SPC BENCHMARK 1™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM SYSTEM STORAGE SAN VOLUME CONTROLLER V5.1

(4-NODE CLUSTER WITH 2 IBM DS8700S)

SPC-1 V1.12

Submitted for Review: February 1, 2010
Submission Identifier: A00086
Revised: March 9, 2010

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	V1.12
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	February 1, 2010
Date the FDR was submitted to the SPC	February 1, 2010
Date the revised FDR was submitted to the SPC Tested Storage Product (TSP) name revision for clarification "IBM System Storage DS8700 *(4 node with SVC 5.1 cluster)*" was revised to: "IBM System Storage SAN Volume Controller v5.1 *(4-node cluster with 2 IBM DS8700s)*"	March 9, 2010
Date the priced storage configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	January 29, 2010

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. SVC Version 5.1, implemented using CF8 nodes as in the present test result, offers 8 Gbps port speeds, 24 GB of cache per node, optional capability (not used in the present test) to incorporate SSD drives, and significantly faster processor technology compared with SVC Version 4.3.

The IBM System Storage DS8000™ series encompasses the flagship disk enterprise storage products in the IBM System Storage portfolio. The DS8700 represents the latest in this series of enterprise disk storage systems designed for high-performance, high-capacity and resiliency. Major new capabilities include IBM POWER6 Processing technology and PCI-e I/O enclosures.

Summary of Results

SPC-1 Results	
Tested Storage Product (TSP) Name: IBM System Storage SAN Volume Controller v5.1 *(4-node cluster with 2 IBM DS8700s)*	
Metric	**Reported Result**
SPC-1 IOPS™	315,043.59
SPC-1 Price-Performance	$22.65/SPC-1 IOPS™
Total ASU Capacity	97,581.657 GB
Data Protection Level	Protected *(Mirroring)*
Total TSP Price (including three-year maintenance)	$7,134,842.39

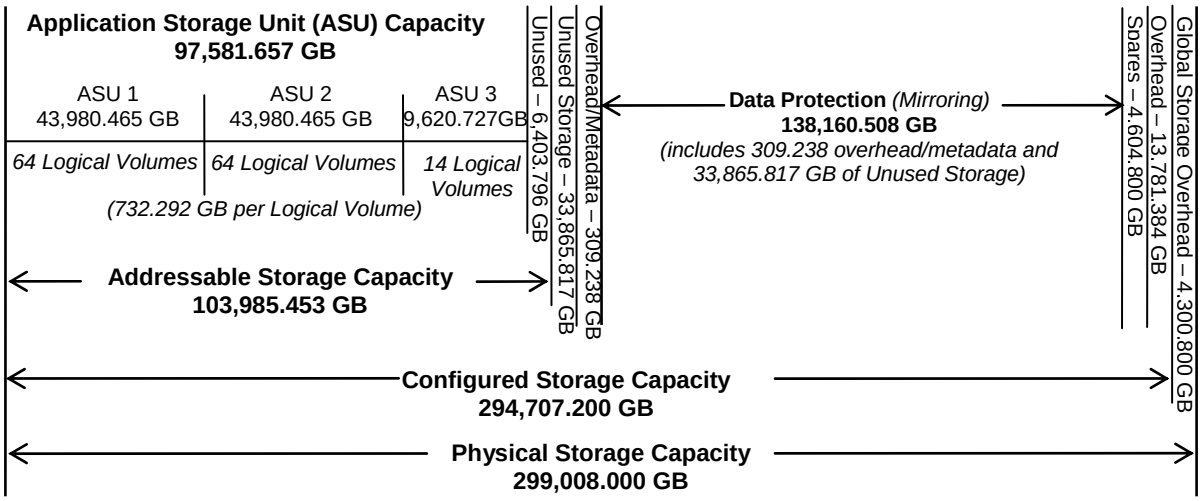
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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 **Protected** using ***Mirroring*** configures two or more identical copies of user data.

