



SPC BENCHMARK 1™

EXECUTIVE SUMMARY

HITACHI DATA SYSTEMS CORPORATION
HITACHI VIRTUAL STORAGE PLATFORM G1000
(WITH HITACHI ACCELERATED FLASH)

SPC-1 V1.14

Submitted for Review: February 19, 2015

Submission Identifier: A00153

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Hitachi Data Systems Corporation – http://www.hds.com James Byun – james.byun@hds.com 2845 Lafayette Street, MS3275 Santa Clara, CA 95050 Phone: (408) 970-1391 FAX: (408) 327-3066
Test Sponsor Alternate Contact	Hitachi Data Systems Corporation – http://www.hds.com William Lundin – William.lundin@hds.com 2845 Lafayette Street, MS3275 Santa Clara, CA 95050 Phone: (408) 970-7534 FAX: (408) 327-3066
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	February 19, 2015
Date the FDR was submitted to the SPC	February 19, 2015
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	February 16, 2015

Tested Storage Product (TSP) Description

Hitachi Virtual Storage Platform G1000 provides the always-available, agile and automated foundation needed for a trusted continuous-cloud infrastructure. Powered with Hitachi global storage virtualization and efficient, scalable, high-performance hardware, this combination enables the continuous operations, self-managing policy-driven management, and agile IT demanded by today's new breed of cloud applications.

- Available customer-driven non-disruptive migration removes maintenance windows. Solutions for multiple data centers ensure that data access and replication are maintained while technology refreshes are performed.
- IT productivity is increased with Hitachi Command Suite, which delivers policy-driven, automated and unified management.
- Heterogeneous workload consolidation allows virtual machine density to be increased through advanced multi-tenancy and quality-of-service management. Resource pooling capabilities can be extended to many multivendor physical controllers.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Hitachi Virtual Storage Platform G1000 (with Hitachi Accelerated Flash)	
Metric	Reported Result
SPC-1 IOPS™	2,004,941.89
SPC-1 Price-Performance™	\$1.00/SPC-1 IOPS™
Total ASU Capacity	30,962.247 GB
Data Protection Level	Protected 2 (mirroring)
Total Price	\$2,003,803.84
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.

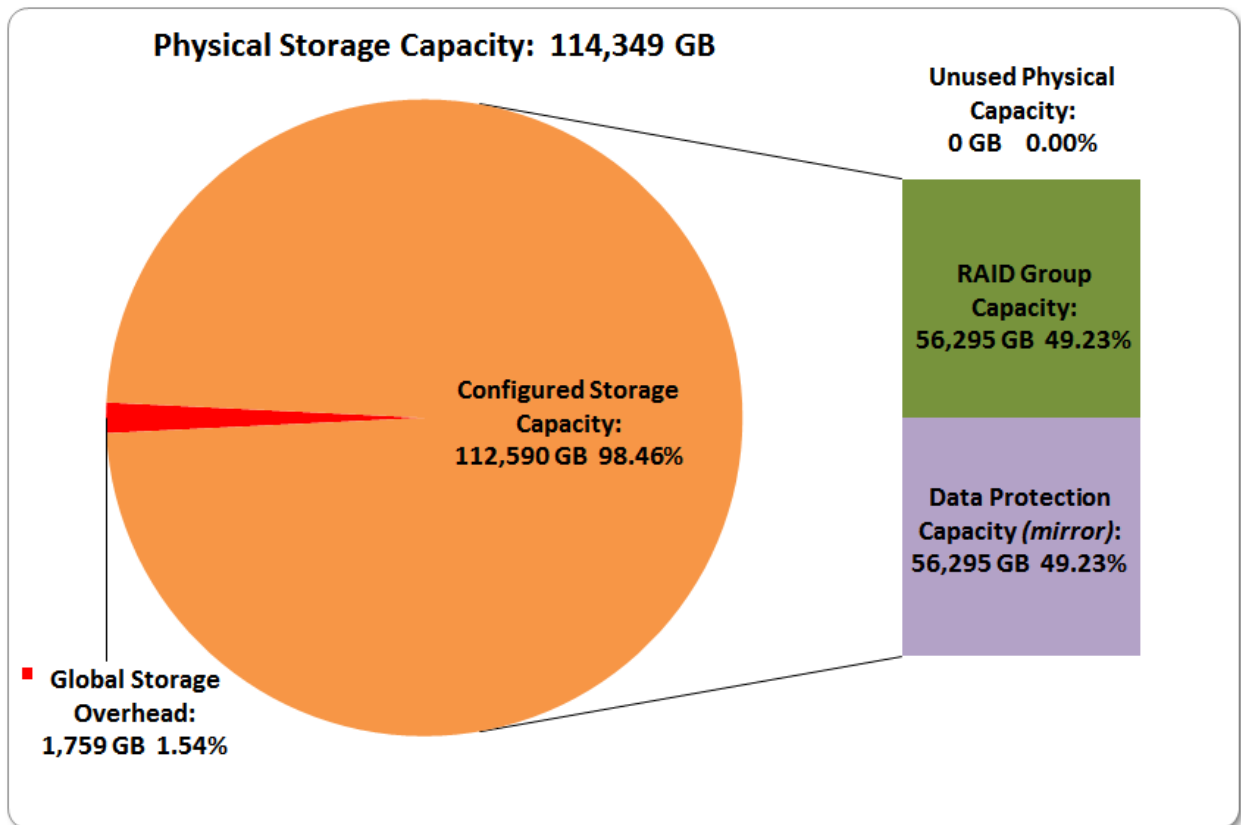
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country (*non-local currency*).

