



**SPC BENCHMARK 1C/ENERGY™
EXECUTIVE SUMMARY**

**SEAGATE TECHNOLOGY LLC
SEAGATE SAVVIO® 10K.3 ST9300603SS**

SPC-1C/E™ V1.3

Submitted for Review: June 3, 2009

Submission Identifier: E00002

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

| Test Sponsor and Contact Information | |
|---|--|
| Test Sponsor Primary Contact | Seagate Technology LLC – http://www.seagate.com Craig Parris – Craig.Parris@seagate.com 1280 Disc Drive Shakopee, MN 55379 Phone: (952) 402-2418 FAX: (952) 402-2695 |
| Test Sponsor Alternate Contact | Seagate Technology LLC – http://www.seagate.com Teresa Worth – Teresa.M.Worth@seagate.com 1280 Disc Drive Shakopee, MN 55379 Phone: (952) 402-3704 FAX: (952) 402-2859 |
| 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

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|--|---------------------|
| SPC-1C/E Specification revision number | V1.3 |
| SPC-1C Workload Generator revision number | V1.0 |
| Date Results were first used publicly | June 3, 2009 |
| Date the FDR was submitted to the SPC | June 3, 2009 |
| Date the TSC is available for shipment to customers | currently available |
| Date the TSC completed audit certification | June 2, 2009 |

Tested Storage Product (TSP) Description

Seagate® Savvio® 10K.3 drives offer the best combination of enterprise performance and power efficiency, with up to 300-GB capacity for mainstream servers and external storage arrays. This third-generation Savvio drive gives you more than twice the number of drives over 3.5-inch products within the same rack configuration, and delivers system-level performance increase. The Savvio 10K.3 drives are the world's first to operate at 6-Gb/s transfer rates, which is part of the new SAS 2.0 feature set. SAS 2.0 was developed to provide additional signal and data integrity features to enable SAS to be ideally suited for use in high-end network storage applications.

The 2.5-inch footprint enables the lowest power profile of any tier-1 mission-critical drive. The Savvio 10K.3 drive with PowerTrim technology uses less power than a 3.5-inch 15K drive. The lower power footprint of 2.5-inch drives enables lower cooling costs. The 2.5-inch drive advantages translate into greater overall value and reduced total cost of ownership to IT organizations and administrators who want to optimize their data center power and performance efficiency.

Summary of Results

| SPC-1C Results | |
|---|-----------------|
| Tested Storage Product: Seagate Savvio® 10K.3 ST9300603SS | |
| Metric | Reported Result |
| SPC-1C IOPS™ | 8,013.39 |
| Total ASU Capacity | 3,600.000 GB |
| Data Protection Level | Unprotected |
| Total Price – Priced Storage Configuration | \$15,209 |

SPC-1C 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-1C benchmark.

A **Data Protection Level** of **UNPROTECTED** makes no claim of data protection in the event of a single point of failure.

