SPC Benchmark 2™

Executive Summary

Sun Microsystems, Inc.
Sun Storage 6180 Array *(RAID-6)*

SPC-2™ V1.3

Submitted for Review: October 9, 2009
Submission Identifier: B00044
Revised: August 4, 2010

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Sun Microsystems, Inc. – http://www.sun.com Steven A. Johnson – steven.a.johnson@oracle.com 500 Eldorado Blvd. UBRM05-194 Broomfield, CO 80021 Phone: (303) 272-9476 FAX: (303) 272-4886
Test Sponsor Alternate Contact	Sun Microsystems, Inc. – http://www.sun.com Jason Schaffer – Jason.schaffer@oracle.com 500 Eldorado Blvd. Broomfield, CO 80021 Phone: (303) 272-4743 FAX: (303) 272-9704
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	October 9, 2009
Date FDR was submitted to the SPC	October 9, 2009

Date revised FDR was submitted to the SPC
  Revised Total TSP Price and SPC-1 Price-Performance *(page 3)*
  Revised pricing *(page 6)*
  Revised TSC/Priced Storage Configuration differences *(page 6)*
  Revised Priced Storage Configuration component table *(page 7)*
  (revisions highlighted in **red** *on the above pages)*
	August 4, 2010

Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	October 9, 2009

Tested Storage Product (TSP) Description

The Sun Storage 6180 Array is a modular, rack mountable and scalable array designed specifically to grow with your applications, lowering acquisition and expansion costs. The NEBS Level-3 certified Sun Storage 6180 Array offers 8 gigabits-per-second (Gb/sec) Fibre Channel (FC) host interfaces designed for both direct attached and SAN attached storage. The system features a fully redundant architecture with drive intermixing (FC or SATA-II disk drives) in the same drive enclosure, leverages the existing Common Storage Modules (CSM200) expansion trays for primary and secondary storage requirements. With redundant components, automated path failover and extensive online configuration, re-configuration, dynamic expansion and maintenance capabilities, the Sun Storage 6180 Array is designed to ensure your data is available 24x7x365.

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.

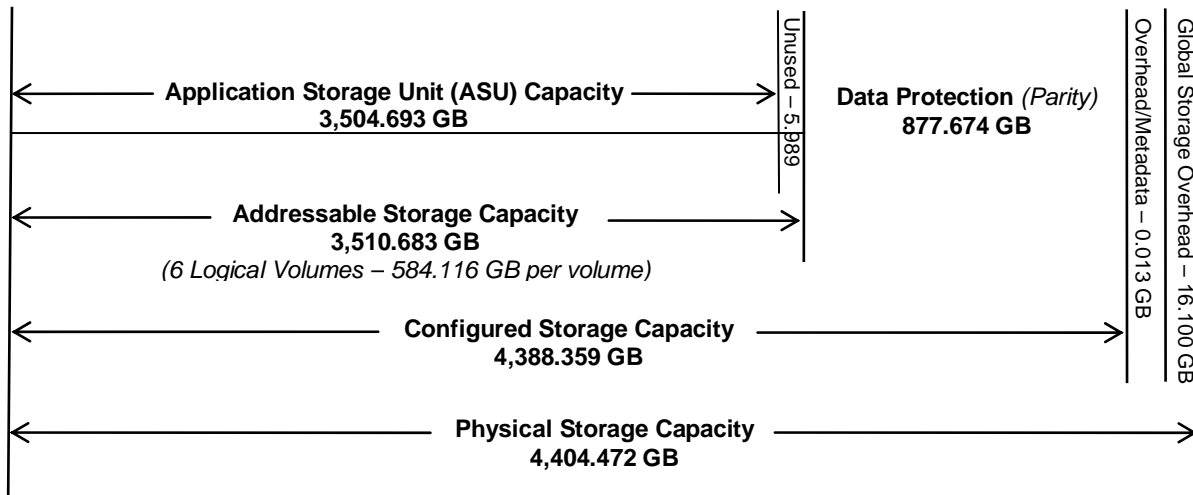| SPC-2 Reported Data				
Sun Storage 6180 Array *(RAID-6)*				
SPC-2 MBPS™	SPC-2 Price-Performance	ASU Capacity (GB)	Total Price	Data Protection Level
1,286.74	$56.88	3,504.693	$73,190	RAID-6
The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (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	1,009.98			$72.47
Write Only:				
1024 KiB Transfer	864.81	32	27.03	
256 KiB Transfer	383.30	32	11.98	
Read-Write:				
1024 KiB Transfer	1,071.56	32	33.49	
256 KiB Transfer	574.05	32	17.94	
Read Only:				
1024 KiB Transfer	1,580.42	32	49.39	
256 KiB Transfer	1,585.74	32	49.55	
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	1,466.08			$49.92
1024 KiB Transfer Size				
4 I/Os Outstanding	1,541.69	32	48.18	
1 I/O Outstanding	1,532.52	32	47.89	
64 KiB Transfer Size				
4 I/Os Outstanding	1,405.70	32	43.93	
1 I/O Outstanding	1,384.43	32	43.26	
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
	1,384.16	1,760	0.79	$52.88

