SPC BENCHMARK 1™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM TOTALSTORAGE®
SAN VOLUME CONTROLLER 3.1

SPC-1 V1.9

Submitted for Review: October 25, 2005
Submission Identifier: A00043
Revised: October 27, 2005
Accepted: December 24, 2005

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-1 Specification revision number	V1.9
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	October 25, 2005
Date the FDR was submitted to the SPC	October 25, 2005
Date the revised FDR was submitted to the SPC • Availability Date changed from October 28, 2005 to November 18, 2005 • The Data Protection Overhead value in the "SPC-1 Storage Capacities" table on page 19 of the Full Disclosure Report has been restated correctly in GB rather than GiB as it was in the initial submission.	October 27, 2005
Date the TSC is/was available for shipment to customers	November 18, 2005
Date the TSC completed audit certification	October 24, 2005

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM TotalStorage® SAN Volume Controller 3.1	
Metric	**Reported Result**
SPC-1 IOPS™	155,519.47
SPC-1 Price-Performance	$12.76/SPC-1 IOPS™
Total ASU Capacity	12,216.796 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$1,983,784.74

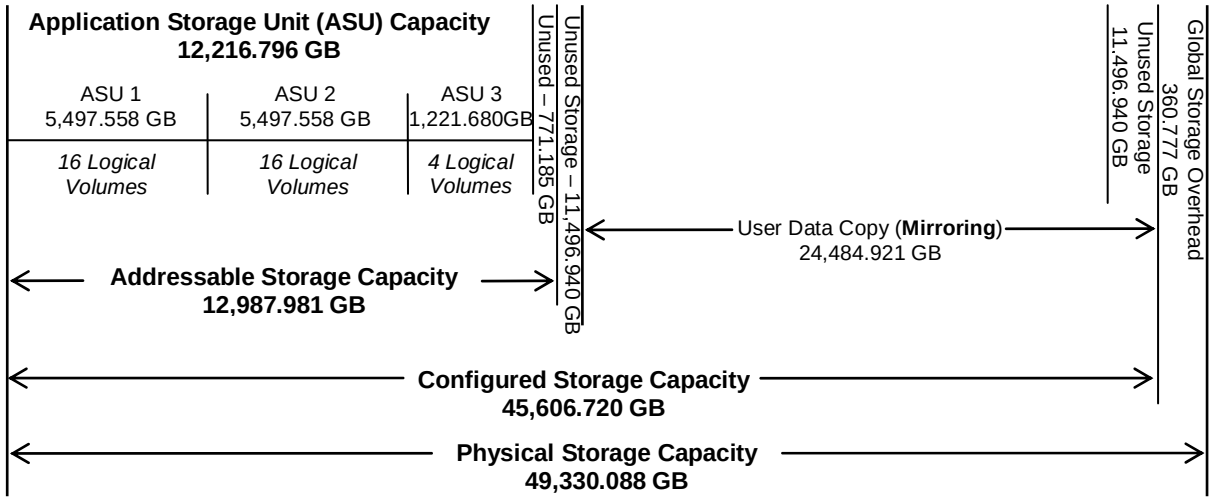
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

