SPC BENCHMARK 1™

EXECUTIVE SUMMARY

HITACHI DATA SYSTEMS CORPORATION

HITACHI UNIFIED STORAGE VM

(WITH HITACHI ACCELERATED FLASH)

SPC-1 V1.14

Submitted for Review: June 17, 2014
Submission Identifier: A00145

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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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	V1.14
SPC-1 Workload Generator revision number	V2.3.0
Date Results were first used publicly	June 17, 2014
Date the FDR was submitted to the SPC	June 17, 2014
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	June 16, 2014

Tested Storage Product (TSP) Description

Hitachi Unified Storage VM eases the management of information. It manages all of your existing storage and consolidates all of your data in a single, virtualized platform. Hitachi Unified Storage VM is built with trusted Hitachi reliability for application availability, flash-accelerated performance and lower cost of ownership. Delivering enterprise storage virtualization in a unified platform lets you manage information more efficiently.

HUS VM places emphasis on high availability with non-disruptive microcode and hardware upgrades, automatic failover architecture with redundant, hot-swappable components, dual data paths and dual control paths and nonvolatile backup of cache using a combination of battery and flash disk drives. Universal data replication can be provided for local and remote data protection across multiple data centers.

Intelligent, controller-based storage virtualization provides a platform for aggregating all storage services for multivendor storage systems. Host-transparent movement, copy and migration of data between storage is enabled with reduced interruption of applications. Hitachi Command Suite provides the software management platform for advanced data and storage management that helps improve administration, operations, provisioning, performance and resilience.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Hitachi Unified Storage VM *(with Hitachi Accelerated Flash)*	
Metric	**Reported Result**
SPC-1 IOPS™	304,127.12
SPC-1 Price-Performance™	$1.18/SPC-1 IOPS™
Total ASU Capacity	9,851.581 GB
Data Protection Level	Protected 2 *(mirroring)*
Total Price	$360,190.52
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

SPC-1 Price-Performance™ is the ratio of **Total Price** to **SPC-1 IOPS™**.

Total ASU (Application Storage Unit) **Capacity** represents the total storage capacity available to be read and written in the course of executing the SPC-1 benchmark.

A **Data Protection Level** of **Protected 2** using ***Mirroring*** configures two or more identical copies of user data..

> ***Protected 2:*** *The single point of failure of any* ***component*** *in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.*

Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 9.

