



**SPC BENCHMARK 1™
EXECUTIVE SUMMARY**

**IBM CORPORATION
IBM TOTALSTORAGE® DS4500
(MIRRORED WRITE CACHE)**

SPC-1 V1.7

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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-1 Specification revision number	V1.7
SPC-1 Workload Generator revision number	V2.00.03
Date Results were first used publicly	August 26, 2003
Date FDR was submitted to the SPC	August 26, 2003
Date revised FDR was submitted to the SPC	September 5, 2006
Date the TSC is/was available for shipment to customers Product name change from FASt900 to DS4500	September 12, 2003
Date the TSC completed audit certification	August 26, 2003

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM TotalStorage® DS4500 (<i>mirrored write cache</i>)	
Metric	Reported Result
SPC-1 IOPS™	18,447.55
SPC-1 Price-Performance	\$16.78/SPC-1 IOPS™
Total ASU Capacity	1,196.092 GB
Data Protection Level	Mirroring
SPC-1 LRT™	2.03 ms
Total TSC Price (including three-year maintenance)	\$309,499

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. The Addressable Storage Capacity, which contains the Total ASU Capacity, was 1,196.09 GB. The Total ASU Capacity utilized 100% of the Addressable Storage Capacity. The actual Configured Storage Capacity was 2,392.18 GB, which included the multiple copies of user data required by a Data Protection Level of Mirroring. The Configured Storage Capacity utilized 60.82% of the priced Physical Storage Capacity of 3,933.36 GB

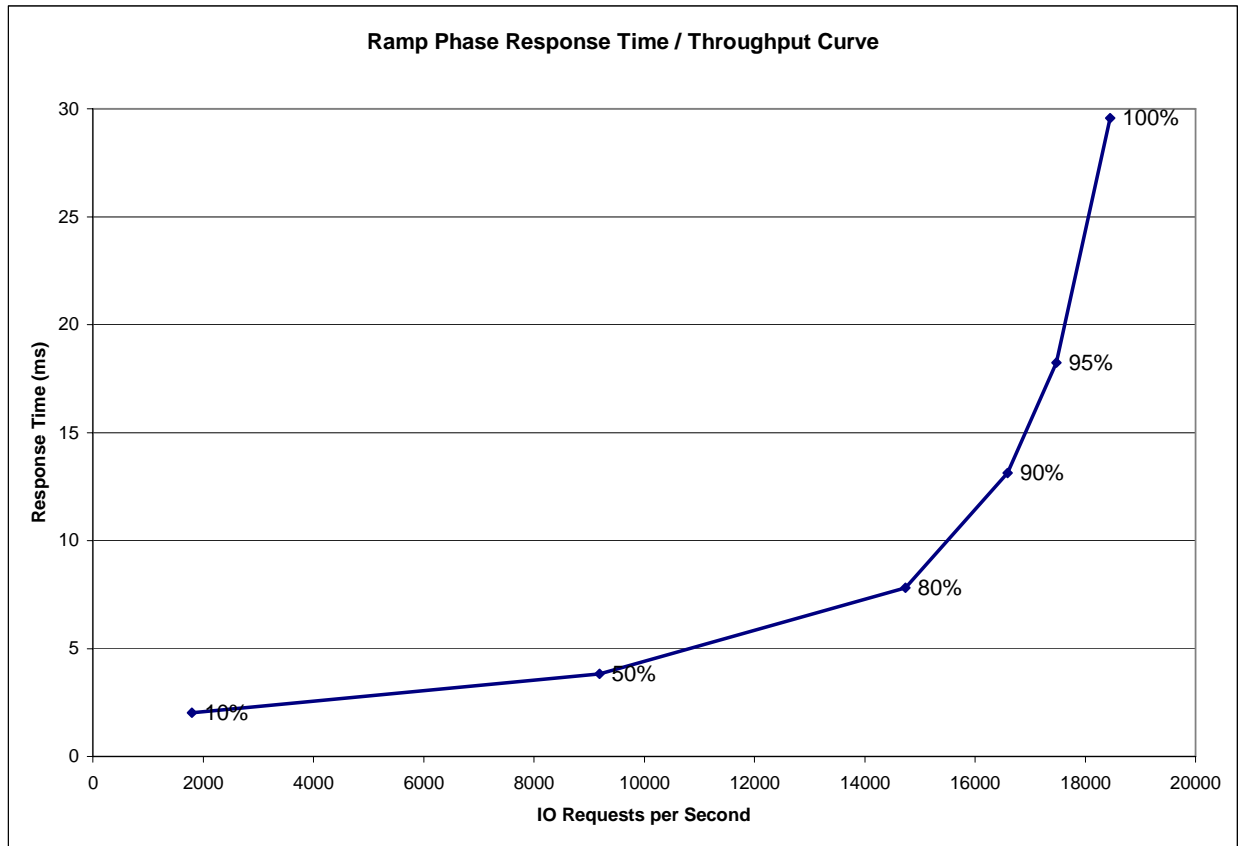
A **Data Protection Level** of Mirroring configures two or more identical copies of user data, maintained on separate disks.