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* provides data protection by distributing check data corresponding to user data across multiple disks in the form of bit-by-bit parity.

Storage Capacities and Relationships

The following diagram *(not to scale)* documents the various storage capacities, used in this benchmark, and their relationships.

```
                                                    Unused – 5.989          Global Storage Overhead – 16.100 GB
                                                                   Overhead/Metadata – 0.013 GB

|←——— Application Storage Unit (ASU) Capacity ———→|      Data Protection (Parity)
                    3,504.693 GB                              877.674 GB

|←——————— Addressable Storage Capacity ———————→|
                    3,510.683 GB
        (6 Logical Volumes – 584.116 GB per volume)

|←——————————— Configured Storage Capacity ———————————————→|
                        4,388.359 GB

|←——————————————— Physical Storage Capacity ———————————————→|
                            4,404.472 GB
```

SPC-1 Storage Capacity Utilization	
Application Utilization	79.57%
Protected Application Utilization	99.50%
Unused Storage Ratio	0.11%

Application Utilization: Total ASU Capacity *(3,504.693 GB)* divided by Physical Storage Capacity *(4,404.472 GB)*

Protected Application Utilization: (Total ASU Capacity *(3,504.693 GB)* plus total Data Protection Capacity *(877.674 GB)* minus unused Data Protection Capacity *(0.000 GB)*) divided by Physical Storage Capacity *(4,404.472 GB)*

Unused Storage Ratio: Total Unused Capacity *(5.989 GB)* divided by Physical Storage Capacity *(4,404.472 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.

