SPC BENCHMARK 1™

EXECUTIVE SUMMARY

IBM CORPORATION
IBM SYSTEM STORAGE® DS3524 EXPRESS

SPC-1 V1.12

Submitted for Review: December 31, 2010
Submission Identifier: A00101

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	IBM Corporation – http://www.ibm.com Bruce McNutt – bmcnutt@us.ibm.com 650 Harry Road C2 500 San Jose, CA 95120 Phone: (408) 927-2717 FAX: 0086 28 62905793
Test Sponsor Alternate Contact	IBM Corporation – http://www.ibm.com Vernon Miller – millerv@us.ibm.com KBV/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-4849 FAX: (520) 799-5550
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	December 31, 2010
Date the FDR was submitted to the SPC	December 31, 2010
Date the priced storage configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	December 30, 2010

Tested Storage Product (TSP) Description

The IBM System Storage DS3500 Express Storage Systems and EXP3500 Express Expansion Units are the newest addition to the IBM System Storage DS3000 series family of entry disk storage systems. The DS3500 delivers affordable, entry-level configurations for small and medium businesses in compact 2U, 19-inch rack mount enclosures, with the flexibility to scale in capacity, performance, host interfaces, and functions as your business grows or requirements change.

Summary of Results

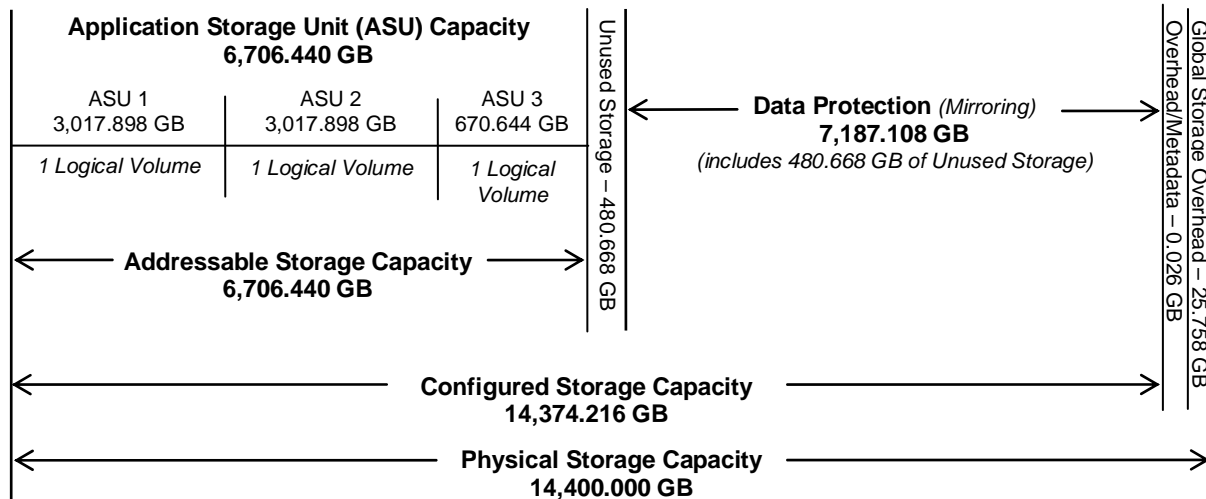| SPC-1 Results	
Tested Storage Configuration (TSC) Name: IBM System Storage® DS3524 Express	
Metric	**Reported Result**
SPC-1 IOPS™	14,797.26
SPC-1 Price-Performance	$3.26/SPC-1 IOPS™
Total ASU Capacity	6,706.440 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$48,310.00

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 ***Mirroring*** configures two or more identical copies of user data.

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.

```
Application Storage Unit (ASU) Capacity          Unused Storage – 480.668 GB        Data Protection (Mirroring)        Global Storage Overhead/Metadata – 0.026 GB / 25.758 GB
6,706.440 GB                                                                        7,187.108 GB
                                                                                    (includes 480.668 GB of Unused Storage)
ASU 1              ASU 2              ASU 3
3,017.898 GB       3,017.898 GB       670.644 GB

1 Logical Volume   1 Logical Volume   1 Logical
                                      Volume

        Addressable Storage Capacity
              6,706.440 GB

                    Configured Storage Capacity
                          14,374.216 GB

                    Physical Storage Capacity
                          14,400.000 GB
```

SPC-1 Storage Capacity Utilization	
Application Utilization	46.57%
Protected Application Utilization	93.15%
Unused Storage Ratio	6.68%

Application Utilization: Application Utilization: Total ASU Capacity *(6,706.440 GB)* divided by Physical Storage Capacity *(14,440.000 GB)*

