SPC Benchmark 1™
Executive Summary

Hewlett-Packard Company
hp StorageWorks Enterprise Virtual Array Model 2C12D

SPC-1 V1.5

Submitted for Review: October 2, 2002
Accepted: December 1, 2002
Revised: December 6, 2002

Executive Summary

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Hewlett-Packard Company www.hp.com Ken Bates ken.bates@hp.com CXO 1-2/N27 301 Rockrimmon Blvd. S Colorado Springs, CO 80919 Phone: (719) 548-2039 FAX: (719) 548-2362
Test Sponsor Alternate Contact	Hewlett-Packard Company www.hp.com James D. Myers jimmy.myers@hp.com 301 Rockrimmon Blvd. S Colorado Springs, CO 80919 Phone: (719) 548-3592 FAX: (719) 548-3699
Auditor	Storage Performance Council www.storageperformance.org Walter E. Baker AuditService@storageperformance.org 1060 El Camino Real, Suite F 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	V1.5
SPC-1 Workload Generator revision number	V1.1
Date Results were first used publicly	October 2, 2002
Date FDR was submitted to the SPC	October 2, 2002
Date revised FDR was submitted to the SPC **December 6, 2002:** Updated pricing and price-performance (pricing, page 12) **October 7, 2002:** Updated part number for EVA Model 2C12D (pricing, page 12) Updated TSC/BC diagrams (pages 13 & 14) Expanded Host System information (page 16) Corrected TSC configuration script (page 17) Added Storage Capacities & Relationship illustration (page 19) Corrected Sustainability Data Rate Table (page 23) Corrected Data Persistence metrics (page 49)	December 6, 2002
Date the TSC is/was available for shipment to customers	July 30, 2002 (pricing effective December 2, 2002)
Date the TSC completed audit certification	September 23, 2002

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: hp StorageWorks Enterprise Virtual Array Model 2C12D	
Metric	**Reported Result**
SPC-1 IOPS™	24,005.54
SPC-1 Price-Performance	$19.99/SPC-1 IOPS™
Total ASU Capacity	2,596.3GB
Data Protection Level	Mirroring
SPC-1 LRT™	2.29 ms
Total TSC Price (including three-year maintenance)	$479,860

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 actual Configured Storage Capacity was 5,193.99 GB, which included the multiple copies of user data required by a Data Protection Level of Mirroring. The Configured Storage Capacity utilized 84.91% of the priced Physical Storage Capacity of 6,117 GB.
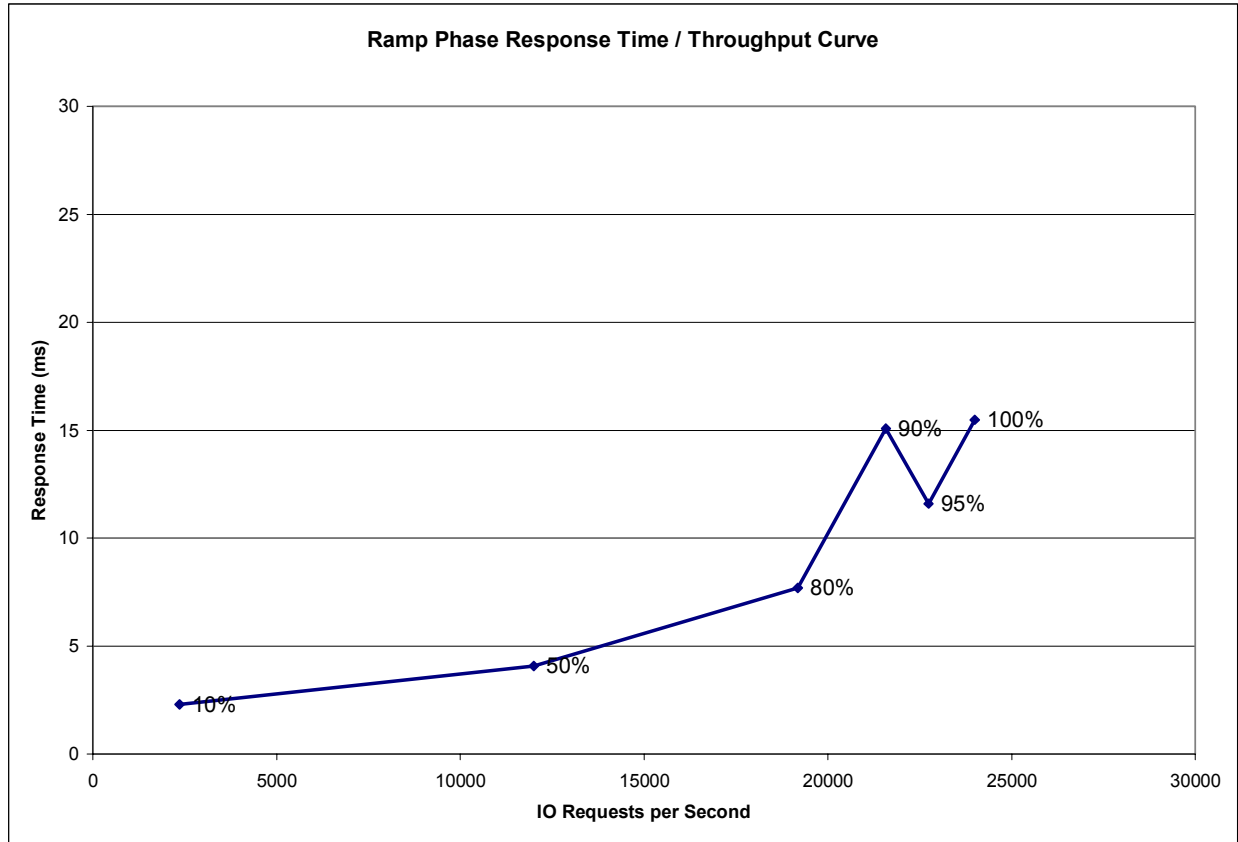
A **Data Protection Level** of Mirroring configures two or more identical copies of user data, maintained on separate disks.