Priced Storage Configuration Pricing

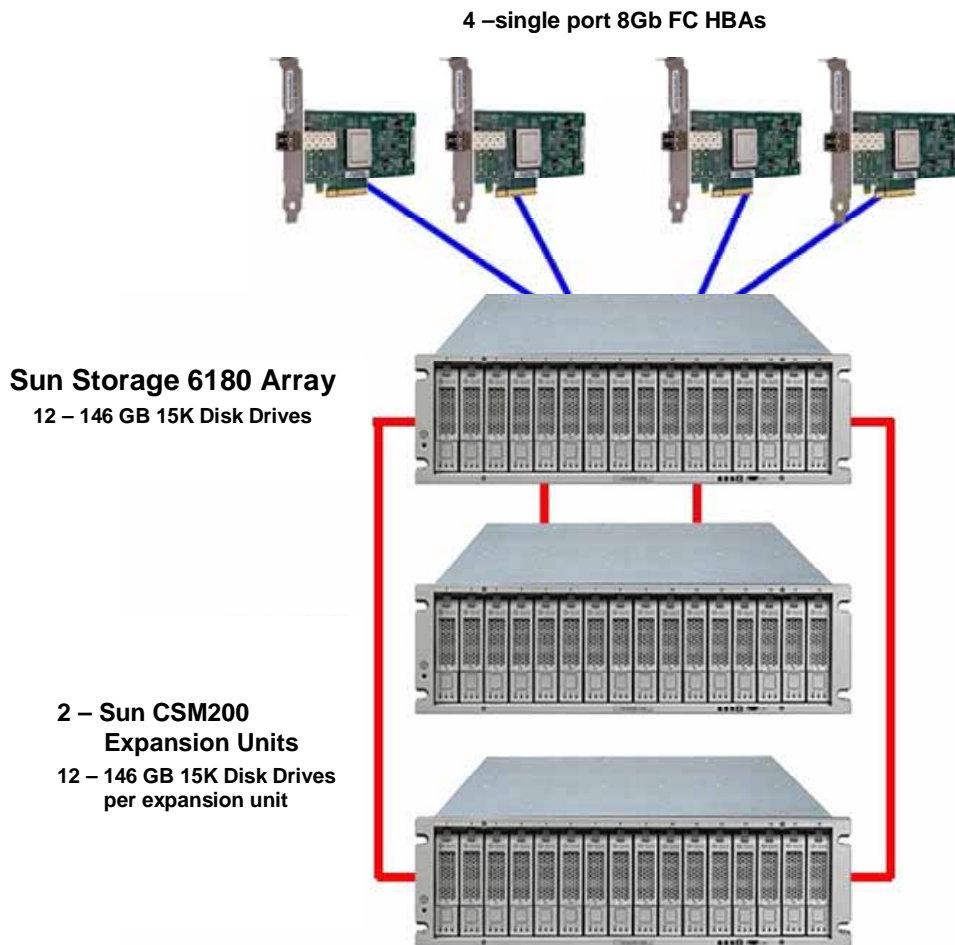| Part Number	Description	Quantity	US List	Total	discount	Ave. Price
TA6180R11A2-0	Sun Storage 6180 array with 4GB cache and 8 * FC host ports, Rack-Ready Controller Tray - Diskless Chassis, 0GB, 0 drives; Includes: 2 * 2GB-cache memory FC RAID Controller cards, 2 * redundant AC power supplies and cooling fans, 2 * FC ports for expansion trays and 8 * 8 Gb/s host ports with shortwave SFPs, 2 * 5M fibre optic cables, 2 * 6M ethernet cables and management software.RoHS-5.	1	$37,995	$37,995	38%	$23,557
TCCSM2R01A0-0Z	RoHS-5, Sun StorageTek (tm) CSM200, Rack-Ready Expansion Tray - Diskless Chassis, 0GB, 0 drives; must order minimum 6 drives. Includes: 2 * I/O Modules, 2 * redundant AC power supplies and cooling fans, 2 * FC ports for expansions, 4 * shortwave SFPs with 2 * LC-LC FC cables. (For factory integration only)	2	$5,995	$11,990	38%	$7,434
	- 16 146GB 15k rpm 4Gb drives	36	$1,495	$53,820	38%	$33,368
X9733A-Z	5M LC-LC Fiber Optic cable	2	$80	$160	38%	$99
SG-XPCIE1FC-QF8-Z	single port 8Gb HBA	4	$1,249	$4,996	38%	$3,098
IWU-61804G8P-24-3G	3-yr Gold Service Maintainance for controller tray	1	$5,328	$5,328	38%	$3,303
	- 7/24 coverage					
	- 4 hour resonse time					
IWU-STCSM2-24-3G	- 4 hour resolution					
	3-yr Gold Service Maintainance for CSM200 expansion tray	2	$1,880	$3,760	38%	$2,331
	- 7/24 coverage					
	- 4 hr response time					
	- 4 hour resolution					
				$118,049		$73,190

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

The differences between the TSC and Priced Storage consisted of the following:

- The TSC was configured with twelve 4 Gbps SFPs, of which eight were used. The Priced Storage Configuration included only the required eight SFPs.

- The TSC was configured with four 8 Gbps SFPs, which were all used. The Priced Storage Configuration included eight 8 Gbps SFPs.

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

Priced Storage Configuration Diagram

4 –single port 8Gb FC HBAs

Sun Storage 6180 Array

12 – 146 GB 15K Disk Drives

**2 – Sun CSM200
Expansion Units**

**12 – 146 GB 15K Disk Drives
per expansion unit**

Priced Storage Configuration Components

Priced Storage Configuration:
4 – single port 8Gb FC HBAs
SC-1/SC-2: Sun Storage 6180 Array
2 – dual-active controllers with:
2 GB cache per controller *(4 GB total)*
4 – 8 Gb Fibre Channel front-end connections   per controller *(8 total, 4 used – 2 per controller)*
8 – 8 Gb shortwave SFPs
4 – 5M LC-LC fibre optic cables
4 – 4 Gb Fibre Channel backend connection   *(4 used)*
2 – Sun CMS200 expansion unit, each with   4 shortwave SFPs *(4 Gb)* and 2 LC-LC fibre optic cables
36 – 146.8 GB 15K RPM disk drives   *(12 in the controller unit and 12 in each expansion unit)*

SPC BENCHMARK 2™ V1.3   EXECUTIVE SUMMARY   Submitted for Review: OCTOBER 9, 2009
Sun Microsystems, Inc.   Submission Identifier: B00044
Sun Storage 6180 Array *(RAID-6)*   Revised: August 4, 2010