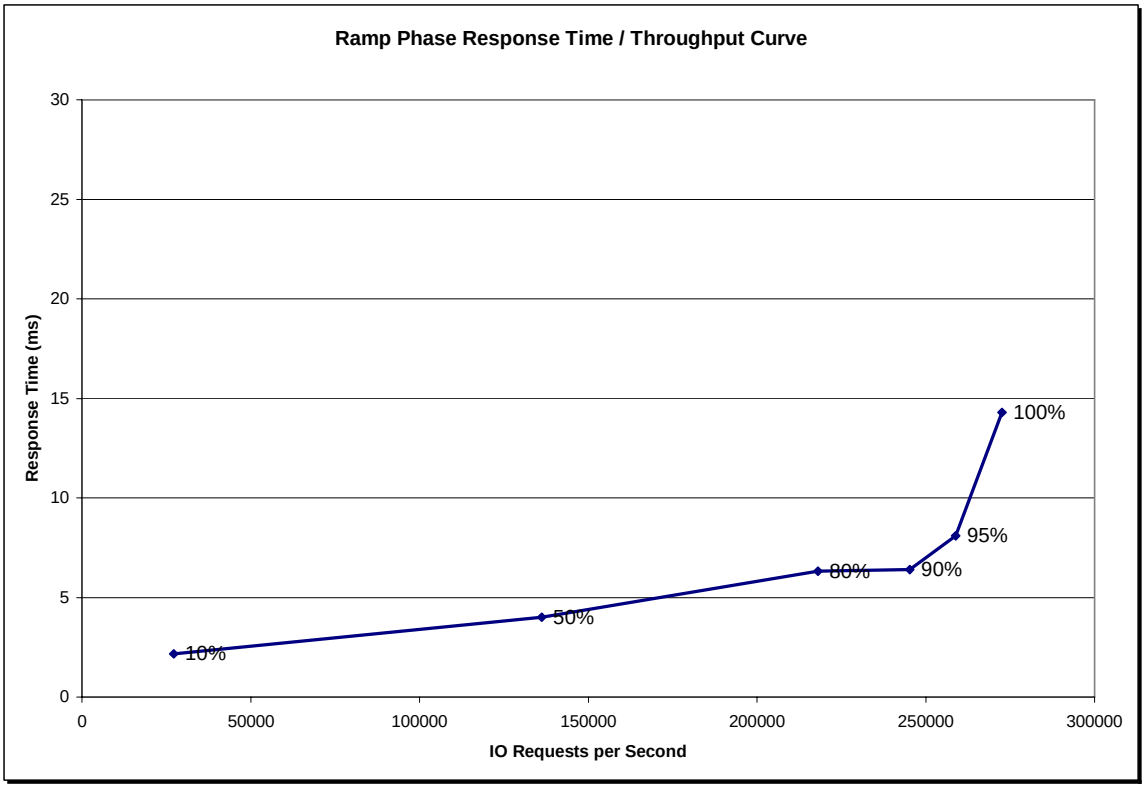
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPS™ metric.

The Average Response Time measured at the any of the above load points cannot exceed 30 milliseconds or the benchmark measurement is invalid.



Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	27,253.74	136,252.48	217,994.73	245,284.14	258,850.08	272,505.19
Average Response Time (ms):						
All ASUs	2.16	4.02	6.33	6.39	8.10	14.30
ASU-1	2.95	4.77	7.36	7.51	9.06	14.96
ASU-2	2.19	4.54	7.20	7.46	9.08	15.04
ASU-3	0.49	2.18	3.76	3.57	5.62	12.58
Reads	4.81	7.06	10.58	10.97	12.38	17.78
Writes	0.44	2.04	3.56	3.41	5.31	12.04