Protected Application Utilization: (Total ASU Capacity *(6,706.440 GB)* plus total Data Protection Capacity *(7,187.108 GB)* minus unused Data Protection Capacity *(480.668 GB)* divided by Physical Storage Capacity *(14,440.000 GB)*
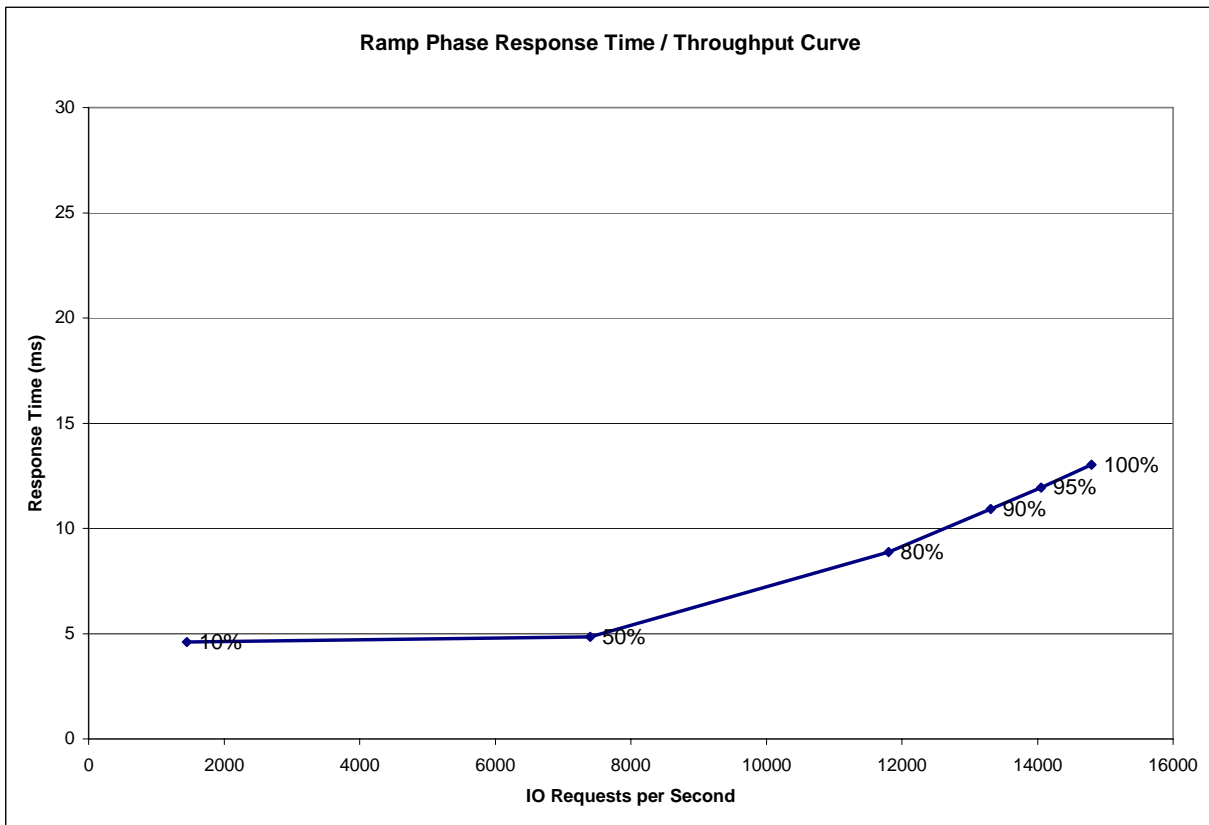
Unused Storage Ratio: Total Unused Capacity *(961.335 GB)* divided by Physical Storage Capacity *(14,440.000 GB)* and may not exceed 45%.

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	1,451.32	7,401.76	11,800.50	13,308.46	14,057.16	14,797.26
Average Response Time (ms):						
All ASUs	4.61	4.84	8.87	10.93	11.95	13.02
ASU-1	4.49	6.44	10.98	13.09	14.15	15.27
ASU-2	6.03	6.78	17.06	23.38	26.42	29.60
ASU-3	4.25	0.59	0.81	0.89	0.94	0.98
Reads	6.69	11.41	21.27	26.35	28.87	31.51
Writes	3.26	0.57	0.79	0.87	0.92	0.97