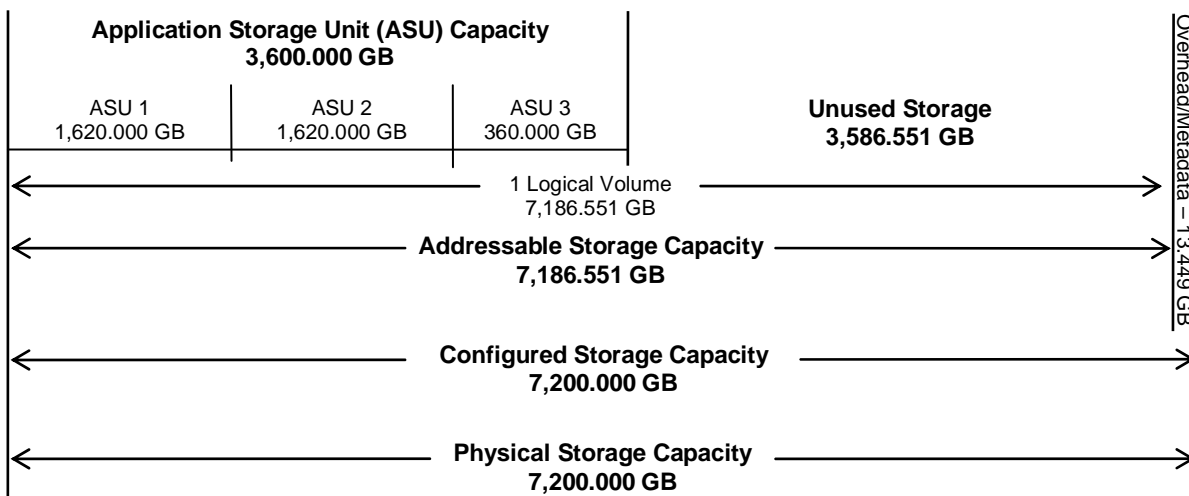
Storage Capacities and Relationships

The Tested Storage Configuration (TSC) must be configured so that there is either no Unused Storage or that the sum of Total ASU Capacity and storage required for data protection equals 50% (+-1 GiB) of the Physical Storage Capacity. This configuration meets the 50% requirement as documented below:

$$7,200.000 \text{ GB (Physical Storage Capacity)} * 0.5 = 3,600.000 \text{ GB}$$

$$3,600.000 \text{ GB (Total ASU Capacity)} + 0.000 \text{ GB (data protection)} = 3,600.000 \text{ GB}$$

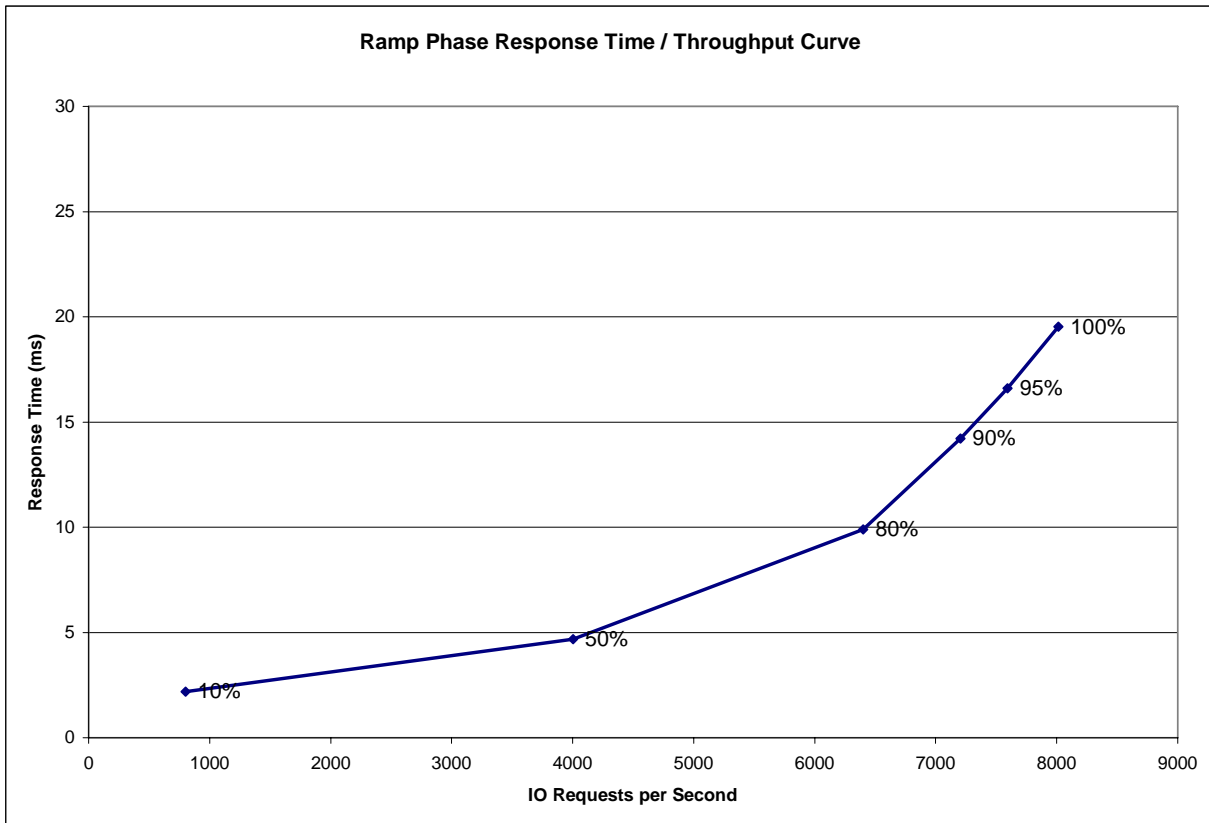
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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 | 799.60 | 4,001.92 | 6,400.37 | 7,203.42 | 7,594.51 | 8,013.39 |
| Average Response Time (ms): | | | | | | |
| All ASUs | 2.18 | 4.68 | 9.91 | 14.21 | 16.60 | 19.54 |
| ASU-1 | 3.04 | 6.15 | 11.35 | 15.00 | 17.36 | 20.81 |
| ASU-2 | 2.64 | 7.08 | 16.70 | 23.65 | 27.89 | 33.70 |
| ASU-3 | 0.16 | 0.49 | 3.89 | 8.37 | 10.05 | 10.63 |
| Reads | 5.30 | 11.16 | 21.58 | 28.67 | 32.98 | 38.75 |
| Writes | 0.15 | 0.46 | 2.29 | 4.79 | 5.95 | 7.03 |