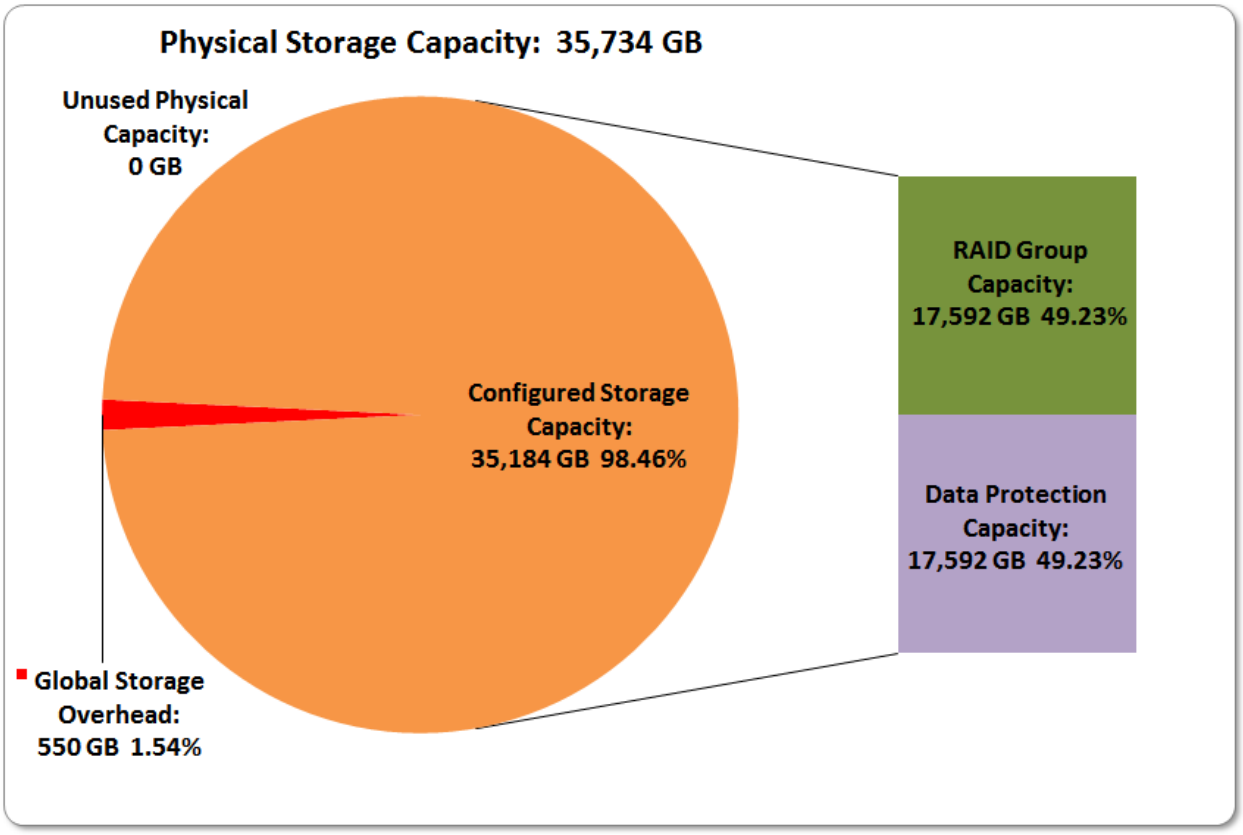
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

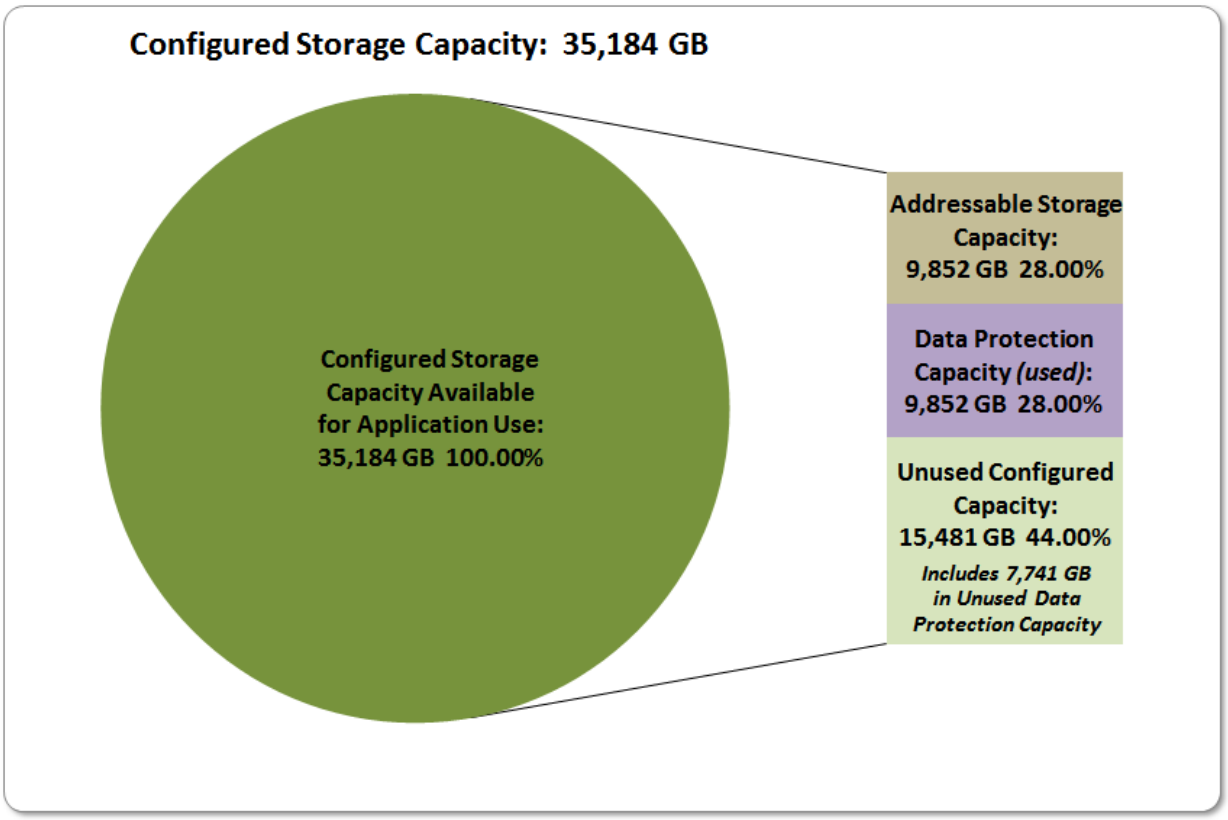
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