Storage Capacities and Relationships

The following diagram and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.



SPC-1 Storage Capacity Utilization	
Application Utilization	32.64%
Protected Application Utilization	67.52%
Unused Storage Ratio	24.79%

Application Utilization: Total ASU Capacity *(97,581.657 GB)* divided by Physical Storage Capacity *(299,008.000 GB)*

Protected Application Utilization: (Total ASU Capacity *(97,581.657 GB)* plus total Data Protection Capacity *(138,160.508 GB)* minus unused Data Protection Capacity *(33,865.817 GB)* divided by Physical Storage Capacity *(299,008.000 GB)*

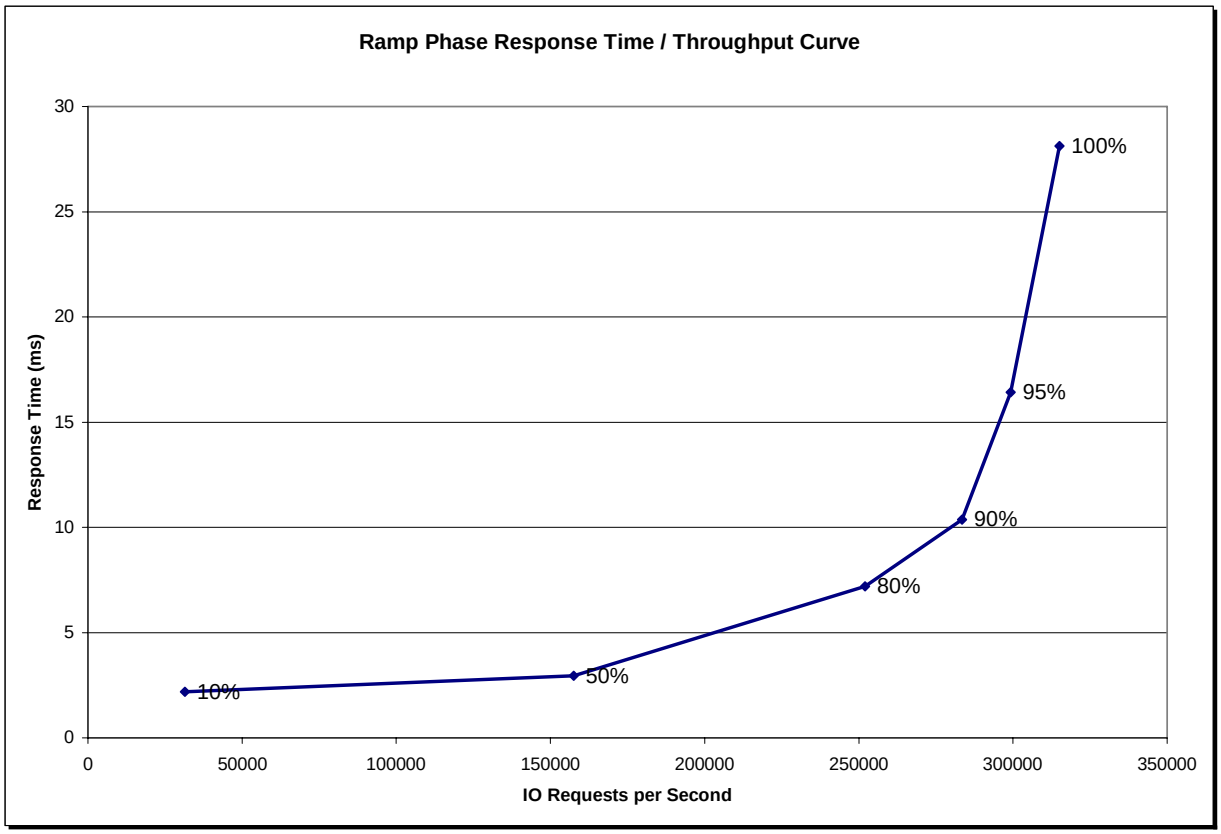
Unused Storage Ratio: Total Unused Capacity *(74,135.43 GB)* divided by Physical Storage Capacity *(299,008.000 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 19-20 in the Full Disclosure Report.