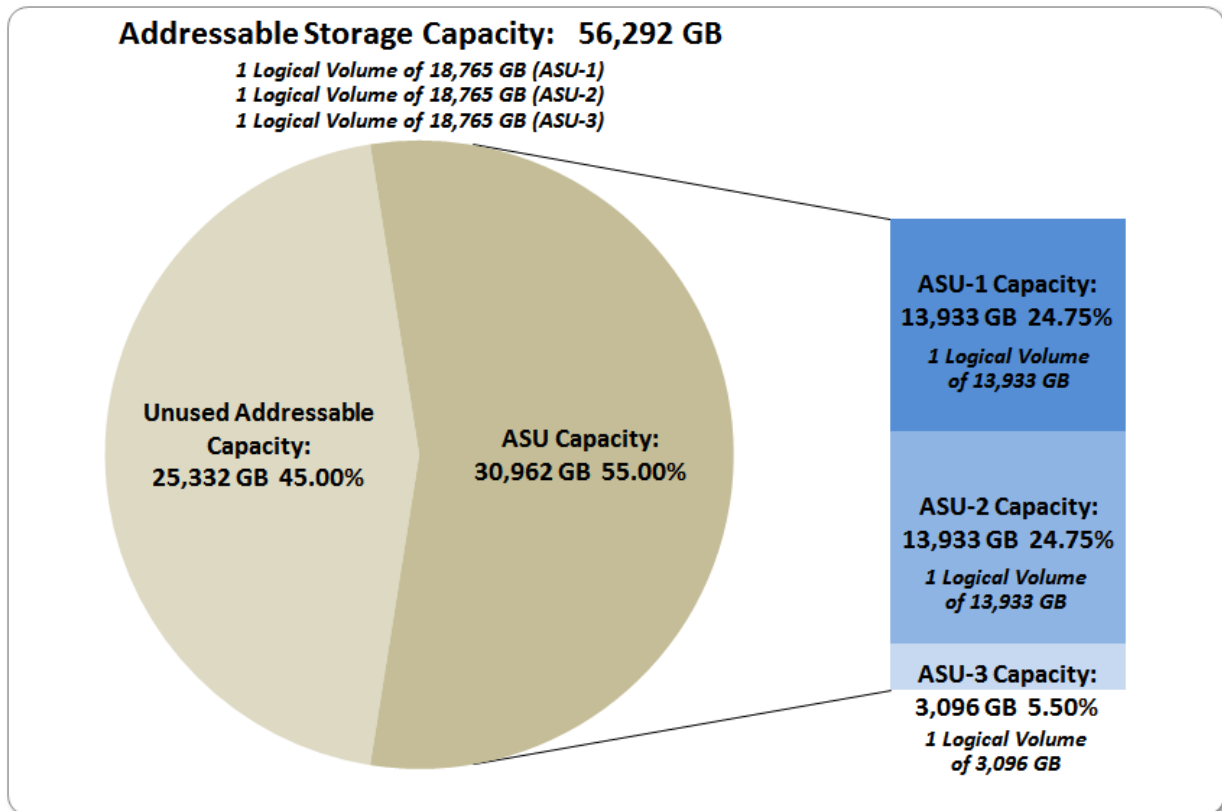
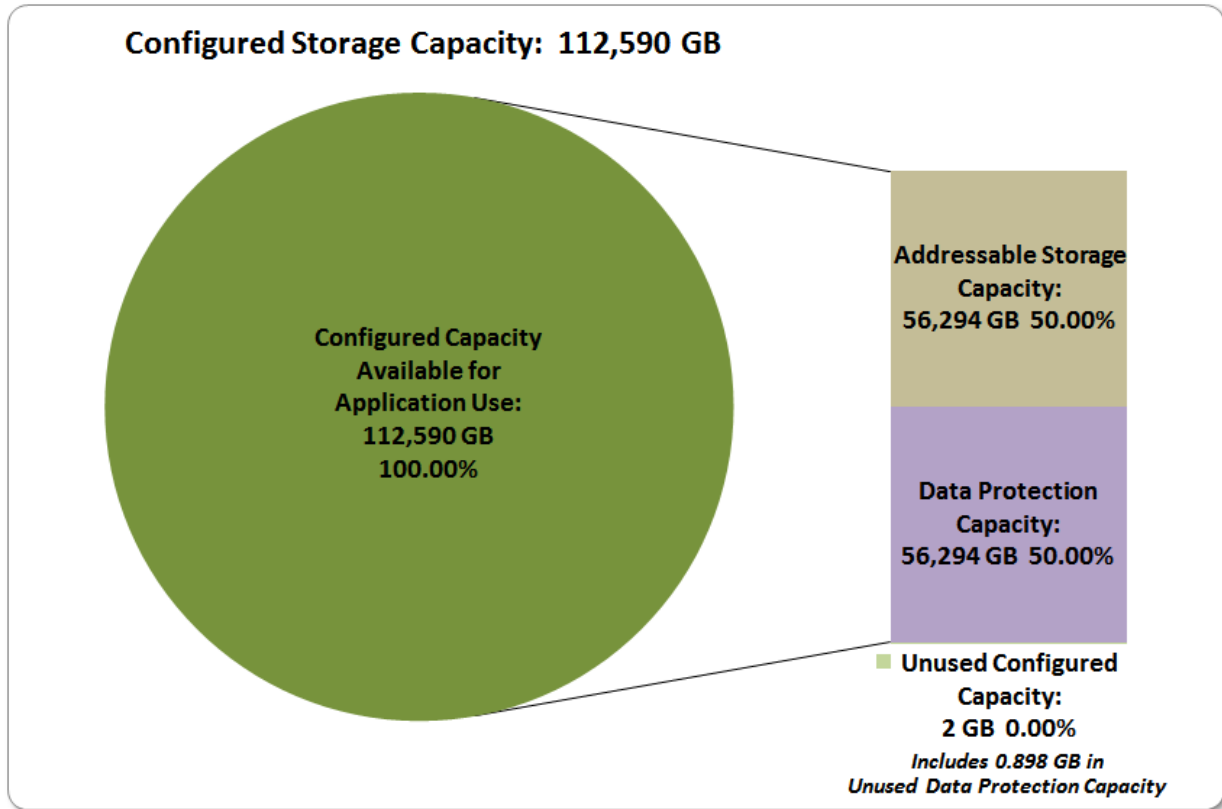
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