SPC-1C/E Reported Data

| | Usage Profile | | | | | |
|---------------------------|----------------------|----------|------|-------------------------|---------------|---------|
| | Hours of Use per Day | | | Nominal | Nominal | Nominal |
| | Heavy | Moderate | Idle | Power, W | Traffic, IOPS | IOPS/W |
| Low Daily Usage: | 0 | 8 | 16 | 184.31 | 1333.97 | 7.24 |
| Medium Daily Usage: | 4 | 14 | 6 | 201.88 | 3401.18 | 16.85 |
| High Daily Usage: | 18 | 6 | 0 | 218.40 | 5800.76 | 26.56 |
| Composite Metrics: | | | | 201.53 | 3,511.97 | 17.43 |
| Annual Energy Use, kWh: | 1,765.41 | | | | | |
| Energy Cost, \$/kWh: | \$ 0.12 | | | Annual Energy Cost, \$: | \$ 211.85 | |

The above usage profile describes conditions in environments that respectively impose light (“low”), moderate (“medium”), and extensive (“high”) demands on the Tested Storage Configuration (TSC).

HEAVY SPC-1C Workload: 221.50W at 80% of maximum reported performance (6,400.37 SPC-1C IOPS).

MODERATE SPC-1C Workload: 209.11W at 50% of maximum reported performance (4,001.92 SPC-1C IOPS).

IDLE SPC-1C Workload: 171.92W at 0% of maximum reported performance (0.00 SPC-1C IOPS).

LOW DAILY USAGE: Zero (0) hours of **HEAVY** SPC-1C Workload, eight (8) hours of **MODERATE** SPC-1C Workload, and sixteen (16) hours of **IDLE** SPC-1C Workload.

MEDIUM DAILY USAGE: Four (4) hours of **HEAVY** SPC-1C Workload, fourteen (14) hours of **MODERATE** SPC-1C Workload, and six (6) hours of **IDLE** SPC-1C Workload.

HIGH DAILY USAGE: Eighteen (18) hours of **HEAVY** SPC-1C Workload, six (6) hours of **MODERATE** SPC-1C Workload, and zero (0) hours of **IDLE** SPC-1C Workload.

NOMINAL POWER, W: The average power consumption over the course of a day (24 hours), taking into account hourly load variations.

NOMINAL TRAFFIC, IOPS: The average level of I/O requests over the course of a day (24 hours), taking into account hourly load variations.

NOMINAL IOPS/W: The overall efficiency with which I/O requests can be supported, reflected by the ratio of **NOMINAL TRAFFIC** versus the **NOMINAL POWER**.

COMPOSITE METRICS: The aggregated **NOMINAL POWER**, **NOMINAL TRAFFIC**, and **NOMINAL IOPS/W** for all three environments: **LOW**, **MEDIUM**, and **HIGH DAILY USAGE**.