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	31,490.26	157,505.18	252,014.01	283,511.26	299,237.39	315,043.59
Average Response Time (ms):						
All ASUs	2.19	2.94	7.19	10.36	16.42	28.13
ASU-1	2.80	3.53	7.52	10.60	16.46	28.03
ASU-2	1.98	2.75	6.71	9.78	15.74	26.36
ASU-3	0.97	1.77	6.71	10.13	16.65	29.12
Reads	4.12	4.85	8.37	11.37	16.82	27.88
Writes	0.93	1.70	6.42	9.71	16.17	28.29

Priced Storage Configuration Pricing

Component			Quantity	Unit Price	Unit Maint	List w/ Maint	% discount	Total Price
2145-CF8		SVC Storage Engine	4	16,500.00	2,616.00	76,464.00	30	53,524.80
	8115	UPS	4	1,000.00	1,656.00	10,624.00	30	7,436.80
2805-MC4		Master Console	1	5,994.00	1,272.00	7,266.00	30	5,086.20
5608-WB1		TPC Basic Edition	1	3,399.00	1,359.00	4,758.00	30	3,330.60
5939-VC5		SVC Software license (base, up to 150 TB)	1	394,490.00	157,796.00	552,286.00	30	386,600.20
7014-T42		19 inch rack	1	5,060.00	888.00	5,948.00	50	2,974.00
2498-B24		8 Gbps fibre channel switch (w/24 enabled ports, 8 Gbps SFPs)	4	15,160.00	1,350.00	66,040.00	20	52,832.00
	5605	Short wave 5m fibre channel cable	24	105.00		2,520.00	20	2,016.00
	5625	Short wave 25 m fibre channel cable	64	210.00		13,440.00	20	10,752.00
73P-2413		Ethernet switch	1	135.99	30.00	165.99	0	165.99
15S-10102		Ethernet 15 foot cable	11	17.00		187.00	0	187.00
9119-595	5716	2 Gbit P5 595 adapter	32	1,999.00		63,968.00	30	44,777.60
2398-LFA		DS8000 Function Authorization	2	763,186.00		1,526,372.00	40	915,823.20
2423-941		System Storage DS8700 (A frame)	2	72,419.00		144,838.00	50	72,419.00
	1050	Battery Assembly	6	1,700.00		10,200.00	50	5,100.00
	1090	Line Cord (US/LA/AP/Canada)	2	1,900.00		3,800.00	50	1,900.00
	1120	Management Console - English Laptop Internal	2	9,160.00		18,320.00	50	9,160.00
	1210	Disk Enclosure Pair	8	10,000.00		80,000.00	50	40,000.00
	1211	Disk Drive Cable Group 1	2	1,000.00		2,000.00	50	1,000.00
	1301	I/O Enclosure Pair PCIE	4	11,780.00		47,120.00	50	23,560.00
	1321	PCI-E Cable Group 2	2	4,100.00		8,200.00	50	4,100.00
	1711	Release 5 Bundle Family	2	40,000.00		80,000.00	50	40,000.00
	2216	146 GB 15K Drive Set	16	46,076.00		737,216.00	50	368,608.00
