SPC Benchmark 1™
Executive Summary

Texas Memory Systems, Inc.
Texas Memory Systems RamSan-620

SPC-1 V1.11

Submitted for Review: October 27, 2009
Submission Identifier: A00085

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Texas Memory Systems, Inc. – http://www.texmemsys.com/ Matt Key – matt.k@ramsan.com 10777 Westheimer Road, Suite 600 Houston, TX 77042 Phone (713) 278-6272 FAX: (713) 266-0332
Test Sponsor Alternate Contact	Texas Memory Systems, Inc. – http://www.texmemsys.com/ Jamon Bowen – jamon.b@ramsan.com 10777 Westheimer Road, Suite 600 Houston, TX 77042 Phone (713) 266-3200 FAX: (713) 266-0332
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 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	V1.11
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	October 27, 2009
Date the FDR was submitted to the SPC	October 27, 2009
Date the priced storage configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	October 22, 2009

Tested Storage Product (TSP) Description

The Texas Memory Systems' RamSan-620 rack mounted SLC NAND Flash system is a 2U enterprise class designed solid state disk offering scalable performance and affordable high capacity that is space and power efficient. In addition it offers:

- 1-5TB usable SLC NAND Flash storage capacity

- ECC and RAID protection designed in at the chip level for the ultimate reliability

- Extremely low latency, delivering 250,000 IOPs and 3GB/s random throughput

- Fibre Channel or Infiniband connectivity

- Highly "green" profile at 230 watts typical power consumption

Summary of Results

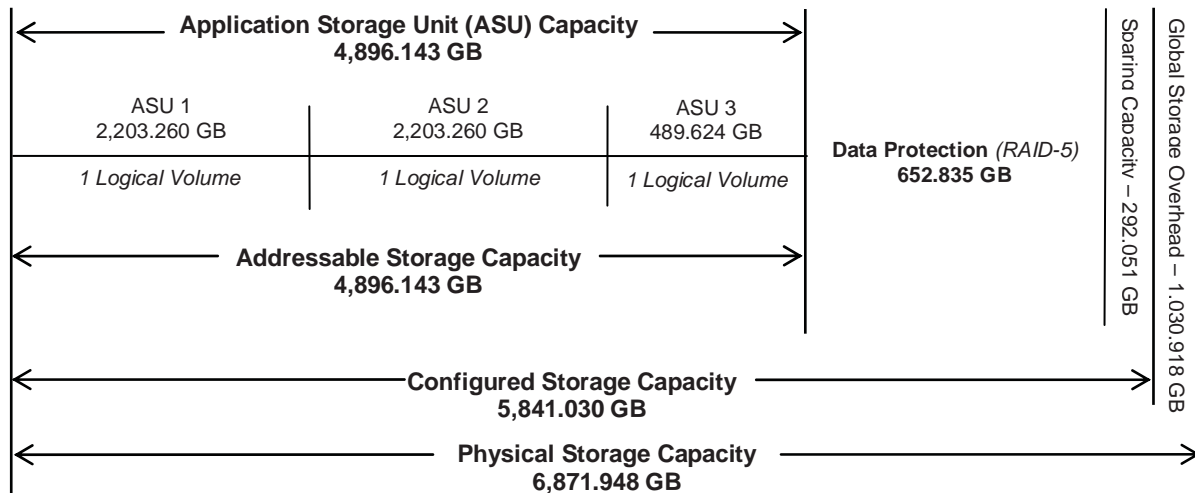| SPC-1 Results	
Tested Storage Configuration (TSC) Name: Texas Memory Systems RamSan-620	
Metric	**Reported Result**
SPC-1 IOPS™	254,994.21
SPC-1 Price-Performance	$1.13/SPC-1 IOPS™
Total ASU Capacity	4,896.143 GB
Data Protection Level	Protected *(RAID-5)*
Total TSC Price (including three-year maintenance)	$287,858

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 *RAID-5* provided data protection by distributing check data corresponding to user data across multiple storage elements in each Storage Device in the form of bit-by-bit parity. In addition, ECC data protection was provided at the sector level.

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.

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|<────────── Application Storage Unit (ASU) Capacity ──────────>|                      Sparing Capacity – 292.051 GB   Global Storage Overhead – 1,030.918 GB
                          4,896.143 GB

        ASU 1                 ASU 2                  ASU 3
      2,203.260 GB          2,203.260 GB           489.624 GB
                                                                         Data Protection (RAID-5)
      1 Logical Volume      1 Logical Volume       1 Logical Volume              652.835 GB

|<──────────────── Addressable Storage Capacity ───────────────>|
                          4,896.143 GB

|<───────────────────── Configured Storage Capacity ─────────────────────────────>|
                          5,841.030 GB

|<──────────────────────── Physical Storage Capacity ──────────────────────────────>|
                          6,871.948 GB
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SPC-1 Storage Capacity Utilization	
Application Utilization	71.25%
Protected Application Utilization	80.75%
Unused Storage Ratio	0.00%

Application Utilization: Total ASU Capacity *(4,896.143 GB)* divided by Physical Storage Capacity *(6,871.948 GB)*

Protected Application Utilization: (Total ASU Capacity *(4,896.143 GB)* plus total Data Protection Capacity *(652.835 GB)* minus unused Data Protection Capacity (0.000 *GB)* divided by Physical Storage Capacity *(6,871.948 GB)*

Unused Storage Ratio: Total Unused Capacity *(0.000 GB)* divided by Physical Storage Capacity *(6,871.948 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 18-19 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.