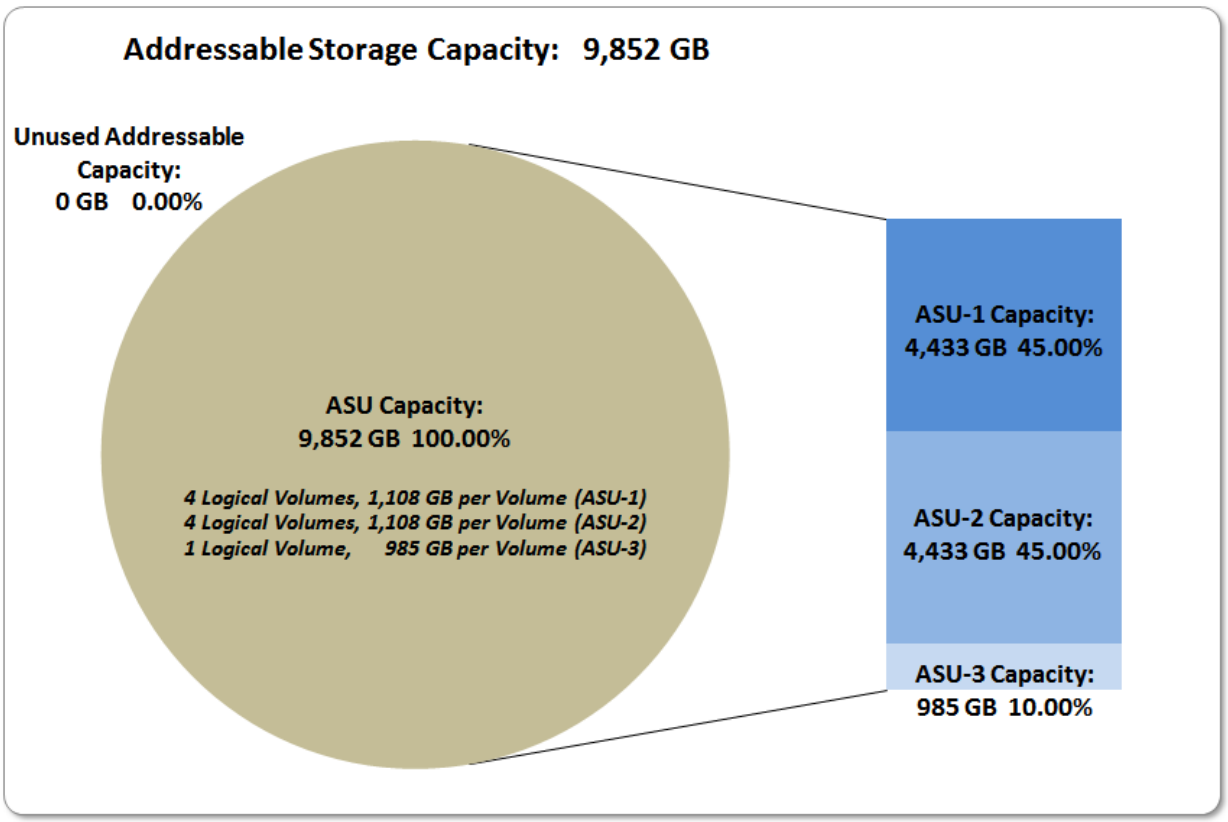
Storage Capacities, Relationships, and Utilization