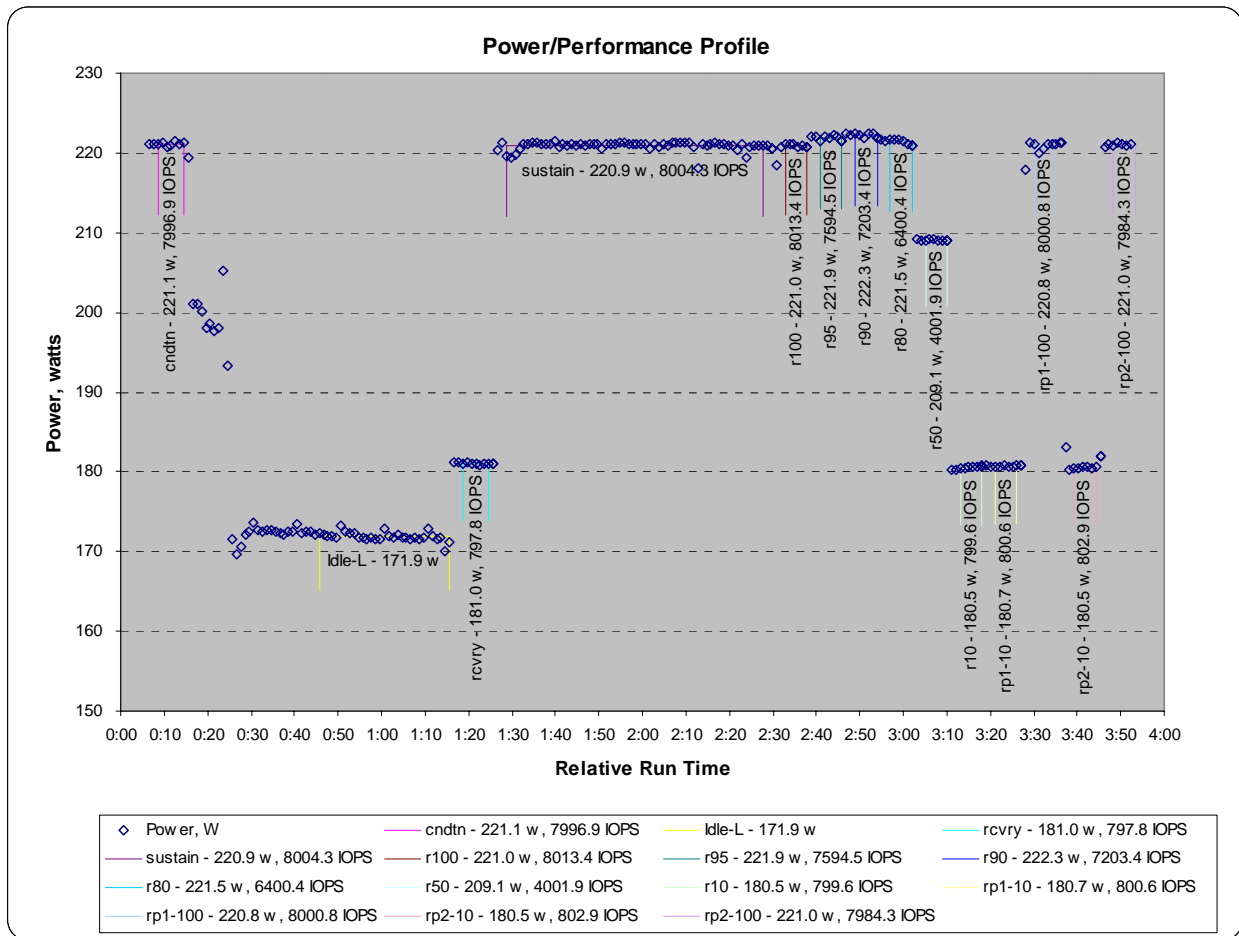
ANNUAL ENERGY USE, KWH: An estimate of the average energy use across the three environments over the course of a year and computed as (**NOMINAL POWER** * 24 * 0.365).

ENERGY COST, \$/kWh: A standardized energy cost per kilowatt hour.

ANNUAL ENERGY COST: An estimate of the annual energy use across the three environments over the course of a year and computed as (ANNUAL ENERGY USE * ENERGY COST).

SPC-1C/E Power/Performance Profile

The SPC-1C/E Power/Performance Profile chart provides a complete “at a glance” illustration and report for each SPC-1C/E execution component. The power consumption at each step is reported and, where appropriate the measured SPC-1C performance (*SPC-1C IOPS*) is also reported.