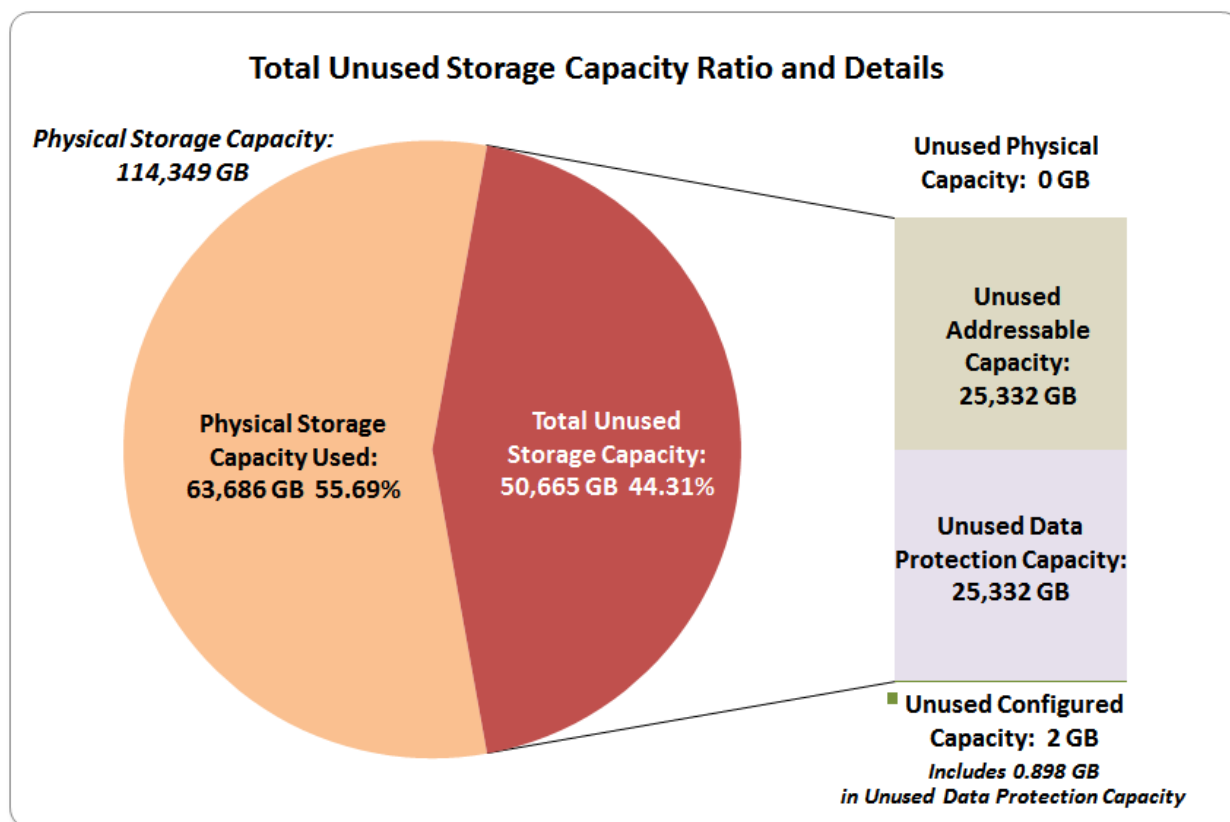
Storage Capacities, Relationships, and Utilization