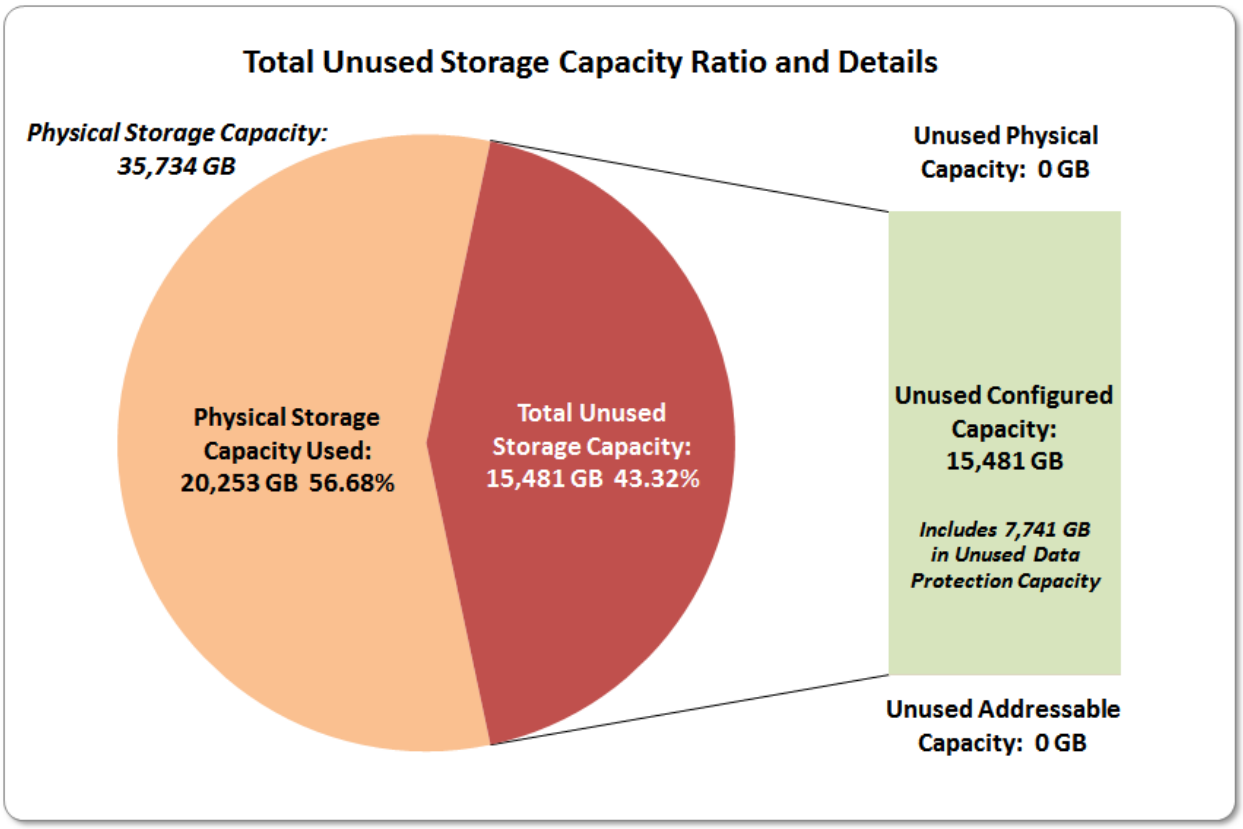
The following four charts and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.