The **SPC-1 LRT™** metric is the Average Response Time measured at the 10% load point, as illustrated on the next page. SPC-1 LRT™ represents the Average Response Time measured on a lightly loaded Tested Storage Configuration (TSC).

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 100% load point 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	1,799.52	9,187.16	14,741.60	16,592.22	17,480.36	18,447.55
Average Response Time (ms):						
All ASUs	2.03	3.82	7.81	13.13	18.25	29.57
ASU-1	2.69	4.99	9.49	14.71	19.45	32.31
ASU-2	1.96	3.52	6.33	10.28	14.41	21.00
ASU-3	0.66	1.45	4.87	11.03	17.38	27.53
Reads	4.23	7.46	12.00	15.83	19.13	28.20
Writes	0.60	1.44	5.07	11.37	17.67	30.47

Tested Storage Configuration Pricing (*Priced Storage Configuration*)

M/T/M	fc#	description	Qty	US List Prices		Total
				Unit Price	Aggregate Price	
1742-90U		IBM TotalStorage FASt900 Storage Server	1	66,500	66,500	
	2104	FAStT FC-2/133 host bus adapter	8	1,485	11,880	
	2210	Shortwave SFP	16	499	7,984	
	3507	FAStT 2Gb miniHub	4	899	3,596	
	5605	5 meter fiber optic cable	8	129	1,032	
	5625	25 meter fiber optic cable	4	189	756	
	7109	FAStT Storage Manager v8.4 upgrade	1	2,999	2,999	
1740-1RU		IBM TotalStorage FAStT EXP700 Storage Expansion Unit	8	6,000	48,000	
	2210	Shortwave SFP	32	499	15,968	
	5211	FAStT 36.4GB/15K rpm 2Gb FC Disk Drive Module	108	1,115	120,420	
	5601	1 meter fiber optic cable	16	79	1,264	
	9009	Attach to FAStT900	8	0	0	
2109-F16		IBM TotalStorage SAN Switch F16	1	25,500	25,500	
	2210	Shortwave Transceiver	4	180	720	
	W73	Warranty Upgrade for 3 years	1	2,880	2,880	
						<u>309,499</u>

NOTES: FAStT models include three year warranty. Warranty extension for 2109-F16 switch added to make entire configuration three years.