Ramp Phase Response Time / Throughput Curve
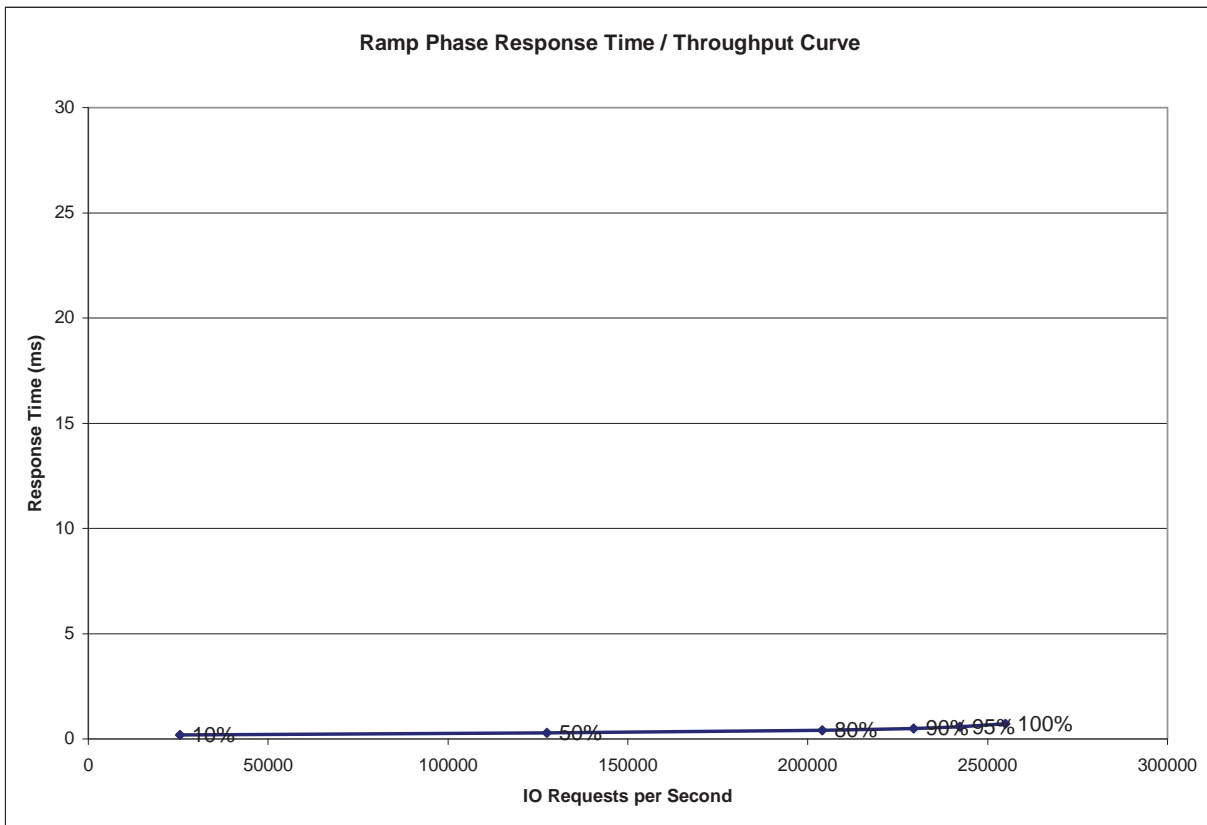
Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	25,505.41	127,521.34	203,995.39	229,490.10	242,258.35	254,994.21
Average Response Time (ms):						
All ASUs	0.19	0.29	0.41	0.49	0.57	0.72
ASU-1	0.21	0.30	0.40	0.47	0.54	0.70
ASU-2	0.17	0.27	0.37	0.44	0.50	0.60
ASU-3	0.15	0.29	0.45	0.56	0.65	0.82
Reads	0.27	0.34	0.41	0.46	0.50	0.62
Writes	0.13	0.26	0.41	0.51	0.61	0.79