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.







SPC-1 Storage Capacity Utilization	
Application Utilization	27.08%
Protected Application Utilization	54.15%
Unused Storage Ratio	44.31%

Application Utilization: Total ASU Capacity (30,962.247 GB) divided by Physical Storage Capacity (114,349.100 GB).

Protected Application Utilization: (Total ASU Capacity (30,962.247 GB) plus total Data Protection Capacity (56,294.833 GB) minus unused Data Protection Capacity (25,332.585 GB)) divided by Physical Storage Capacity (114,349.100 GB).

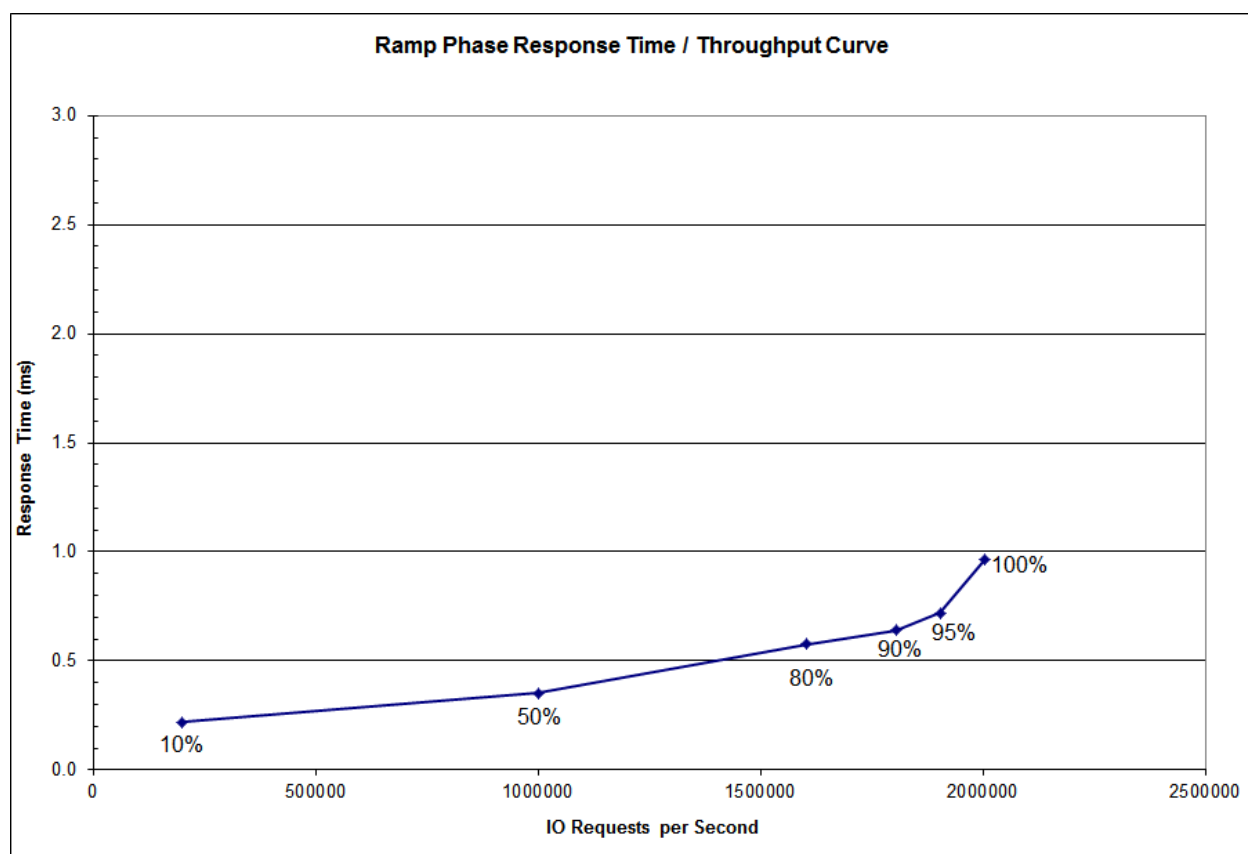
Unused Storage Ratio: Total Unused Capacity (50,665.170 GB) divided by Physical Storage Capacity (114,349.100 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 25-26 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	200,512.33	1,000,301.01	1,604,017.59	1,804,534.05	1,904,840.59	2,004,941.89
Average Response Time (ms):						
All ASUs	0.22	0.35	0.58	0.64	0.72	0.96
ASU-1	0.24	0.39	0.64	0.67	0.73	1.02
ASU-2	0.23	0.41	0.75	0.96	1.11	1.37
ASU-3	0.17	0.24	0.38	0.44	0.52	0.67
Reads	0.31	0.54	0.90	0.96	1.05	1.44
Writes	0.16	0.23	0.37	0.43	0.50	0.65