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.
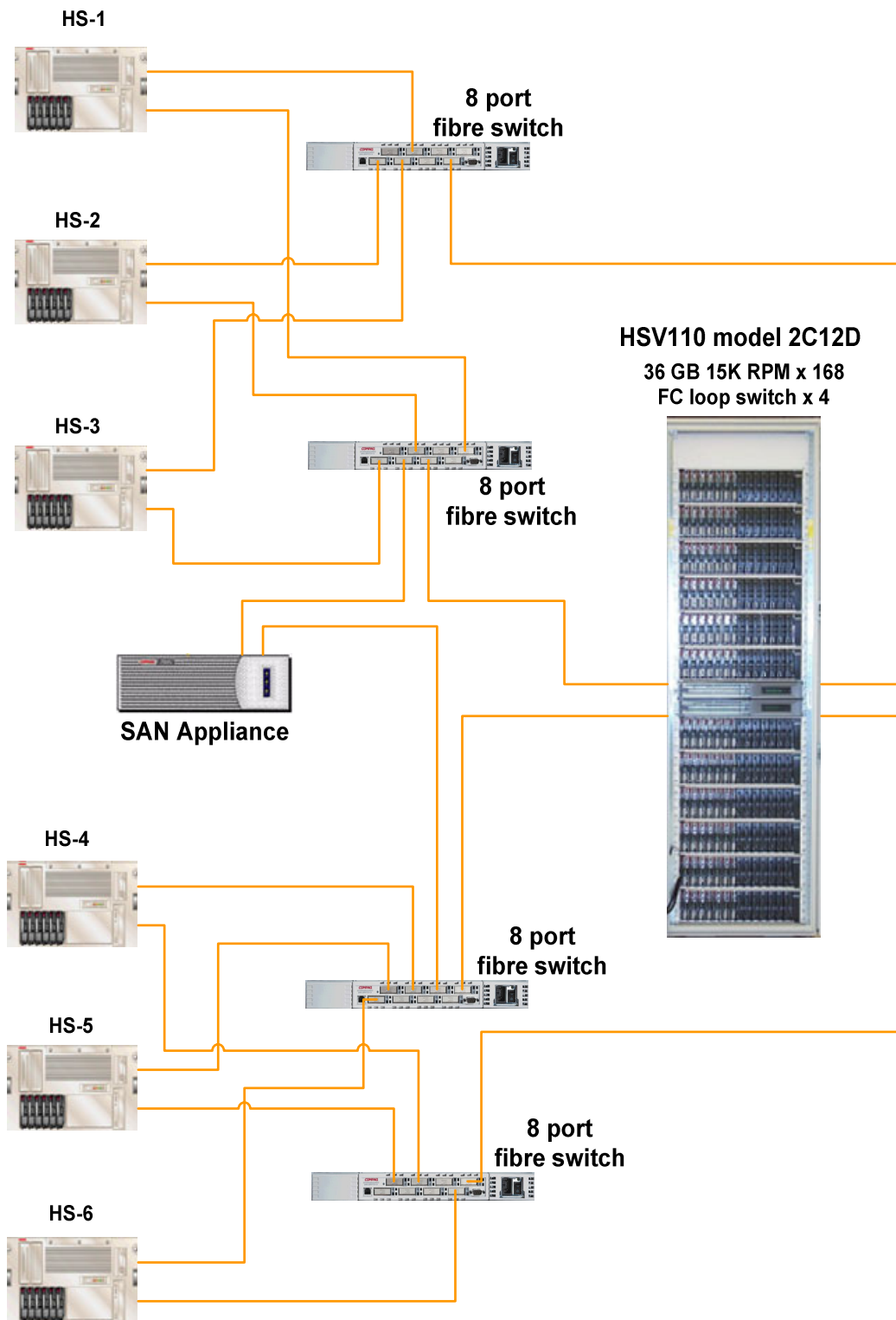
Ramp Phase Response Time / Throughput Curve

Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	2,356.44	11,997.74	19,188.91	21,584.27	22,745.03	24,005.54
Average Response Time (ms):						
All ASUs	2.29	4.08	7.69	15.07	11.59	15.49
ASU-1	3.07	5.58	11.04	22.75	17.13	23.43
ASU-2	3.15	5.31	8.00	10.02	10.00	11.00
ASU-3	0.27	0.35	0.44	1.02	0.54	0.61
Reads	5.46	9.83	16.87	27.95	23.64	29.61
Writes	0.24	0.33	1.71	6.70	3.75	6.29

Tested Storage Configuration Pricing

Part Number	Description / Notes	Qty	List	Extended US List Price	Extended Avg US Sell Price
	Storage Hardware / Software				
283198-B21	EVA, Model 2C12D-B 60Hz	1	$193,020	$193,020	$135,114
236205-B21	36GB FC Drive, 15K	168	$2,100	$352,800	$246,960
258158-888	Configure-To-Order	1	$0	$0	$0
250203-B23	VCS v2.0 Dual HSV Cntlr (base software license)	1	$31,900	$31,900	$22,330
250195-B22	WNT/W2K KIT v2.0 ENT VIR ARY	1	$100	$100	$70
189715-002	Management Appliance II	1	$10,500	$10,500	$7,350
281380-002	Software CarePaq Priority Service Extension	1	$30,941	$30,941	$21,659
	Interconnect Hardware				
258707-B21	SAN Switch 2/8-EL	4	$6,400	$25,600	$22,528
176479-B21	FC PCI HBA for WinNT/X86	12	$1,705	$20,460	$18,005
221692-B22	5-meter LC-LC Multi-Mode Fibre Cable	18	$82	$1,476	$1,299
221470-B21	2Gb/s SFP	14	$369	$5,166	$4,546
	Extended Total			$671,963	$479,860

Benchmark Configuration/Tested Storage Configuration Diagram

HS-1

**8 port
fibre switch**

HS-2

HSV110 model 2C12D

**36 GB 15K RPM x 168
FC loop switch x 4**

HS-3

**8 port
fibre switch**

SAN Appliance

HS-4

**8 port
fibre switch**

HS-5

**8 port
fibre switch**

HS-6

Host System (HS-1 – HS-6) Configuration

Quantity	Type	# CPUs	CPU Type	CPU MHz	Memory	Operating System	System I/O Interconnect	HBAs	HBA to Storage Interconnect	Workload Generator
2	ML-530	2	P III Xeon	800	512	Window 2000 Server	PCI	2 x LP952	Fibre Channel	Yes
2	ML-530	2	P III Xeon	933	512	Window 2000 Server	PCI	2 x LP952	Fibre Channel	Yes
1	ML-530	2	P III Xeon	1000	512	Window 2000 Server	PCI	2 x LP952	Fibre Channel	Yes
1	ML-530	2	P III Xeon	1000	768	Window 2000 Server	PCI	2 x LP952	Fibre Channel	Yes

Tested Storage Configuration (TSC) Diagram – Front and Rear View

HSV110 2C12D Front View

HSV110 2C12D Back View

Disk Shelves

Single Disk Drive

FC/AL Connector Switch to shelf

FC Loop Switch (4 total)

FC/AL Connector Controller to switch

HF1 HF2 MP 1B 2B 1A 2A

HF1 HF2 MP 1B 2B 1A 2A

2 Controllers
SC-1 & SC-2
2 Front End Fibre Channel
4 Back End Fibre Channel
Each controller accesses all 168 disk drives