Priced Storage Configuration Pricing

Ln #	Qty	Part	Description	Unit Price	Ext. Price
HARDWARE					
1	1	U-RamSan-620/5TB	5-TB RamSan-620. Includes: 5TB Flash storage 1-FC140 (dual ported 4Gbit Fibre Channel). Redundant batteries, fans and power modules.	$ 220,000	$ 220,000
2	3	U-FC-140	Additional Dual 4-Gb Fibre Channel Link. Up to three additional links can be ordered.	$3,000	$ 9,000
3	1	U-620-ActiveSpare	Firmware feature that enables designation of one FTF card as an active spare.	$4,000	$ 4,000

Hardware List Price	$	233,000
Hardware Discount	0% $	-
HARDWARE SUB-TOTAL	$	**233,000**

Ln #	Qty	Part	Description	Unit Price	Ext. Price
SUPPORT					
3	1	U-620-Critical-Year1	Advanced Parts Replacement with 7x24x4 on-site service for one year, which must run concurrent with first year of warranty. If this SKU is ordered, [24x7-Phone-Support] and [SparesKit] must be ordered per site. Customer is responsible for shipping. Price and availability may vary based on location.*	$4000/unit	$ 4,000
4	1	U-620-Critical-AddYr	Advanced Parts Replacement with 7x24x4 on-site Service for one year. [24x7-Phone-Support] must be ordered per site. Customer is responsible for shipping. Price and availability may vary based on location. Maximum of two additional years of on-site service can be ordered.*	$4000/unit + 5% of hardware list	$ 15,650
5	1	U-620-Critical-AddYr	Advanced Parts Replacement with 7x24x4 on-site Service for one year. [24x7-Phone-Support] must be ordered per site. Customer is responsible for shipping. Price and availability may vary based on location. Maximum of two additional years of on-site service can be ordered.*	$4000/unit + 5% of hardware list	$ 15,650
6	3	U-24x7-Phone-Support	One-year 24x7 technical support by phone per site.	$ 1,000	$ 3,000
7	1	U-620-SparesKit/256GBFM	Includes 1 Power Supply, 1 Fan Bank, Spare 256GB Flash Module.	$ 8,750	$ 8,750

Support List Price	$	47,050
Support Discount	0% $	-
SUPPORT SUB-TOTAL	$	**47,050**

Ln #	Qty	Part	Description	Unit Price	Ext. Price
ADDITIONAL ITEMS					
8	8	U-QLE2460	Qlogic 4gb Fibre channel host bus adapters	$929	$ 7,432
9	8	U-3MLCLC	Three meter LC-LC fibre channel cable	$22	$ 176

ADDITIONAL ITEMS SUB-TOTAL	$	**7,608**

Ln #	Qty	Part	Description	Unit Price	Ext. Price
10	1	Shipping	Overnight courier service	$200	$ 200

TOTAL PURCHASE PRICE	$	**287,858**

Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration
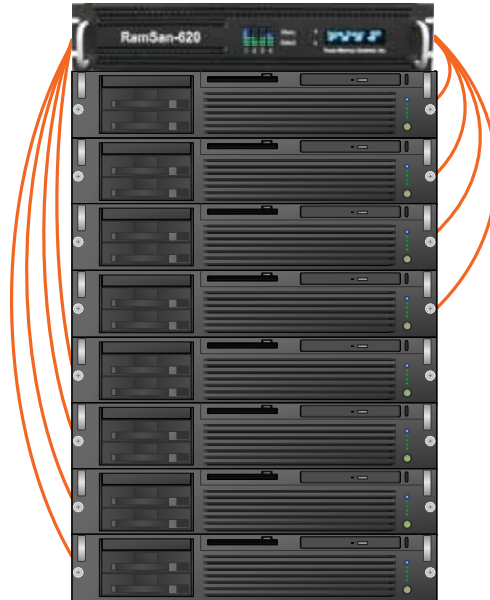
There were no differences between the TSC and Priced Storage Configuration.

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

Texas Memory Systems RamSan-620

4 – dual port 4Gb FC Controllers

20 – 320 GiB Solid State Devices

8 – Qlogic QLE2462 HBAs

8 – Supermicro AMD Opteron Host Systems

Benchmark Configuration/Tested Storage Configuration Priced Storage Configuration Components

Host System:	Tested Storage Configuration (TSC)/ Priced Storage Configuration:
8 – Supermicro AMD Opteron Servers, each with:	8 – Qlogic QLE2462 4Gb dual-port PCIe HBAs
2 – AMD Opteron Model 275 dual core 2.2 GHz CPUs	**Texas Memory Systems RamSan-620**
2 x 1024 KB L2 cache per CPU	4 – dual port 4Gb FC controllers 16 GB controller cache *(768 MiB/Solid State Device)*
4 GB main memory	8 – 4Gb Fibre Channel front-end connections
Windows Server 2003 Enterprise Edition with SP2	4 – proprietary bus backend connections
TMS MPIO Driver 1.1.5	20 – 320 GiB Solid State Devices
PCI	
WG	