Priced Storage Configuration Pricing

Product Description	Qty	Unit List Price	Product List Price
Virtual Storage Platform G1000 Microcode Kit	1	\$0.00	\$0.00
Virtual Storage Platform G1000 Product Documentation Library	1	\$0.00	\$0.00
Dummy FMD	31	\$0.00	\$0.00
R800 Controller Rail Kit	2	\$299.00	\$598.00
Minkels Universal Plus Rack 600x1200x2010 mm (WxDxH) 42U	2	\$8,063.00	\$16,126.00
Corner Guide Rail Kit	8	\$65.00	\$520.00
Side Panel 1200mm Depth - Hitachi logo branded - left	1	\$731.00	\$731.00
Side Panel 1200mm Depth - Hitachi logo branded - right	1	\$731.00	\$731.00
8Gbps Fibre Channel Front-end Director (<i>FED pair</i>) (<i>16-Ports per FED pair</i>)	4	\$18,940.00	\$75,760.00
1.6TB Flash Module Drive	64	\$32,750.00	\$2,096,000.00
Cache Backup Module Kit for Large Memory	4	\$12,980.00	\$51,920.00
Cache Flash Memory (<i>256GB</i>)	8	\$20,330.00	\$162,640.00
Secondary Controller Chassis (<i>includes 1 VSD pair and 1 CPC pair</i>)	1	\$112,350.00	\$112,350.00
Back-end interface cable (<i>2m</i>)	2	\$2,770.00	\$5,540.00
Cache Memory Module (<i>32GB</i>)	64	\$5,640.00	\$360,960.00
Cache Path Control Adapter (<i>CPC pair</i>)	2	\$49,730.00	\$99,460.00
Flash Module Drive Chassis	2	\$65,080.00	\$130,160.00
Hub	2	\$3,330.00	\$6,660.00
Inter-controller connecting cable 5m	1	\$65,860.00	\$65,860.00
Inter-controller connecting kit 5m	1	\$65,860.00	\$65,860.00
Virtual Storage Director (VSD) Pair	6	\$72,400.00	\$434,400.00
Flash Module Chassis Power Cord Kit (<i>Americas/APAC</i>)	2	\$2,320.00	\$4,640.00
Controller Chassis Power Cord Kit (<i>Americas/APAC</i>)	2	\$780.00	\$1,560.00
Standard Back-end Director (<i>BED pair</i>)	4	\$14,980.00	\$59,920.00
Primary Controller Chassis (<i>includes 1 VSD pair, 1 CPC pair, and 1 Service Processor</i>)	1	\$72,460.00	\$72,460.00
4GB USB memory stick with lanyard	1	\$102.00	\$102.00
LAN Cable 14ft	1	\$0.00	\$0.00
RJ-45 Modular In-Line Coupler 6 Conductor	1	\$4.00	\$4.00
PDU 0RU 12xC13 1Phase 208V 30A NEMA L6-30P	8	\$735.00	\$5,880.00
Name Plate (HTC-R8)	2	\$0.00	\$0.00
Name Plate (G1000)	2	\$0.00	\$0.00
Front Door (R800) - 600mm Width	2	\$2,614.00	\$5,228.00
Back-end interface cable (1m)	2	\$2,490.00	\$4,980.00
Hardware Components:		---	\$3,841,050.00
VSP G1000 SVOS Media	1	\$0.00	\$0.00
VSP G1000 SVOS Base (Incl 1 VSD Pair)	1	\$20,000.00	\$20,000.00
VSP G1000 SVOS Add'l VSD Pair	7	\$35,000.00	\$245,000.00
VSP G1000 SVOS 20TB Initial Purchase Block	1	\$30,000.00	\$30,000.00
VSP G1000 SVOS 40TB Initial Purchase Block	1	\$60,000.00	\$60,000.00
Software Components:		---	\$355,000.00

Product Description	Qty	Unit List Price	Product List Price
SVC VSP G1000 Installation Planning	1	\$5,000.00	\$5,000.00
SVC VSP G1000 Installation - Control Frame	2	\$6,500.00	\$13,000.00
SVC VSP G1000 1.6TB FMD 1Mo Yr-A STD (per FMD)	2,340	\$0.00	\$0.00
SVC VSP G1000 256GB Flash Cache 1Mo Yr-A STD (per module)	288	\$0.00	\$0.00
SVC VSP G1000 CBXB 1Mo Yr-A STD (per CBX)	36	\$0.00	\$0.00
SVC VSP G1000 VSD Pair 1Mo Yr-A STD (per VSD Pair)	216	\$0.00	\$0.00
SVC VSP G1000 CBXA 1Mo Yr-A STD (per CBX)	36	\$0.00	\$0.00
Installation and Hardware Support:		---	\$18,000.00
SVC VSP G1000 SVOS Base (Incl 1 VSD Pair)- SW Sppt	36	\$300.00	\$10,800.00
SVC VSP G1000 SVOS Add'l VSD Pair - SW Sppt	252	\$525.00	\$132,300.00
SVC VSP G1000 SVOS 20TB Initial Purchase Block - SW Sppt	36	\$450.00	\$16,200.00
SVC VSP G1000 SVOS 40TB Initial Purchase Block - SW Sppt	36	\$900.00	\$32,400.00
Software Support:		---	\$191,700.00
Emulex LightPulse Dual Port Fibre Channel Host Bus Adapter LPE16002-M6	32	\$1,204.00	\$38,528.00
Fibre Channel Cables	64	\$8.56	\$547.84
Third Party Components:		---	\$39,075.84

Hardware Components	\$3,841,050.00	58%	\$1,613,241.00
Software Components	\$355,000.00	39%	\$216,550.00
Installation & Hardware Support	\$18,000.00	0%	\$18,000.00
Software Support	\$191,700.00	39%	\$116,937.00
Third Party Components	\$39,075.84	0%	\$39,075.84
Total:			\$2,003,803.84