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

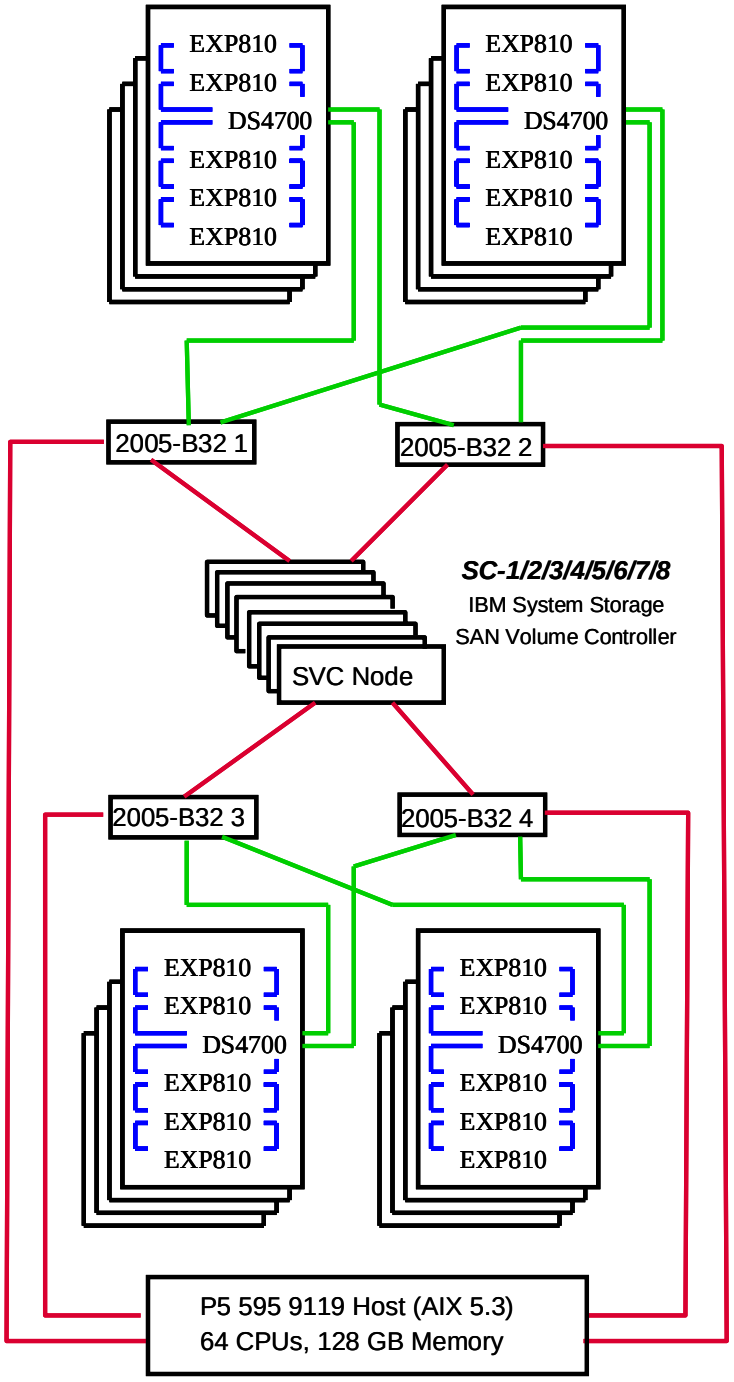
Component	Comments	Quantity	Unit Price	Unit Maint	List w/ Maint	% discount	Total Price
SVC 3550 Storage Engine		8	16,500.00	6,696.00	185,568.00	30	129,897.60
UPS		8	1,250.00	2,592.00	30,736.00	30	21,515.20
Master Console		1	7,499.00	3,816.00	11,315.00	30	7,920.50
SVC Software license	up to 100 virtualized TB	1	332,000.00	132,800.00	464,800.00	30	325,360.00
19 inch rack (7014-T42)		9	3,970.00	1,512.00	49,338.00	50	24,669.00
32 port fibre channel switch (2005-B32)	w/ 32 SFP, 32 ports enabled	4	38,573.00	2,657.00	164,920.00	20	131,936.00
DS 4700 with 16 15K RPM drives (73 GB)	w/ 4 SFP, 2 5m cables	16	43,563	13,950	920,208.00	37	579,731.04
EXP810 with 16 15K RPM drives (73 GB)	w/ 4 SFP, 2 1m cables	80	33,862	5,640	3,160,160.00	37	1,990,900.80
Ethernet switch (73P-2413)		2	135.99	30.00	331.98	42	192.55
Short wave fibre channel cable (5 m)		32	129		4,128.00	20	3,302.40
Short wave fibre channel cable (25 m)		32	189		6,048.00	20	4,838.40
Ethernet cable (7 feet)		8	6.99		55.92	0	55.92
Ethernet cable (25 feet)		32	14.99		479.68	0	479.68
4 Gbit P5 595 adapter (5758)		32	1,999.00		63,968.00	0	63,968.00
Total Price							3,284,767.09

The above pricing provides maintenance/support for 24 hours per day, 7 days per week for three years with four hour acknowledgement and four hour subsequent response (support engineer onsite or customer replaceable part available).

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

There were no differences between the Tested Storage Configuration and the Priced Storage Configuration.

Benchmark Configuration/Tested Storage Configuration Diagram



Notes:

All storage is managed by each node (single image).

Each EXP810 and DS4700 has 16 disks (total of 1536). Disks are 73 GB, 15K RPM.

Each switch has one zone for node-to-storage traffic, two zones for node-to-host traffic (even nodes to half of fcs's, odd nodes to half of fcs's).

Represents 1 FC path per line drawn

Represents 4 FC paths per line drawn

Represents 8 FC paths per line drawn

Benchmark Configuration/Tested Storage Configuration Components

Host Systems:	Tested Storage Configuration (TSC):
UID=HS-1	32 – 4 Gbit P5 595 HBAs
IBM P5 595 Model 9119	***UID=SC-1/2/3/4/5/6/7/8:*** 8 – TotalStorage® SAN Volume Controllers per controller: 2 – 2.333 GHz Intel Xeon Dual-Core CPUs 864 MiB data cache 160 MiB processor cache 4 – 4 Gbit FC ports
64 – 1.9 GHz CPUs – 2 CPUs/POWER5 chip 32 KB L1 cache, 960 KB L2 cache, and 18 MB L3 cache per CPU	
128 GB main memory	
AIX 5.3	
PCI-X/RIO	4 – 32 port FC switches
WG	2 – Ethernet switch
	16 – DS4700 enclosures 80 – EXP810 enclosures 16 – 73 GB, 15K RPM disk drives per enclosure
	9 – 19 inch racks
	8 – UPS