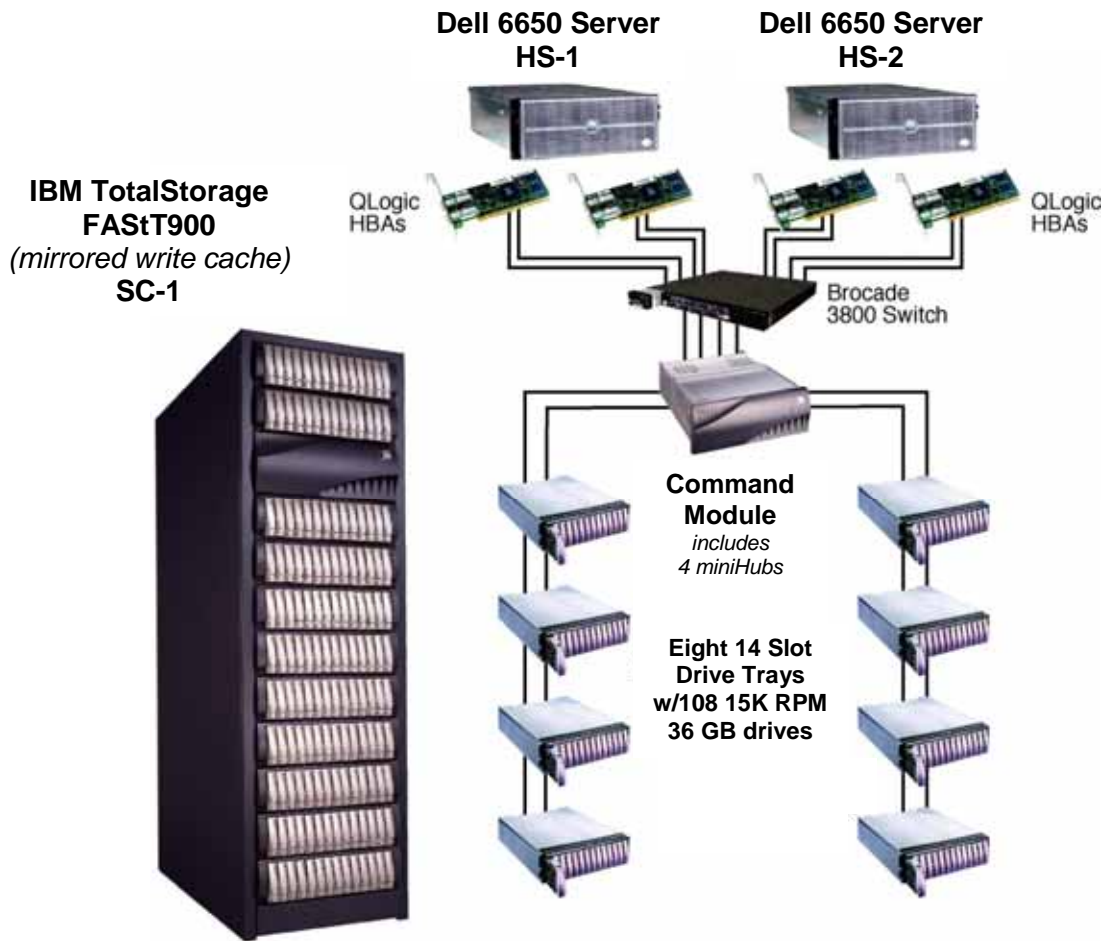
Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The following are the differences between the TSC and Priced Storage Configuration:

- Eight FAStT FC-2/133 HBAs (single port) were priced rather than the four QLogic 2342 dual channel HBAs used in the TSC.
- The priced disk drives have been configured to self-identify as a FAStT brand.
- The mounting of each drive is in an IBM drive carrier.
- The 'data scrubbing' option has a default setting of "off" in the TSC, but would need to be explicitly set to "off" in the Priced Storage Configuration.
- Twenty-five meter fiber optic cables were priced rather than the 30 meter cables used in the TSC.
- The IBM TotalStorage SAN Switch F16 is an IBM relabeled version of the Brocade 3800 Switch identical to the component used in the TSC.

The differences listed above, if applied to the TSC, would not have a negative performance impact on the reported SPC-1 performance.

Benchmark Configuration/Tested Storage Configuration Diagram



Host Systems:	Tested Storage Configuration (TSC):
UID=HS1, HS2	UID=SC-1
2 – Dell 6650 Servers	2 – QLogic 2342 HBAs per Host System
4 – 2 GHz Pentium 4 Xeon CPUs per Host System	Brocade 3800 Switch
3 GB main memory per Host System	Command Module (includes 4 miniHubs)
Windows 2000, SP3	2 –Disk Array Controllers 1 GB RAM per controller
WG	4 – 2gb Fibre Channel host connections
	4 – 2gb Fibre Channel drive connections
	8 –Drive Modules
	108 – 36GB 15K RPM Disk Drives