The capacity values in each of the following four charts are listed as integer values, for readability, rather than the decimal values listed elsewhere in this document.




Configured Storage Capacity: 35,184 GB
Configured Storage Capacity Available for Application Use: 35,184 GB 100.00%
Addressable Storage Capacity: 9,852 GB 28.00%
Data Protection Capacity (used): 9,852 GB 28.00%
Unused Configured Capacity: 15,481 GB 44.00%
Includes 7,741 GB in Unused Data Protection Capacity


Addressable Storage Capacity: 9,852 GB
Unused Addressable Capacity: 0 GB 0.00%
ASU Capacity: 9,852 GB 100.00%
4 Logical Volumes, 1,108 GB per Volume (ASU-1)
4 Logical Volumes, 1,108 GB per Volume (ASU-2)
1 Logical Volume, 985 GB per Volume (ASU-3)
ASU-1 Capacity: 4,433 GB 45.00%
ASU-2 Capacity: 4,433 GB 45.00%
ASU-3 Capacity: 985 GB 10.00%



SPC-1 Storage Capacity Utilization	
Application Utilization	27.57%
Protected Application Utilization	55.14%
Unused Storage Ratio	43.32%

Application Utilization: Total ASU Capacity *(9,851.581 GB)* divided by Physical Storage Capacity *(35,734.094 GB)*.

Protected Application Utilization: (Total ASU Capacity *(9,851.581 GB)* plus total Data Protection Capacity *(17,592.167 GB)* minus unused Data Protection Capacity *(7,740.585 GB)*) divided by Physical Storage Capacity *(35,734.094 GB)*.

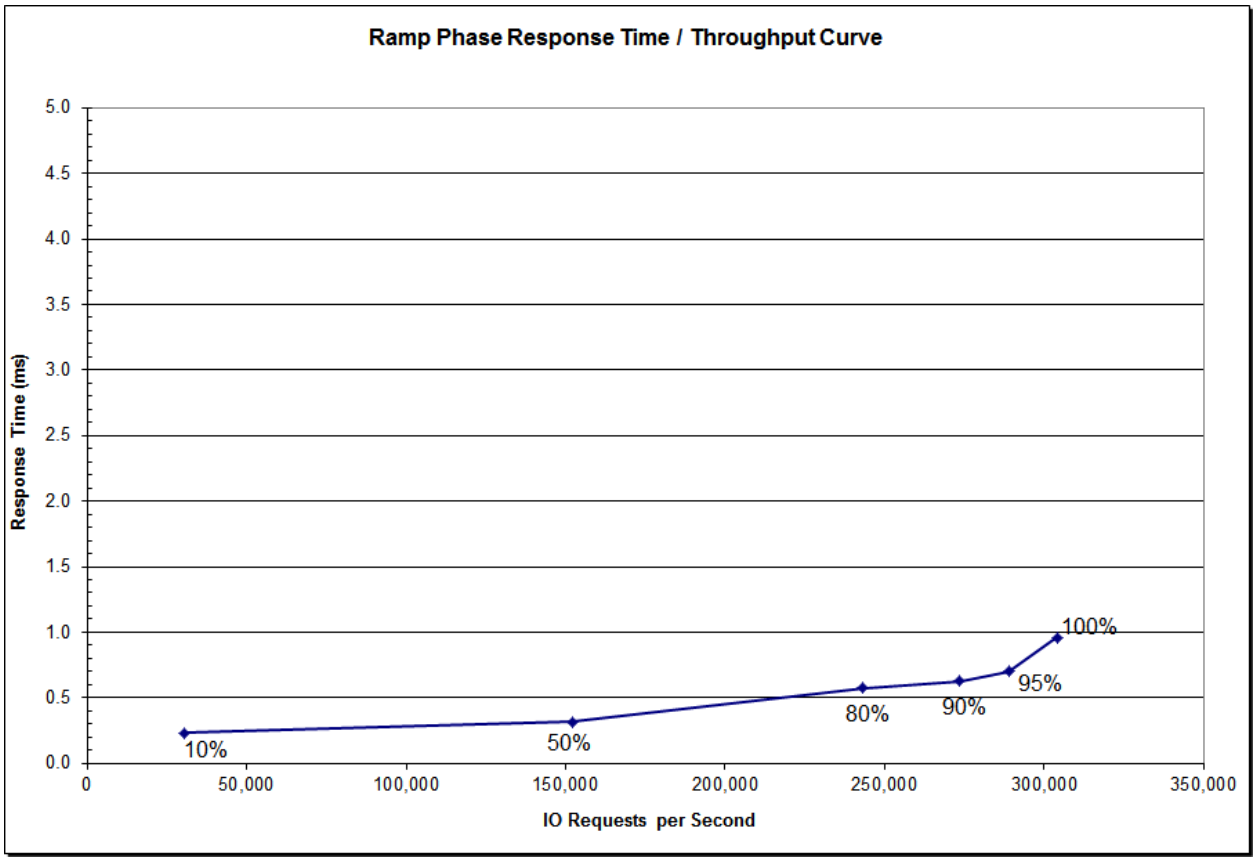
Unused Storage Ratio: Total Unused Capacity *(GB)* divided by Physical Storage Capacity *(35,734.094 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 27-28 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	30,400.59	152,071.60	243,276.72	273,618.15	288,840.88	304,127.12
Average Response Time (ms):						
All ASUs	0.23	0.32	0.57	0.63	0.70	0.96
ASU-1	0.27	0.37	0.66	0.73	0.82	1.11
ASU-2	0.22	0.30	0.55	0.61	0.67	0.93
ASU-3	0.17	0.21	0.41	0.42	0.47	0.66
Reads	0.34	0.50	0.85	0.97	1.08	1.45
Writes	0.16	0.20	0.39	0.40	0.45	0.64

