SPC BENCHMARK 2™

EXECUTIVE SUMMARY

TEXAS MEMORY SYSTEMS, INC.

TEXAS MEMORY SYSTEMS RAMSAN-630

SPC-2™ V1.3

Submitted for Review: May 10, 2011
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EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Texas Memory Systems, Inc. – http://www.ramsan.com Timothy Logan – timothy.logan@texmemsys.com 10777 Westheimer, Ste. 600 Houston, TX 77042 Phone: (713) 266-3200 FAX: (713) 266-0332
Test Sponsor Alternate Contact	Texas Memory Systems, Inc. – http://www.ramsan.com Jamon Bowen – jamon.b@texmemsys.com 10777 Westheimer, Ste. 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-2 Specification revision number	V1.3
SPC-2 Workload Generator revision number	V1.0
Date Results were first used publicly	May 10, 2011
Date FDR was submitted to the SPC	May 10, 2011
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	May 10, 2011

Tested Storage Product (TSP) Description

The Texas Memory Systems' RamSan-630 rack mounted SLC NAND Flash system is a 3U enterprise class designed solid state disk offering scalable performance and affordable high capacity. In addition it offers:

- 1-10TB usable SLC NAND Flash storage capacity
- ECC and RAID protection designed in at the chip level
- Extremely low latency, providing both outstanding transaction and bandwidth performance
- Fibre Channel or Infiniband connectivity

The SPC-1 result demonstrates the latest performance ability of the Texas Memory Systems' RamSan product line. This product is available for purchase today.

SPC-2 Reported Data

SPC-2 Reported Data consists of three groups of information:

- The following SPC-2 Primary Metrics, which characterize the overall benchmark result:
  - SPC-2 MBPS™
  - SPC-2 Price Performance
  - Application Storage Unit (ASU) Capacity
- Supplemental data to the SPC-2 Primary Metrics.
  - Total Price
  - Data Protection Level
- Reported Data for each SPC Test: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand Delivery (VOD) Test.

SPC-2 Reported Data				
Texas Memory Systems RamSan-630				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
8,323.13	$49.37	8,116.563	$ 410,926.90	Protected *(RAID-5)*
The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD)				
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LFP Composite	7,129.06			$57.64
Write Only:				
1024 KiB Transfer	10,602.06	10	1,060.21	
256 KiB Transfer	4,187.26	10	418.73	
Read-Write:				
1024 KiB Transfer	5,461.05	20	273.05	
256 KiB Transfer	4,927.81	20	246.39	
Read Only:				
1024 KiB Transfer	8,010.56	10	801.06	
256 KiB Transfer	9,585.61	40	239.64	
The above SPC-2 Data Rate value for LFP Composite represents the aggregate performance of all three LFP Test Phases: (Write Only, Read-Write, and Read Only).				
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LDQ Composite	9,189.62			$44.72
1024 KiB Transfer Size				
4 I/Os Outstanding	10,648.56	10	1,064.86	
1 I/O Outstanding	9,841.00	20	492.05	
64 KiB Transfer Size				
4 I/Os Outstanding	10,703.31	40	267.58	
1 I/O Outstanding	5,565.62	40	139.14	
The above SPC-2 Data Rate value for LDQ Composite represents the aggregate performance of the two LDQ Test Phases: (1024 KiB and 64 KiB Transfer Sizes).				
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate *(MB/second)*	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
	8,650.71	11,000	0.79	$47.50

SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

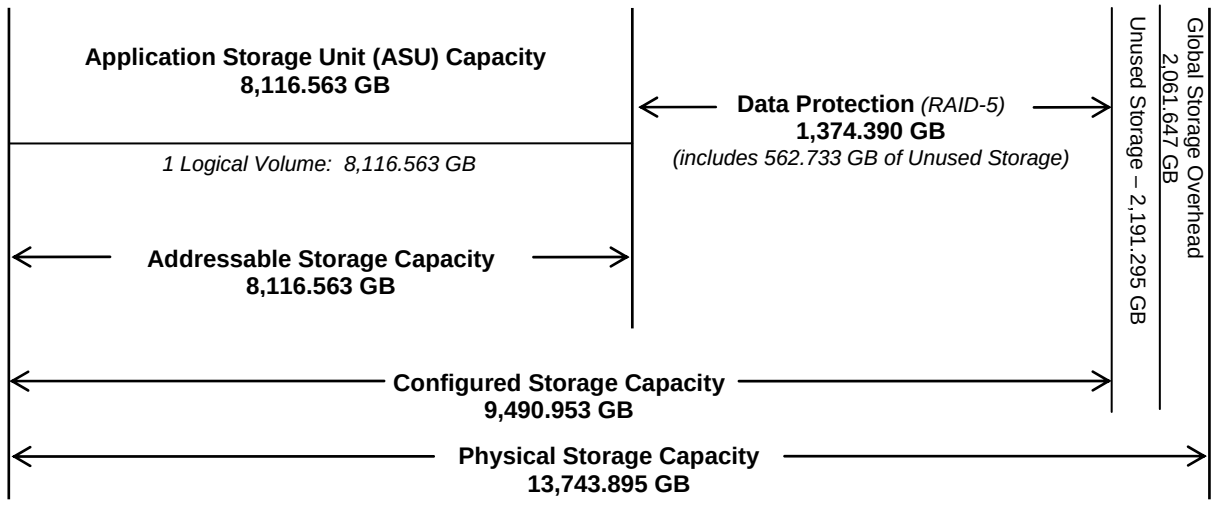
ASU (Application Storage Unit) **Capacity** represents the total storage capacity read and written in the course of executing the SPC-2 benchmark.

