SPC BENCHMARK 2™

EXECUTIVE SUMMARY

IBM CORPORATION

IBM SYSTEM STORAGE
SAN VOLUME CONTROLLER V6.4
WITH IBM STORWIZE® V7000 DISK STORAGE

SPC-2™ V1.3

Submitted for Review: August 1, 2012
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EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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Revision Information and Key Dates

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SPC-2 Specification revision number	V1.3
SPC-2 Workload Generator revision number	V1.0
Date Results were first used publicly	August 1, 2012
Date FDR was submitted to the SPC	August 1, 2012
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	July 31, 2012

Tested Storage Product (TSP) Description

The IBM System Storage SAN Volume Controller (SVC) enables a single point of control for disparate, heterogeneous storage resources to help support improved business application availability and greater resource utilization. SAN Volume Controller is designed to pool storage volumes from IBM and non-IBM storage systems into a single reservoir of capacity for centralized management.

SVC Version 6.4 is the latest level of software, implemented using CG8 storage engines. Each CG8 storage engine is equipped with 24 GB of cache and four 8 Gbps fibre channel ports. The storage engine also features the optional capability, to add 10 Gbps Ethernet or SSD drives managed with EasyTier.

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				
IBM SAN Volume Controller v6.4 w/IBM Storwize® V7000 disk storage				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
14,581.03	$129.14	74,491.913	$1,883,036.58	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	13,309.02			$141.49
Write Only:				
1024 KiB Transfer	9,719.50	256	37.97	
256 KiB Transfer	9,352.97	256	36.54	
Read-Write:				
1024 KiB Transfer	12,303.82	256	48.06	
256 KiB Transfer	12,207.29	256	47.68	
Read Only:				
1024 KiB Transfer	17,962.89	128	140.34	
256 KiB Transfer	18,307.67	128	143.03	
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	17,851.22			$105.49
1024 KiB Transfer Size				
4 I/Os Outstanding	17,039.33	128	133.12	
1 I/O Outstanding	17,889.36	128	139.76	
64 KiB Transfer Size				
4 I/Os Outstanding	18,015.02	128	140.74	
1 I/O Outstanding	18,461.17	256	72.11	
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**
	12,582.86	16,000	0.79	$149.65

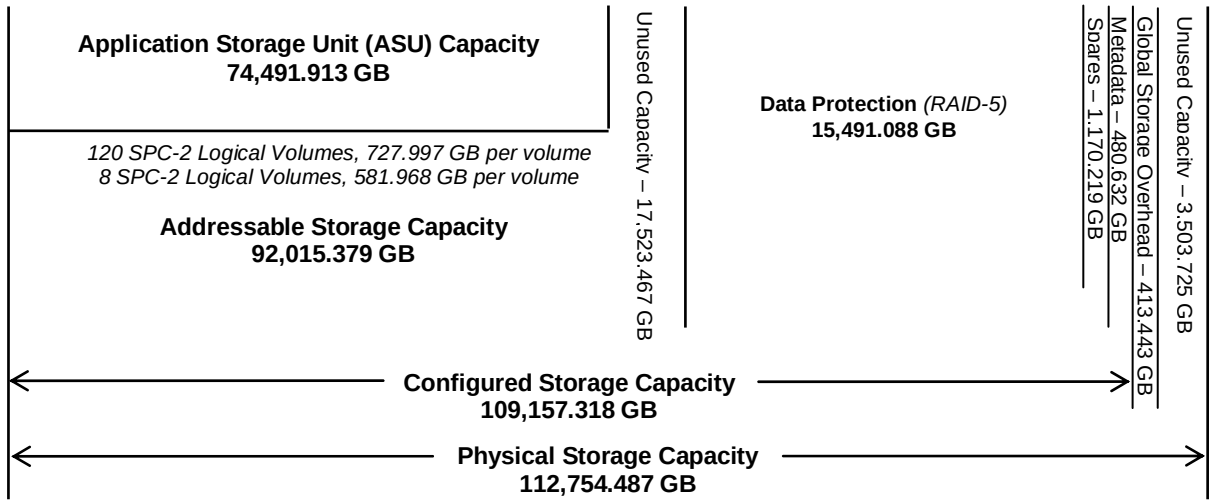
SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