Priced Storage Configuration Pricing

Product Description	Qty	Unit List Price	Product List Price
Hitachi Unified Storage VM Microcode Kit	1	$0.00	$0.00
Hitachi Unified Storage VM Product Documentation Library	1	$0.00	$0.00
Dummy FMD	4	$0.00	$0.00
Universal rail kit	1	$239.00	$239.00
Minkels Universal Rack 600x1200x2010 mm (WxDxH) 42U	1	$4,474.00	$4,474.00
Left Corner Guide Rail 740 mm Depth	2	$21.00	$42.00
Right Corner Guide Rail 740 mm Depth	2	$21.00	$42.00
Side Panel 1200 mm Depth (qty 1)	2	$292.00	$584.00
4GB USB memory stick with lanyard	1	$102.00	$102.00
HUS VM 16GB Cache Module	16	$4,295.00	$68,720.00
HUS VM Cache Flash Memory Module (supports 256GB)	1	$19,776.00	$19,776.00
HUS VM B/E I/O Module	4	$1,393.00	$5,572.00
HUS VM Drive Box (Flash)	2	$16,056.00	$32,112.00
HUS VM Controller Chassis	1	$74,000.00	$74,000.00
HUS VM 1.6TB Flash Module Drive for Base	20	$28,427.00	$568,540.00
HUS VM 4x8Gbps FC Interface Adapter	8	$3,267.00	$26,136.00
LAN Cable 14ft	1	$0.00	$0.00
RJ-45 Modular In-Line Coupler 6 Conductor	1	$4.00	$4.00
PDU 0RU 10xC13 2xC19 1Phase 208V 30A NEMA L6-30P	4	$781.00	$3,124.00
Power Cable - 208/220V, 1m (3ft)	6	$9.00	$54.00
Brocade 6510 Switch, 36P, 8Gb SWL SFPs, Rack Kit	2	$30,903.90	$61,807.80
Hardware Components:		---	**$865,328.80**
HUS VM Hitachi Base Operating System 5TB Block License	1	$6,500.00	$6,500.00
HUS VM BOS flash optimization Base License (20TB)	1	$37,800.00	$37,800.00
Software Components:		---	**$44,300.00**
HUS VM Service Installation	1	$2,750.00	$2,750.00
HUS VM Hardware Maintenance Support - Includes 3 years of Standard Support (24 x 7 x 4 hour response)	1	$7,817.76	$7,817.76
HUS VM Storage Software Support - Includes 3 years of Standard Support	1	$19,935.00	$19,935.00
Brocade 6510 Service Installation	1	$250.00	$250.00
Brocade 6510 Hardware Maintenance Support - Includes 3 years of Standard Support	2	$3,150.00	$6,300.00
Installation and Support:		---	**$37,052.76**
Emulex LightPulse Dual Port Fibre Channel Host Bus Adapter LPE12002-M8	8	$550.00	$4,400.00
Fibre Channel Cables	32	$11.49	$367.68
Third Party Components:		---	**$4,767.68**