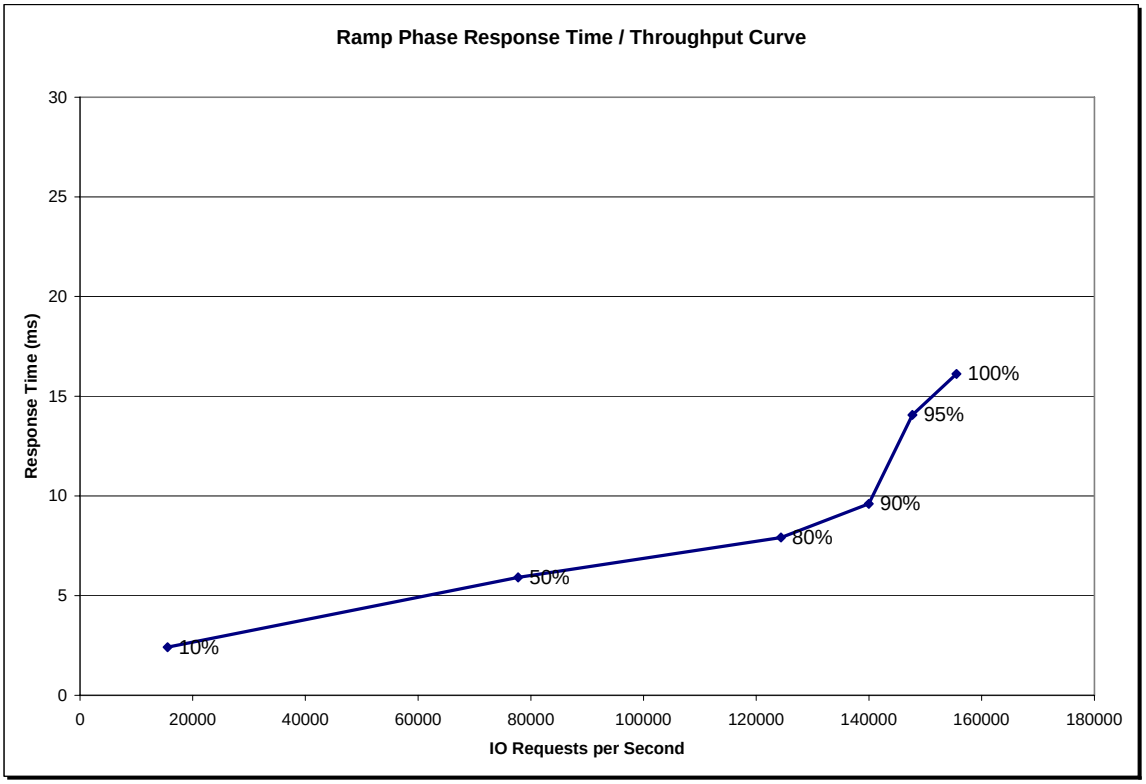
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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	15,556.55	77,747.99	124,381.62	139,971.90	147,705.17	155,519.47
Average Response Time (ms):						
All ASUs	2.41	5.91	7.92	9.60	14.06	16.12
ASU-1	3.12	7.65	10.26	12.32	17.62	20.57
ASU-2	2.56	7.44	9.55	11.55	16.71	19.35
ASU-3	0.83	1.55	2.23	2.99	5.37	5.26
Reads	4.93	12.80	16.83	19.89	26.88	32.23
Writes	0.77	1.43	2.12	2.91	5.72	5.64

