SPC BENCHMARK 1™

EXECUTIVE SUMMARY

TEXAS MEMORY SYSTEMS, INC.

TEXAS MEMORY SYSTEMS RAMSAN-630

SPC-1 V1.12

Submitted for Review: May 10, 2011
Submission Identifier: A00105

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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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-1 Specification revision number	V1.12
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	May 10, 2011
Date the FDR was submitted to the SPC	May 10, 2011
Date the priced storage configuration is 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.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Texas Memory Systems RamSan-630	
Metric	**Reported Result**
SPC-1 IOPS™	400,503.26
SPC-1 Price-Performance	$1.05/SPC-1 IOPS™
Total ASU Capacity	8,116.579 GB
Data Protection Level	Protected *(RAID-5)*
Total TSC Price (including three-year maintenance)	$419,292.00

SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.
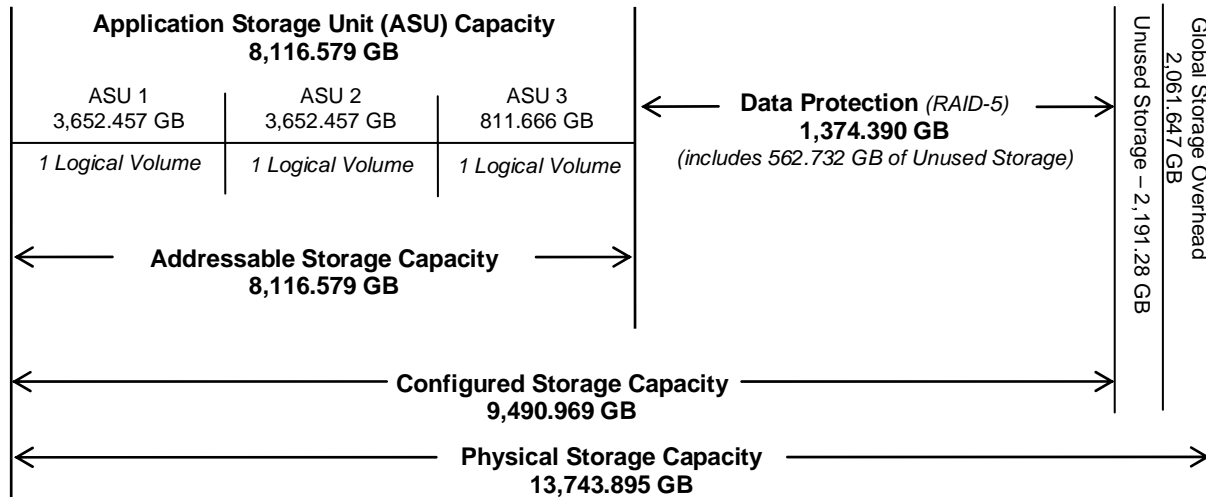
Total ASU (Application Storage Unit) **Capacity** represents the total storage capacity read and written in the course of executing the SPC-1 benchmark.