Tested Storage Configuration Pricing (*Priced Storage Configuration*)

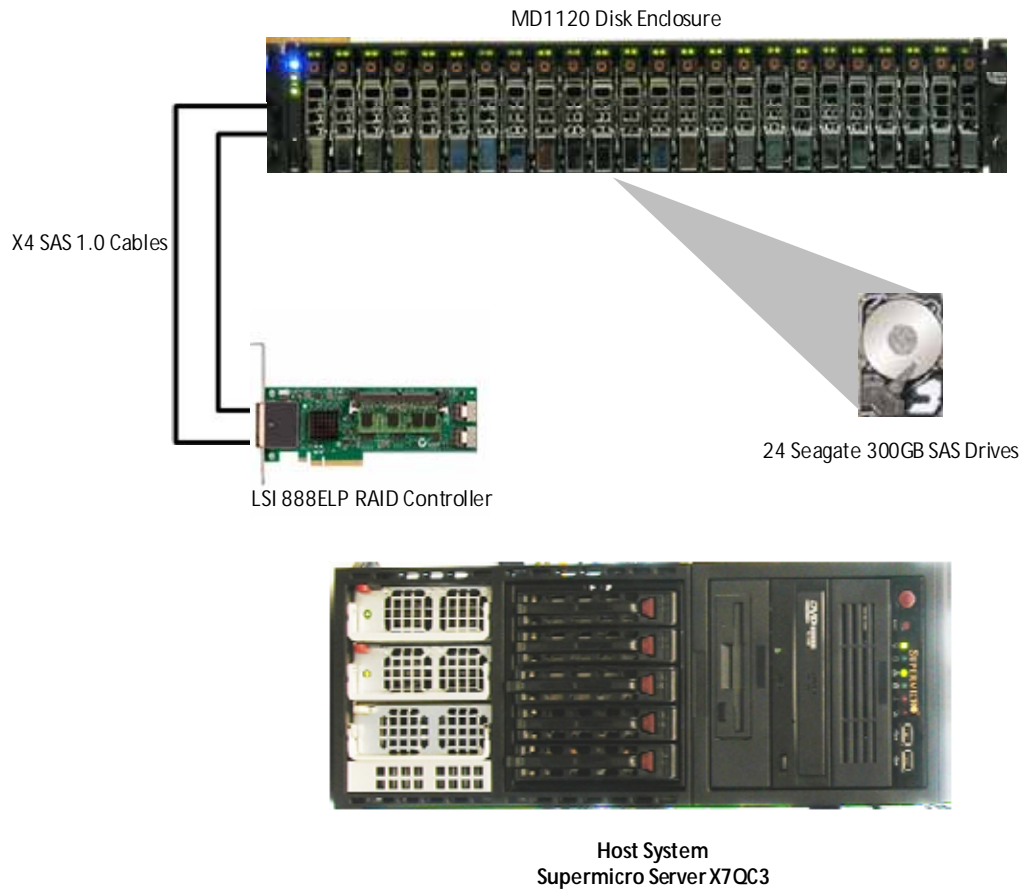
| Description | | Part Numbers | Qty | Price | Extended Price |
|----------------------------------|--------------------|--------------|-----|--------------|-----------------|
| 300GB SAS 2.5" 10K RPM HDD | | ST9300603SS | 24 | \$404 | \$9,689 |
| LSI MegaRAID 8888ELP | <i>third-party</i> | LSI00142 | 1 | \$641 | \$641 |
| 2U 24 bay External Storage Array | <i>third-party</i> | Dell MD1120 | 1 | \$4,878 | \$4,878 |
| incl 2 SAS -2M Cables | | | | | |
| incl 24 drive trays | | | | | |
| incl 3 year hardware support | | | | | |
| | | | | Total | \$15,209 |

The Dell MD1120 Disk Storage Enclosure order is required to include a minimum of two (2) disk drives. Those two drives were removed from the enclosure and replaced by the twenty-four (24) priced disk drives for the benchmark execution.

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

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

Benchmark Configuration/Tested Storage Configuration Diagram



Benchmark Configuration/Tested Storage Configuration Components

| Host System: | Tested Storage Configuration (TSC): |
|---|---|
| Supermicro Server X7QC3 2 – 2.66 GHz Intel Xeon processors 6 cores per processor 2 x 32 KB L1 cache 2 x 3 MB L2 cache | 1 – LSI MegaRaid 8888ELP RAID external controller with: 512 MB cache 1 - x8 PCIe 1.0 host connection 2 - 3 Gb/s SAS 1.0 disk connections |
| 8 GB main memory | 1 – Dell PowerVault MD1120 Disk Storage Enclosure with 2 – 2x 2m SAS cables |
| Windows 2003 Standard Edition SP2 | |
| PCIe 1.0 | 24 – Seagate Savvio® 300 GB 2.5” SAS disks |