A **Data Protection Level** of **Protected** using ***RAID-5***.

The Texas Memory Systems RamSan-630 uses a modified RAID-5 algorithm to ensure that the failure of a Flash memory chip does not result in data corruption. The modification to the RAID-5 makes an important leap forward over HDD-based RAID-5 write performance. On HDD RAID-5 implementations, any time even a small block of data is written, the RAID-5 controller must read back the entire data stripe and the parity bits, then rewrite the data, and finally rewrite the parity. But the RamSan-630 always writes to a new location on the Flash medium as part of its wear leveling algorithm, so a read of the old data and parity before a write is not required.

Storage Capacities and Relationships

The following diagram *(not to scale)* 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	59.06%
Protected Application Utilization	64.96%
Unused Storage Ratio	20.04%

Application Utilization: Total ASU Capacity *(8,116.563 GB)* divided by Physical Storage Capacity *(13,743.895 GB)*

Protected Application Utilization: (Total ASU Capacity *(8,116.563 GB)* plus total Data Protection Capacity *(1,374.390 GB)* minus unused Data Protection Capacity *(562.733 GB)* divided by Physical Storage Capacity *(13,743.895 GB)*.

Unused Storage Ratio: Total Unused Capacity *(2,754.029 GB)* divided by Physical Storage Capacity *(13,743.895 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 21-22 in the Full Disclosure Report.

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

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

Priced Storage Configuration Pricing

Ln #	Qty	Part	Description	Unit Price	Ext Price
HARDWARE					
1	1	U-RS630/10	RamSan-630 (10TB)	$314,500.00	$314,500.00
2	1	U-630-IB-381-i	Included IB Interface	$0.00	$0.00
3	4	U-630-IB-381	Additional IB Interface	$4,000.00	$16,000.00
4	1	U-630-SparesKit-GM/500GB-i	Included Spares Kit with 500GB Flash	$0.00	$0.00
5	1	U-630-RackSL	Rack Slide Kit	$200.00	$200.00

Hardware List Price		$330,700.00
Hardware Discount	0%	-
Hardware Sub-Total		$330,700.00

Ln #	Qty	Part	Description	Unit Price	Ext Price
SUPPORT					
6	1	i-Warranty-Critical	Critical Warranty	$72,710.00	$72,710.00

Support List Price		$72,710.00
Support Discount	0%	-
Support Sub-Total		$72,710.00

Ln #	Qty	Part	Description	Unit Price	Ext Price
Third-Party Components					
8	10	MHQH19B-XTR	Mellanox QDR Single Port HCA	$594.82	$5,948.20
9	10	J9281B	HP X242 SFP+ SFP+ 1m Direct Attach Cable	$156.87	$1,568.70

Third-Party Components SUB-TOTAL	$7,516.90
TOTAL PURCHASE PRICE	**$410,926.90**

The following pricing includes the following:

- Acknowledgement of new and existing hardware and/or software problems within four hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration component.

Priced Storage Configuration Diagram

Texas Memory Systems
RamSan-630

20 – 640 GiB Solid State Devices *(SSDs)*
5 – dual-ported QDR InfiniBand Controllers
10 – Mellanox MHQH19B HCAs

Priced Configuration Components

Priced Storage Configuration Components:
10 – Mellanox MHQH19B HCAs
Texas Memory System RamSan-630 5 – dual-ported QDR InfiniBand Controllers 10 – IB-381 InfiniBand QDR connections *(10 used)* 20 – 640 GiB Solid State Devices *(SSDs)*
10 – HP X242 SFP+ SFP+ 1m direct attach cables
1 – U-630 Spares Kit with 500 GB Flash
1 – Rack Slide Kit