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

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 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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┌──────────────────────────────────────────────────┐ │                        │ │ U G U │
│      Application Storage Unit (ASU) Capacity       │ │                        │ │ n l n │
│                   8,116.579 GB                     │ │                        │ │ u o s │
│                                                    │ │                        │ │ s b e │
├─────────────┬─────────────┬──────────────┐        │ │                        │ │ e a d │
│    ASU 1    │    ASU 2    │    ASU 3     │        │◄─── Data Protection (RAID-5)───►│ d l 2 │
│ 3,652.457 GB│ 3,652.457 GB│  811.666 GB  │        │         1,374.390 GB            │ S , │
│             │             │              │        │ (includes 562.732 GB of Unused  │ t S 0 │
├─────────────┼─────────────┼──────────────┤        │           Storage)              │ o t 6 │
│ 1 Logical   │ 1 Logical   │ 1 Logical    │        │                                 │ r o 1 │
│ Volume      │ Volume      │ Volume       │        │                                 │ a r . │
└─────────────┴─────────────┴──────────────┘        │                                 │ g a 6 │
◄────────── Addressable Storage Capacity ──────────►                                  │ e g 4 │
                  8,116.579 GB                                                        │ – e 7 │
                                                                                      │ 2 O │
                                                                                      │ , v G │
◄──────────────── Configured Storage Capacity ──────────────────────────────────────►│ 1 e B │
                      9,490.969 GB                                                    │ 9 r │
                                                                                      │ 1 h │
◄──────────────────── Physical Storage Capacity ─────────────────────────────────────►│ . e │
                        13,743.895 GB                                                 │ 2 a │
                                                                                      │ 8 d │
                                                                                      │ G │
                                                                                      │ B │
```

SPC-1 Storage Capacity Utilization	
Application Utilization	59.06%
Protected Application Utilization	64.96%
Unused Storage Ratio	20.04%

Application Utilization: Total ASU Capacity *(8,116.579 GB)* divided by Physical Storage Capacity *(8,116.579 GB)*

Protected Application Utilization: (Total ASU Capacity *(8,116.579 GB)* plus total Data Protection Capacity *(1,374.390 GB)* minus unused Data Protection Capacity *(562.732 GB)* divided by Physical Storage Capacity *(8,116.579 GB)*

Unused Storage Ratio: Total Unused Capacity *(2,754.011 GB)* divided by Physical Storage Capacity *(8,116.579 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.
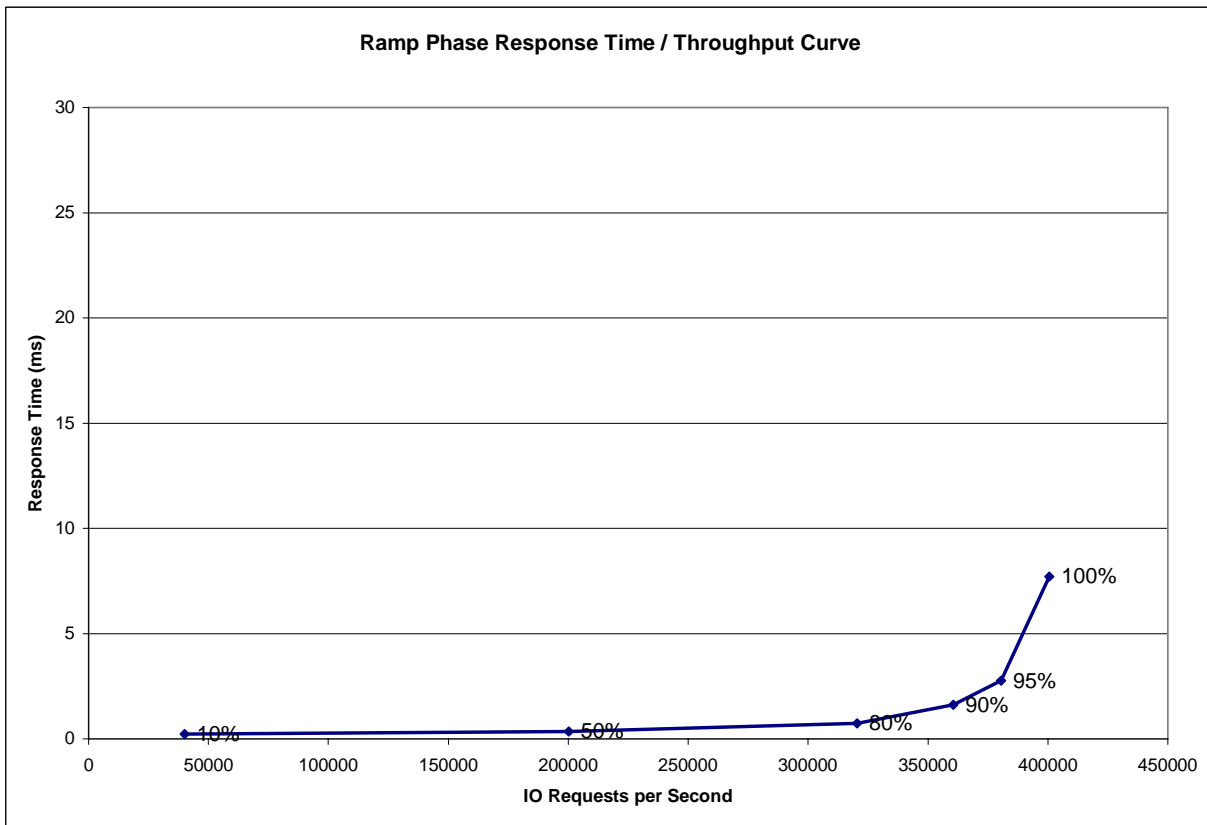
Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	40,045.71	200,250.39	320,375.99	360,425.44	380,450.36	400,503.26
Average Response Time (ms):						
All ASUs	0.22	0.34	0.75	1.61	2.76	7.71
ASU-1	0.25	0.36	0.72	1.45	2.48	8.14
ASU-2	0.24	0.36	0.73	1.43	2.22	4.36
ASU-3	0.15	0.28	0.80	2.04	3.60	8.25
Reads	0.34	0.45	0.69	0.98	1.39	4.88
Writes	0.14	0.27	0.78	2.02	3.65	9.55

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-FC-381-i	Included FC Interface	$0.00	$0.00
3	4	U-630-FC-381	Additional FC 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	QLE2562-CK	QLogic 8Gb PCIe x8 Fibre Channel 2-port HBA	$1,549.80	$15,498.00
9	10	J9281B	Tripp Lite multimode duplex Fibre Channel cable LC/LC 2m	$38.40	$384.00

ADDITIONAL ITEMS SUB-TOTAL	$15,882.00
TOTAL PURCHASE PRICE	**$419,292.00**

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 the Priced Storage Configuration.

Priced Storage Configuration Diagram

**Texas Memory Systems
RamSan-630**

20 – 640 GiB Solid State Devices *(SSDs)*
5 – dual-port FC-381 8Gb FC interfaces
10 – Qlogic QLE2562 8Gb FC HBAs

Priced Storage Configuration Components

Priced Storage Configuration Components:
10 – Qlogic QLE2562-CK 8Gb Fibre Channel HBAs
Texas Memory System RamSan-630 5 – dual-port FC-381 8Gb Fibre Channel interfaces 10 – FC-381 8Gb Fibre Channel connections *(10 used)* 20 – 640 GiB Solid State Devices *(SSDs)*
10 – multimode duplex Fibre Channel LC/LC 2m cables
1 – U-630 Spares Kit with 500 GB Flash
1 – Rack Slide Kit