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)* 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	66.07%
Protected Application Utilization	79.80%
Unused Storage Ratio	18.36%

Application Utilization: Total ASU Capacity *(74,491.913 GB)* divided by Physical Storage Capacity *(112,754.487 GB)*

Protected Application Utilization: Total ASU Capacity *(74,491.913 GB)* plus total Data Protection Capacity *(15,491.088 GB)* minus unused Data Protection Capacity *(0.000 GB)* divided by Physical Storage Capacity *(112,754.487 GB)*.

Unused Storage Ratio: Total Unused Capacity *(20,707.192 GB)* divided by Physical Storage Capacity *(112,754.487 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 23-24 in the Full Disclosure Report.

Priced Storage Configuration Pricing

Component	Quantity	Unit Price	Unit Maint	List w/ Maint	% discount	Total Price
SVC 3550 Storage Engine (2145-CG8)	8	16,500.00	2,616.00	152,928.00	39	93,286.08
UPS (2145-CG8 8115)	8	1,000.00	1,656.00	21,248.00	39	12,961.28
SVC Software license (base) up to 100 TB	1	248,280.00	0.00	248,280.00	39	151,450.80
SVC Software maintenance 3 yr SWMA	1	0.00	99,312.00	99,312.00	0	99,312.00
19 inch rack (7014-T42)	3	5,715.00	888.00	19,809.00	50	9,904.50
24 port fibre channel switch (2498-B24) w/ 24 SFP, 24 ports enabled	4	15,940.00	10,800.00	106,960.00	20	85,568.00
V7000 controller (2076-124) w/ 4 SFP, 24x15K RPM, 146 GB	8	51,764.00	3,500.00	442,112.00	39	269,688.32
V7000 expansion (2076-224) w/ 2 SAS cables, 24x15K RPM, 146 GB	24	31,534.00	2,016.00	805,200.00	39	491,172.00
V7000 base software for Cont. + Exp.	32	18,000.00	0.00	576,000.00	39	351,360.00
V7000 software maintenance 3 yr SWMA	32	0.00	7,200.00	230,400.00	0	230,400.00
Ethernet switch 78Y6611	2	320.00	60.00	760.00	20	608.00
1m fibre channel cable (2076-124 5301)	32	79.00	0.00	2,528.00	20	2,022.40
5m fibre channel cable (2076-124 5305)	32	129.00	0.00	4,128.00	20	3,302.40
25m fibre channel cable (2076-124 5625)	32	189.00	0.00	6,048.00	20	4,838.40
14ft ethernet cable (30R-6650)	30	7.00	0.00	210.00	20	168.00
8 Gbps dual port FC adapter (9117-5735)	24	4,583.00	0.00	109,992.00	30	76,994.40
Total Price						**1,883,036.58**

