



**SPC BENCHMARK 1™
EXECUTIVE SUMMARY**

**IBM CORPORATION
IBM TOTALSTORAGE® SAN VOLUME CONTROLLER 1.2.1**

SPC-1 V1.8

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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

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SPC-1 Specification revision number	V1.8
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	December 3, 2004
Date FDR was submitted to the SPC	December 3, 2004
Date the TSC will be available for shipment to customers	October 29, 2004
Date the TSC completed audit certification	December 2, 2004

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM TotalStorage® SAN Volume Controller 1.2.1	
Metric	Reported Result
SPC-1 IOPS™	100,128.61
SPC-1 Price-Performance	\$12.50/SPC-1 IOPS™
Total ASU Capacity	7,200.000 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	\$1,251,984.75

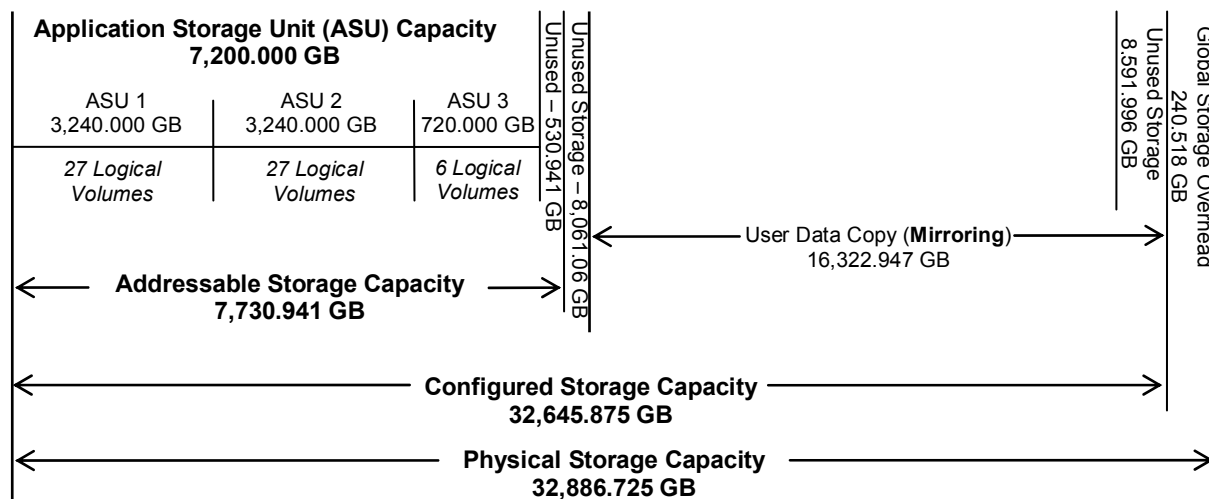
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