Priced Storage Configuration Pricing

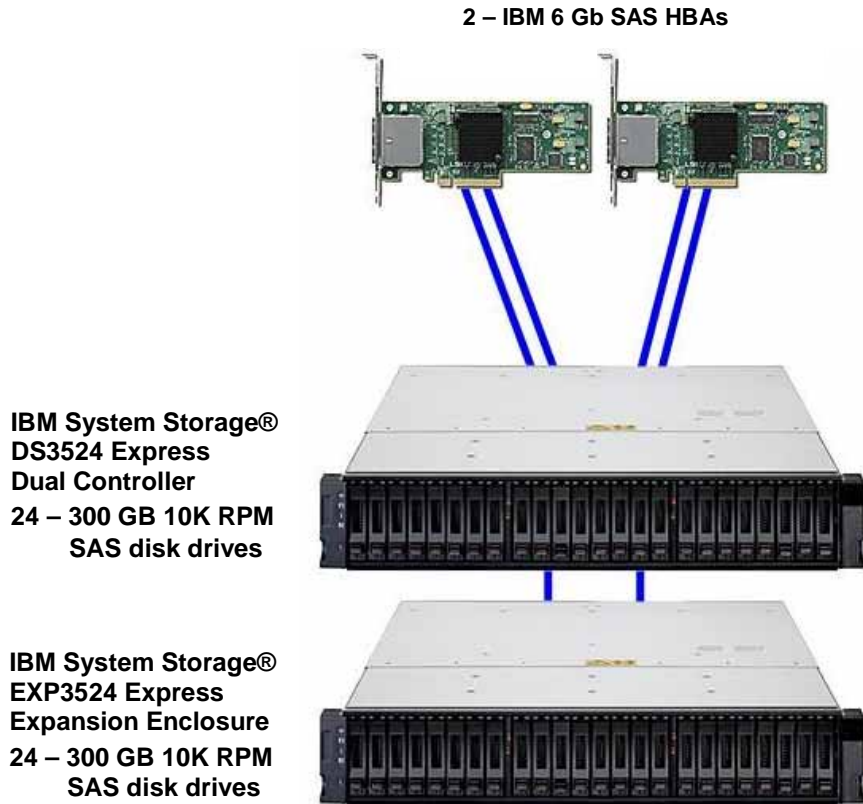| Item	IBM Description	Feature Code (4 digits) or Part Number (7 digits)	Qty	Unit Price (usd)	Total (usd)
HBA	IBM 6Gb SAS HBA	46M0907	2	$ 199.00	$ 398.00
Storage System	IBM System Storage DS3524 Express Dual Controller	2812	1	$ 9,299.00	$ 9,299.00
Memory	2 GB cache upgrade	3630	2	$ 2,499.00	$ 4,998.00
Expansion Unit	IBM System Storage EXP3524 Express	2822	1	$ 3,999.00	$ 3,999.00
Drives	300GB 10,000 rpm 6Gb SAS 2.5" HDD	5210	48	$ 549.00	$ 26,352.00
Cables	1m SAS Cable	3708	6	$ 119.00	$ 714.00
Maintenance and Warranty	DS3524 3 Year Onsite Repair 24x7 4 Hour Response	67567DT	1	$ 1,350.00	$ 1,350.00
Maintenance and Warranty	EXP3524 3 Year Onsite Repair 24x7 4 Hour Response	67567F3	1	$ 1,200.00	$ 1,200.00
				Total Price List (usd)	$ 48,310.00

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

The difference between the Tested Storage Configuration and Priced Storage Configuration is that the priced disk drives are mounted in an IBM drive carrier and each disk drive is configured to self-identify as a DS3000 brand. That difference, if applied to the TSC, would not have a negative impact on the reported SPC-1 performance.

Priced Storage Configuration Diagram

2 – IBM 6 Gb SAS HBAs

**IBM System Storage®
DS3524 Express
Dual Controller**

**24 – 300 GB 10K RPM
SAS disk drives**

**IBM System Storage®
EXP3524 Express
Expansion Enclosure**

**24 – 300 GB 10K RPM
SAS disk drives**

Priced Storage Configuration Components

Priced Storage Configuration
2 – IBM 6 Gb dual-ported SAS HBAs
IBM System Storage® DS3524 Express   **IBM System Storage® DS3524 Express dual controller with:** 　　2 GB cache per controller *(4 GB total)* 　　2 – 6 Gb SAS host connections per controller 　　　*(4 total, 4 used)* 　　1 – 6 Gb SAS drive connections per controller 　　　*(2 total, 2 used)*
6 – 1m SAS cables
1 – IBM System Storage® EXP3524 Express expansion unit
48 – 300 GB 10K RPM SAS disk drives 　　24 disk drives in the base unit 　　24 disk drives in the expansion enclosure