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

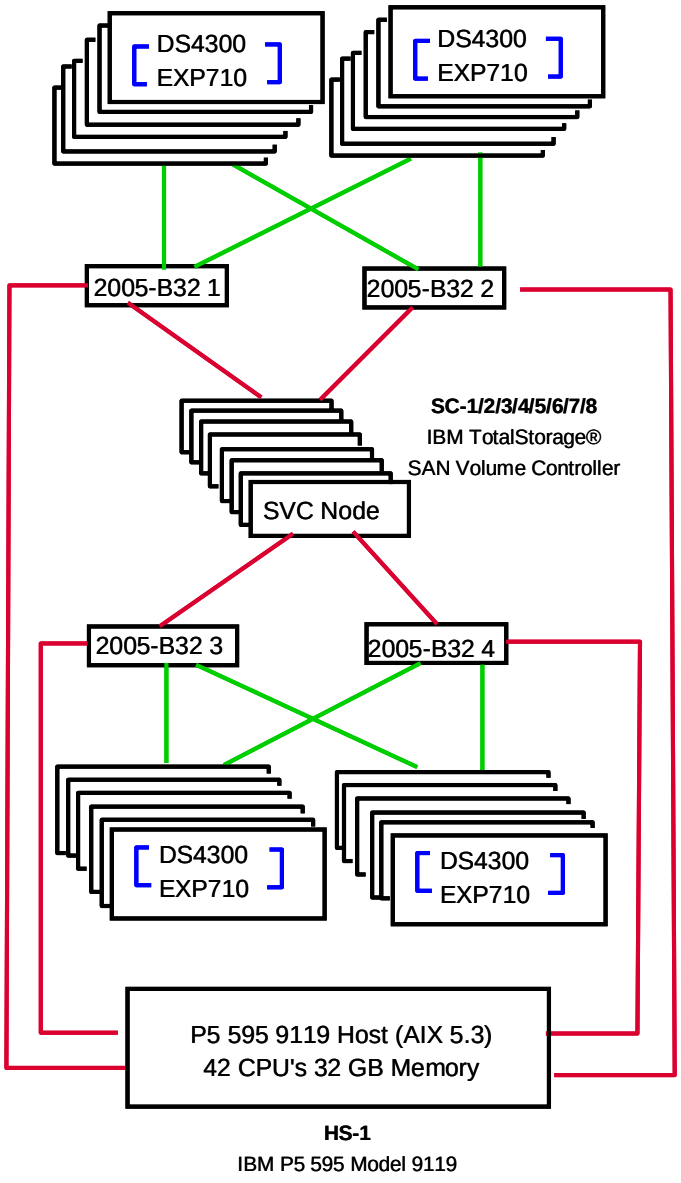
Component	Comments	Quantity	Unit Price	Unit Maint	List w/ Maint	% discount	Total Price
SVC Storage Engine		8	13,750.00	3,564.00	138,512.00	30	96,958.40
UPS		8	1,250.00	2,268.00	28,144.00	30	19,700.80
Master Console		1	7,499.00	3,312.00	10,811.00	30	7,567.70
SVC Software license	up to 48 virtualized TB	1	212,000.00	84,800.00	296,800.00	10	267,120.00
19 inch rack (7014-T42)		5	8,660.00	888.00	47,740.00	50	23,870.00
32 port fibre channel switch (2005-B32)	32 of 32 ports enabled	4	36,475.00	4,200.00	162,700.00	20	130,160.00
Ethernet switch (22P-8743)		3	380.00	100.00	1,440.00	42	835.20
DS4300 with 14 15K RPM drives (73 GB)	w/ 6 SFP, 4 5m cables	24	47,895.00	2,499.00	1,209,456.00	37	761,957.28
EXP710 with 14 15K RPM drives (73 GB)	w/ 4 SFP, 2 1m cables	24	37,640.00	760.00	921,600.00	37	580,608.00
SFP (4 pack)		4	550.00		2,200.00	20	1,760.00
Short wave 2Gbit fibre channel cable (25 m)		32	210.00		6,720.00	20	5,376.00
Ethernet cable (7 feet)		16	6.99		111.84	0	111.84
Ethernet cable (25 feet)		48	14.99		719.52	0	719.52
2 Gbit P5 595 adapter (5716)		32	2,720.00		87,040.00	0	87,040.00
Total Price							**$ 1,983,784.74**

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). The discount applied to the above pricing is the IBM "field delegation" discount.

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 DS4300 and EXP710 has 14 disks (total of 672). Disks are 73 GB, 15K RPM.

Each switch has one zone for node-to-host traffic, one zone for node-to-storage traffic

Benchmark Configuration/Tested Storage Configuration Diagram (cont.)

Host Systems:	Tested Storage Configuration (TSC):
UID=HS-1	32 – 2 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: xSeries 335 processor which contains: 2 – 3.0 GHz Intel P4 CPUs 8 GB memory/cache 4 – 2 Gbit FC ports
42 – 1.9 GHz CPUs – 2 CPUs/POWER5 chip 32 KB L1 cache, 960 KB L2 cache, and 18 MB L3 cache per CPU	
32 GB main memory	
AIX 5.3	
PCI-X/RIO	4 – 32 port FC switches
WG	3 – Ethernet switch
	24 – DS4300 enclosures 24 – EXP700 enclosures 14 – 73 GB, 15K RPM disk drives per enclosure
	5 – 19 inch racks
	8 – UPS