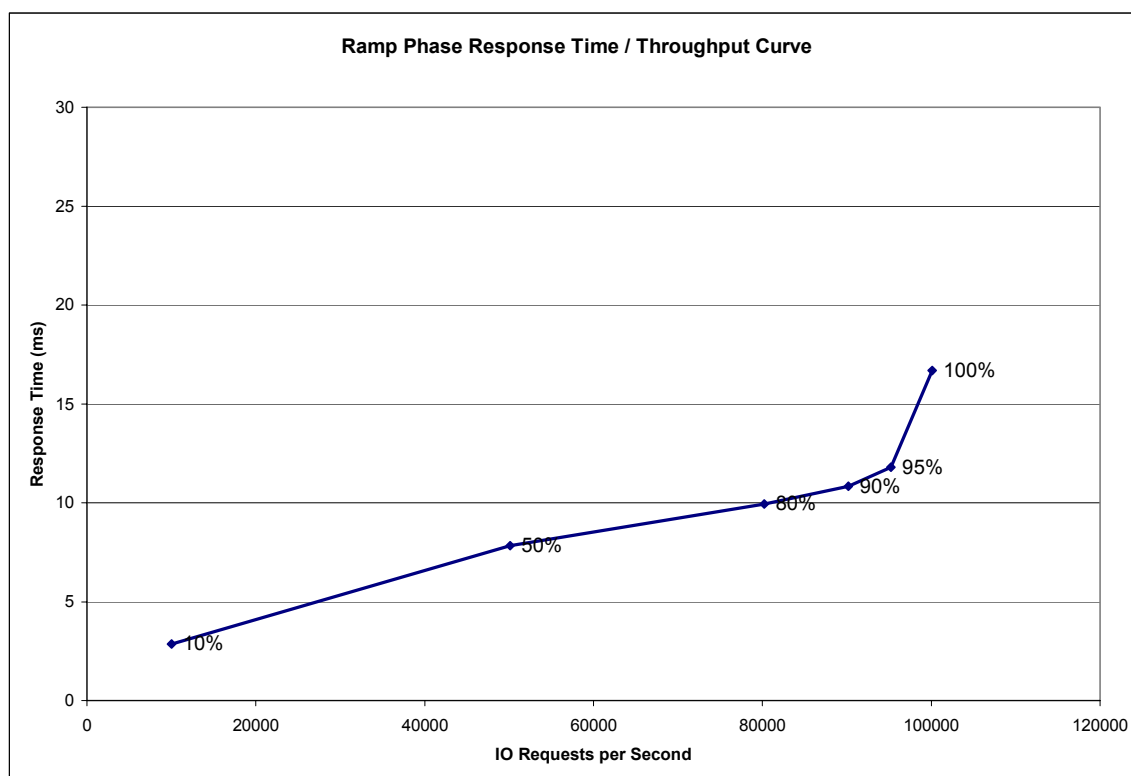
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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	10,002.25	50,107.23	80,228.63	90,196.93	95,200.02	100,128.61
Average Response Time (ms):						
All ASUs	2.85	7.84	9.93	10.84	11.80	16.68
ASU-1	3.96	10.66	13.23	14.18	15.28	21.20
ASU-2	2.93	9.63	12.31	13.26	14.36	20.11
ASU-3	0.47	1.07	1.92	2.72	3.30	5.59
Reads	6.61	18.36	22.45	23.57	25.15	34.17
Writes	0.41	0.99	1.79	2.56	3.11	5.29

Tested Storage Configuration Pricing (*Priced Storage Configuration*)