	3043	Device Adapter Pair III	8	10,000.00		80,000.00	50	40,000.00
	3143	4Gb SW FCP/FICON Adapter PCIE	16	33,920.00		542,720.00	50	271,360.00
	4226	384 GB Processor Memory (4-Way)	2	1,176,960.00		2,353,920.00	50	1,176,960.00
	4302	4 Way Processor Card	2	80,893.00		161,786.00	50	80,893.00
2423-94E		System Storage DS8700 Expansion Unit (B frame)	2	73,500.00		147,000.00	50	73,500.00
	1050	Battery Assembly	4	1,700.00		6,800.00	50	3,400.00
	1090	Line Cord (US/LA/AP/Canada)	2	1,900.00		3,800.00	50	1,900.00
	1210	Disk Enclosure Pair	16	10,000.00		160,000.00	50	80,000.00
	1212	Disk Drive Cable Group 2	2	1,900.00		3,800.00	50	1,900.00
	1301	I/O Enclosure Pair PCIE	4	11,780.00		47,120.00	50	23,560.00
	1322	PCIE Cable Group 3	2	5,000.00		10,000.00	50	5,000.00
	2216	146 GB 15K Drive Set	32	46,076.00		1,474,432.00	50	737,216.00
	3043	Device Adapter Pair III	8	10,000.00		80,000.00	50	40,000.00
	3143	4Gb SW FCP/FICON Adapter PCIE	16	33,920.00		542,720.00	50	271,360.00
2423-94E		System Storage DS8700 Expansion Unit (C frame)	2	73,500.00		147,000.00	50	73,500.00
	1090	Line Cord (US/LA/AP/Canada)	2	1,900.00		3,800.00	50	1,900.00
	1210	Disk Enclosure Pair	16	10,000.00		160,000.00	50	80,000.00
	1214	Disk Drive Cable Group 4	2	2,400.00		4,800.00	50	2,400.00
	2216	146 GB 15K Drive Set	32	46,076.00		1,474,432.00	50	737,216.00
2423-94E		System Storage DS8700 Expansion Unit (D frame)	2	73,500.00		147,000.00	50	73,500.00
	1090	Line Cord (US/LA/AP/Canada)	2	1,900.00		3,800.00	50	1,900.00
	1210	Disk Enclosure Pair	16	10,000.00		160,000.00	50	80,000.00
	1214	Disk Drive Cable Group 4	2	2,400.00		4,800.00	50	2,400.00
	2216	146 GB 15K Drive Set	32	46,076.00		1,474,432.00	50	737,216.00
2423-94E		System Storage DS8700 Expansion Unit (E frame)	2	73,500.00		147,000.00	50	73,500.00
	1090	Line Cord (US/LA/AP/Canada)	2	1,900.00		3,800.00	50	1,900.00
	1210	Disk Enclosure Pair	8	10,000.00		80,000.00	50	40,000.00
	1214	Disk Drive Cable Group 4	2	2,400.00		4,800.00	50	2,400.00
	2216	146 GB 15K Drive Set	16	46,076.00		737,216.00	50	368,608.00
		Total Price						**7,134,842.39**