Hardware Components	**$865,328.80**	**65%**	**$302,865.08**
Software Components	**$44,300.00**	**65%**	**$15,505.00**
Installation & Support	**$37,052.76**	**0%**	**$37,052.76**
Third Party Components	**$4,767.68**	**0%**	**$4,767.68**
Total:			**$360,190.52**

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 within four (4) hours.
- Onsite presence 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 Priced 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

A second 36-port FC switch was included in the Priced Storage Configuration as a spare to fulfill one of the requirements for a data protection level of **Protected 2**. If that second switch was added to the TSC, there would be no impact on the measured SPC-1 performance.

Priced Storage Configuration Diagram

8 - Emulex LPe12002 dual-port 8 Gb FC HBAs

• • • *16 - 8 Gbps FC connections*

Brocade 6510 36-port 16 Gb FC Switch

• • • *16 - 8 Gbps FC connections*

Hitachi Unified Storage VM
(with Hitachi Accelerated Flash)

1 HiStar-based storage controller with:
- 2 Cache blades with:
  - 128 GB cache per blade *(256 GB total)*
  - 128 GB flash per blade for cache backup *(256 GB total)*
- 2 Processor blades with:
  - 8 GB of local memory per blade *(16 GB total)*

8 - FC Host Modules
(4 – 8 Gbps ports per module, 32 ports total)

4 - SAS I/O Modules
(2 – 4x6 Gbps ports per module)
(4 – 6 Gbps links per port)
(8 links per SAS I/O module, 32 total)

2 - Flash Module Drive Enclosures

20 - 1.6 TB Flash Module Drives (FMDs)
(10 FMDs per Flash Module Drive Enclosure)

1 - 19" Rack with PDUs

Priced Storage Configuration Components

Priced Storage Configuration:
8 – Emulex LightPulse LPe12002-M8 8Gbps dual port FC HBAs
2 – Brocade 6510 FC switch, 32 active ports, 32 8Gb SFPs *(a second switch was included to serve as a spare)*
Hitachi Unified Storage VM *(with Hitachi Accelerated Flash)* 1 HiStar-based storage controller with: 2 Cache blades with: 128 GB cache per blade *(256 GB total)* 128 GB flash for cache backup per blade *(256 GB total)* 1 flash battery per blade *(2 total)* 2 Processor blades with 8 GB of local memory per blade *(16 GB total)* 8 – FC Host Modules *(4 – 8 Gbps ports per module)* *(16 ports per blade, 32 ports total)* *(8 ports used per blade, 16 total used)* 4 – SAS I/O Modules *(2 – 4x6Gbps ports per module)* *(4 – 1x6Gbps links per port)* *(8 links per module, 32 total links, 16 links used)*
2 – Flash Module Drive Enclosures
20 – 1.6 TB Flash Module Drives (FMDs) *(10 FMDs per Flash Module Drive Enclosure)*
1 – 19” rack with PDUs