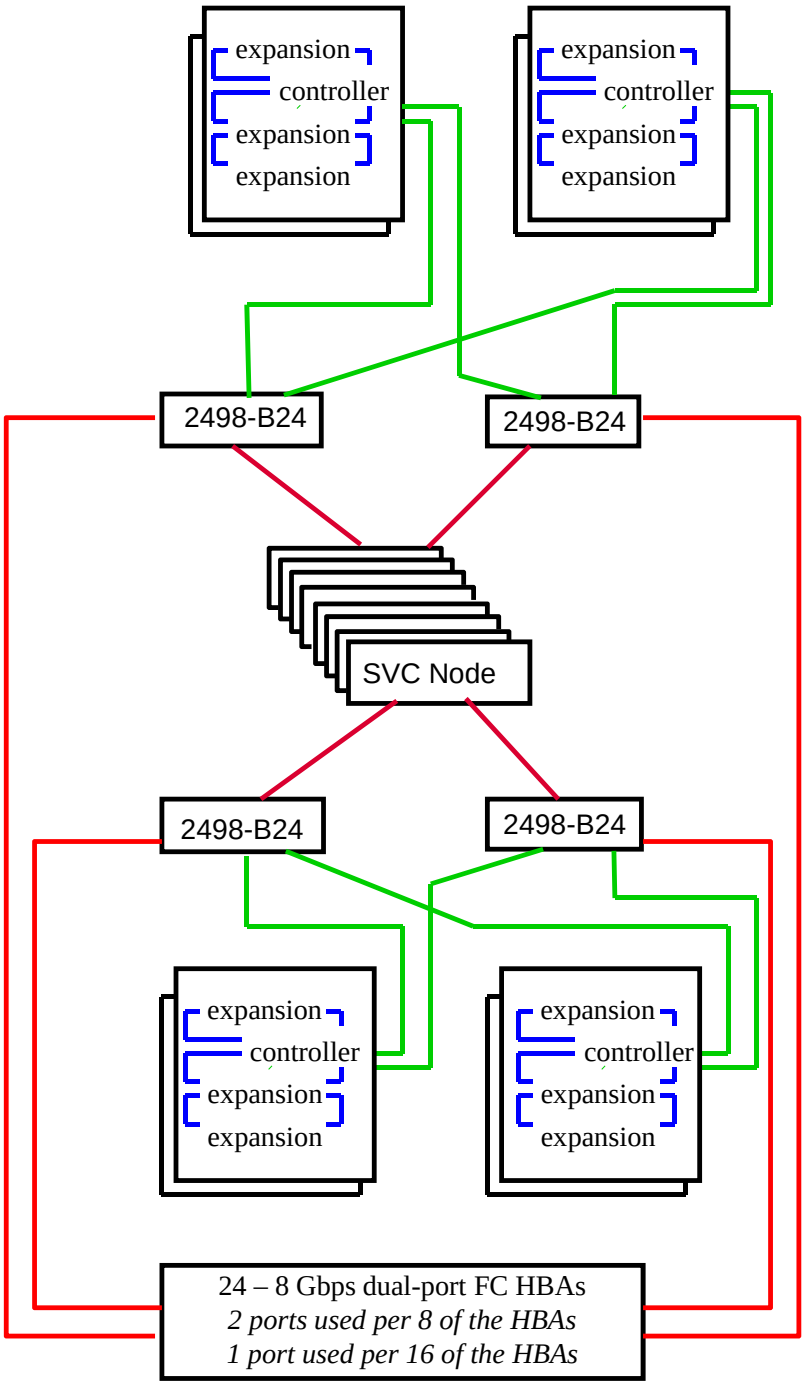
The following pricing includes the following:

- 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.

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.

Priced Storage Configuration Diagram



SVC Node:
8 – SAN Volume Controller nodes
(each node manages all storage as a single image}

2498-B24:
4 – 24-port FC switches
(each switch has one zone for node-to-storage traffic and two zones for node-to-host traffic)

controller:
8 – V7000 Controllers
(each controller has 24 disks)

expansion:
24 – V7000 Expansion Enclosures
(each enclosure has 24 disks)

768 – 146 GB, 15K RPM disks

Priced Configuration Components

Priced Storage Configuration:
24 – 8 Gbps dual port FC HBAs
IBM System Storage SAN Volume Controller ***(8 node SVC 6.4 cluster)*** Each SVC node includes: 24 GB cache 4 – 8 Gbps FC connections *(all 4 used for both node to Host System and node to V7000 connectivity)*
8 – IBM Storwize® V7000 each with 2 nodes Each V7000 includes: 1 – V7000 Controller with 16 GB cache, 4 SFPs 24 – 2.5” 146 GB, 15K RPM disk drives 2 – front-end 8 Gbps FC connections *(2 used)* 4 – SAS backend 4x6Gbps connections *(4 used)* 4 – V7000 Expansion Enclosures each with 24 – 2.5” 146 GB, 15K RPM disk drives
768 – 2.5” 146 GB, 15K RPM disk drives *(distributed between V7000 Controllers and Expansion Enclosures as described above)*
4 – 24 port Fibre Channel switches each with 24 ports enabled and 24 SFPs
2 – Ethernet switches
8 – UPS *(SVC backup)*
3 – 19 inch racks