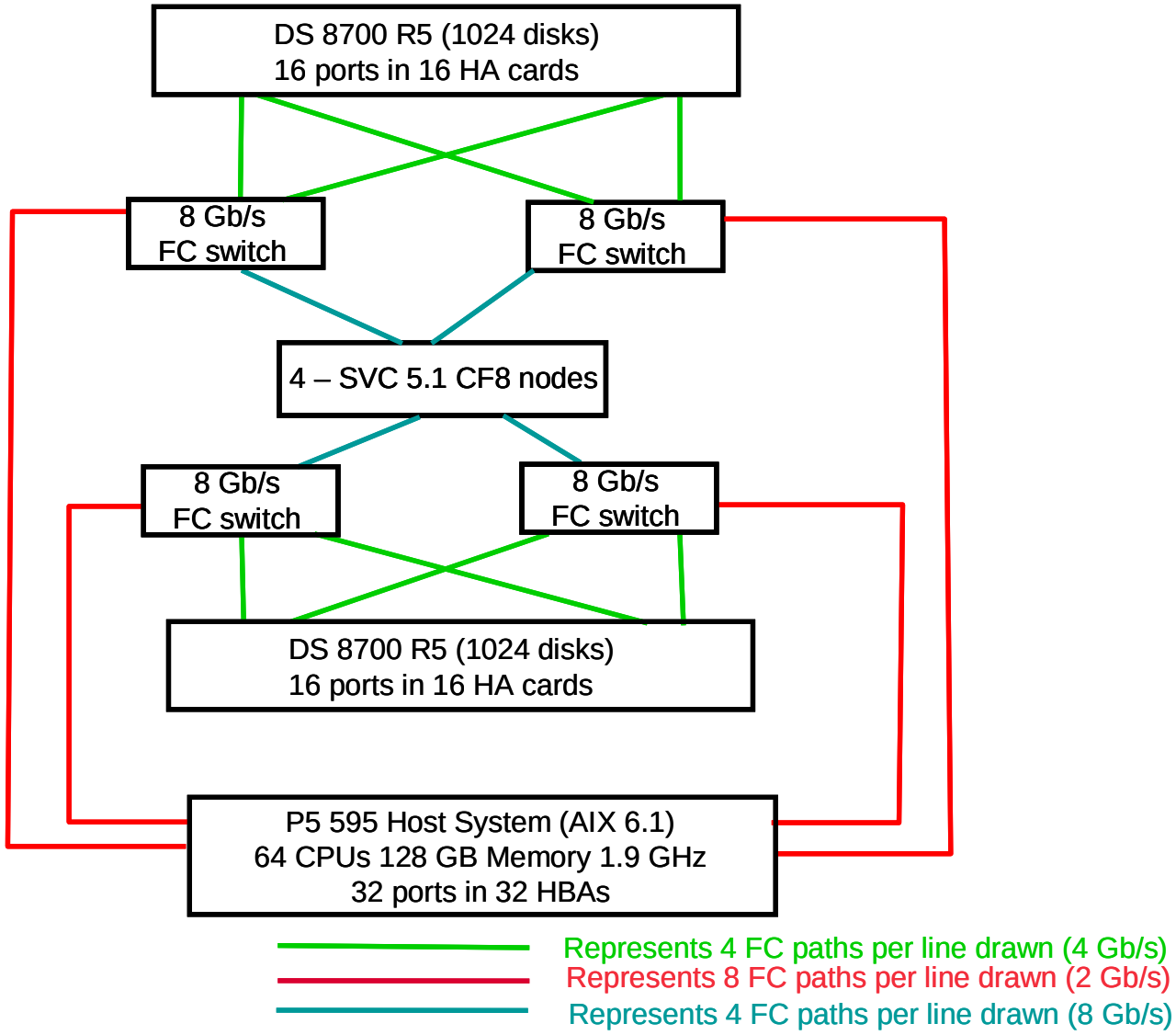
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- Acknowledgement of new and existing problems with four (4) hours.
- Onsite present of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Price Storage Configuration that can be remedied by the repair or replacement of a Priced Storage Configuration component.

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

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

Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Diagram



All storage was managed by each SVC node (single image). Each switch had 24 ports enabled, with one zone for node-to-storage traffic and one zone for node-to-host traffic

Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Components

Host System:	Tested Storage Configuration (TSC)/ Priced Storage Configuration:
IBM P5 595 Model 9119	32 – 2 Gbit P5 595 HBAs
64 – dual core CPUs, 2 CPUs/POWER5 chip 32 KB L1 cache, 960 KB L2 cache, and 18 MB L3 cache per CPU	***IBM System Storage DS8700 (4 node SVC 5.1 cluster):*** 2 – IBM DS8700 each with: 384 GB memory/cache 16 – 4 Gbit FC front-end physical connections *(32 total)* 64 – 2 Gbit backend physical connections *(128 total)* 1024 – 146 GB 15K RPM disk drives *(2048 total)*
128 GB main memory	
AIX 6.1 TL 03	
PCI-X/RIO	
	4 – IBM SAN Volume Controller nodes each with: 24 GB memory/cache 4 – 8Gbit FC connections
	1 – Master Console
	2 – Management Consoles
	4 – IBM 2498-B24 8 Gbps FC switches
	2 – DS8700 base units
	8 – DS8700 Expansion Units
	4 – UPS