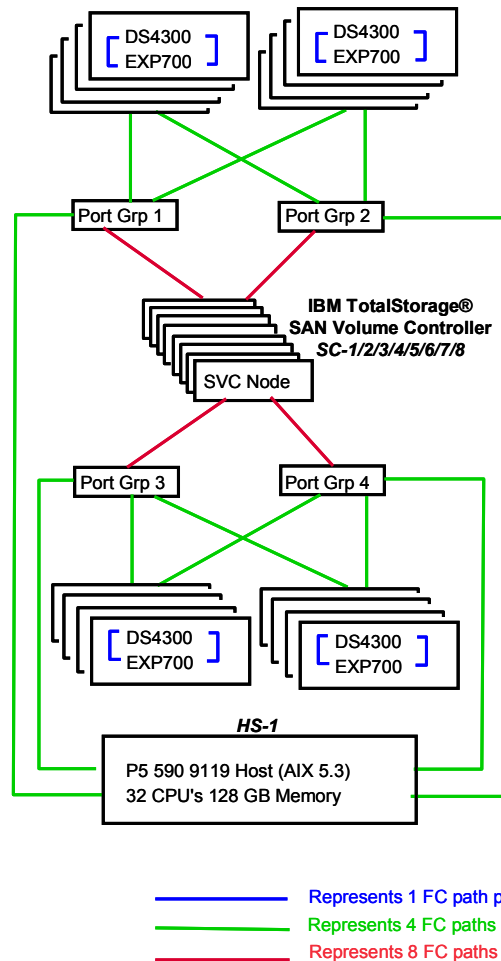
Component	Comments	Quantity	Unit Price	Unit Maint	List w/ Maint	% discount	Total Price
SVC Processor		8	13,750.00	3,564.00	138,512.00	30	96,958.40
UPS		4	5,000.00	9,720.00	58,880.00	30	41,216.00
Master Console		1	7,499.00	3,312.00	10,811.00	30	7,567.70
SVC Software license	up to 32 virtualized TB	1	125,000.00	34,000.00	159,000.00	30	111,300.00
19 inch rack (7014-T42)		4	3,433.00	0.00	13,732.00	50	6,866.00
24 port fibre channel switch (2005-B32)	24 of 32 ports enabled	4	26,750.00	2,278.00	116,112.00	20	92,889.60
Ethernet switch (22P-8743)		2	489.99	35.00	1,049.98	42	608.99
DS4300 with 14 15K RPM drives (73 GB)	w/ 6 SFP, 4 5m cables	16	47,895.00	2,499.00	806,304.00	39	491,845.44
EXP700 with 14 15K RPM drives (73 GB)	w/ 4 SFP, 2 1m cables	16	35,544.00	760.00	580,864.00	39	354,327.04
SFP (4 pack)	in addition to items 11, 12	4	550.00	0.00	2,200.00	20	1,760.00
Short wave 2Gbit fibre channel cable (25 m)		16	210.00	0.00	3,360.00	20	2,688.00
Ethernet cable (7 feet)		24	6.99	0.00	167.76	0	167.76
Ethernet cable (25 feet)		18	14.99	0.00	269.82	0	269.82
2 Gbit P5 590 adapter (5716)		16	2,720.00	0.00	43,520.00	0	43,520.00
Total Price							\$ 1,251,984.75

Maintenance/support is provided 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

The TSC used a single Cisco 9509 switch and the Priced Storage Configuration substituted four (4) IBM 2005 B32 switches in its place. The latencies of fibre channel switch technology are measured in small numbers of microseconds, and hence represent a vanishingly small fraction of typical SPC-1 response times. Under these circumstances, the exact choice of fibre channel switch should be expected to have no measurable impact on SPC-1 performance. In addition, to the degree that there might be any difference in performance in using four IBM 2005-B32 switches versus a single Cisco 9509 switch, this small difference should be expected to favor the four B32 switches. The 9509 used in the TSC is a 2 Gbit switch made approximately two years ago, and is not fully non-blocking. By comparison, the technology of the each B32 supports 4 Gbit speeds and is fully non-blocking.

Benchmark Configuration/Tested Storage Configuration Diagram



Notes:

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

Each DS4300 and EXP700 has 14 disks (total of 448). Disks are 73 GB, 15K RPM.

Each group of 20 ports has one zone for node-to-host traffic, one zone for node-to-storage traffic

Host Systems:	Tested Storage Configuration (TSC):
UID=HS-1	12 – 2 Gbit P5 590 HBAs
IBM P5 590 Model 9119	UID=SC-1/2/3/4/5/6/7/8:
32 – 1.65 GHz CPUs – 2 CPUs/POWER5 chip 32 KB L1 cache, 960 KB L2 cache, and 18 MB L3 cache per CPU	8 – TotalStorage® SAN Volume Controllers Per controller:
128 GB main memory	xSeries 335 processor which contains:
AIX 5.3	2 – 2.4 GHz Intel P4 CPUs
PCI-X/RIO	4 GB memory/cache
WG	4 – 2 Gbit FC ports
	4 – 32 port FC switches
	1 – Ethernet switch
	16 – DS4300 enclosures
	16 – EXP700 enclosures
	14 – 73 GB, 15K RPM disk drives per enclosure
	4 – 19 inch racks
	4 – UPS