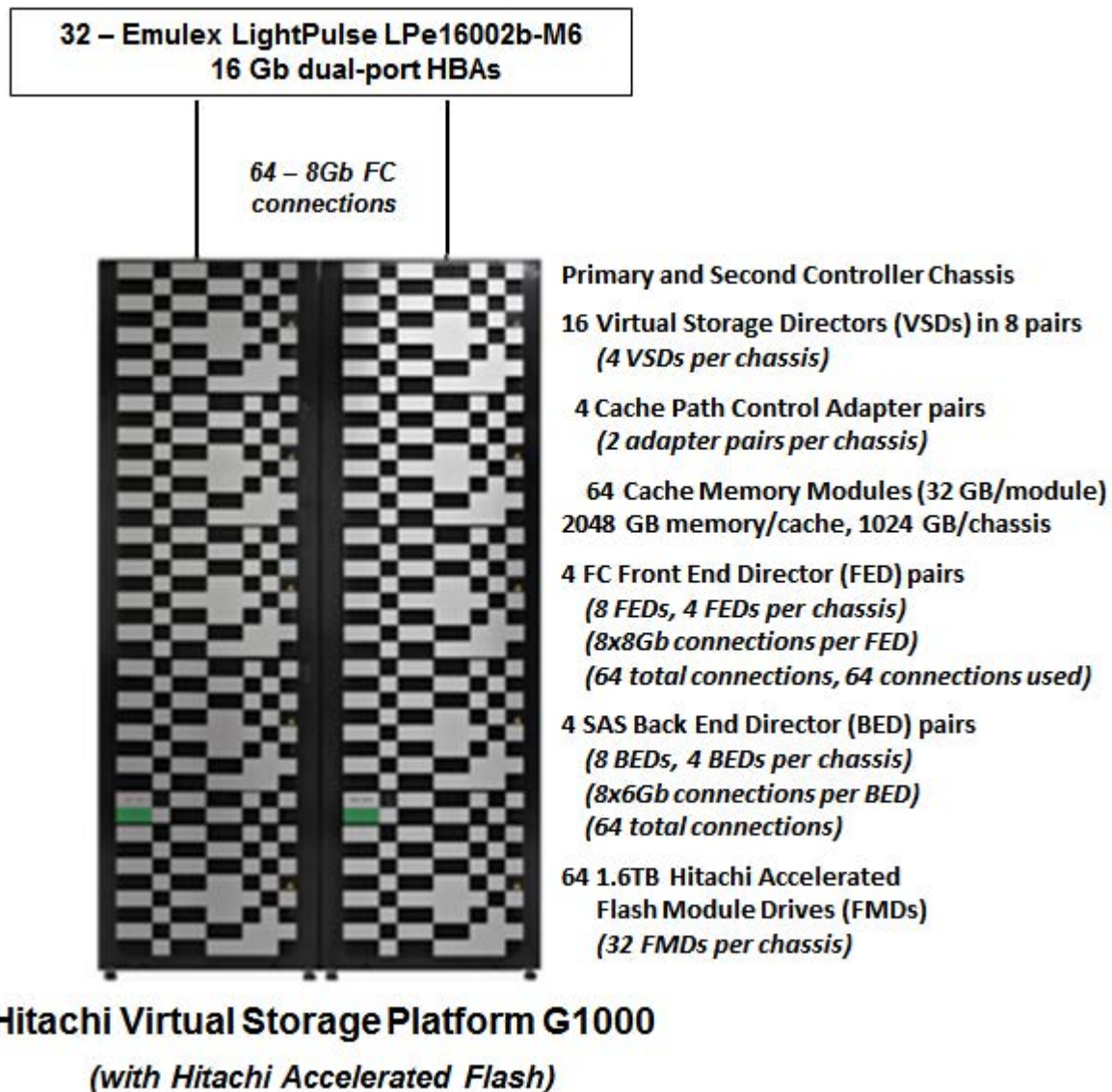
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- 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

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

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration:
32 – Emulex LightPulse LPE16002-M6 16Gb dual-port HBAs
Hitachi Virtual Storage Platform G1000 (with Hitachi Accelerated Flash) Primary and Second Controller Chassis 1 – Inter-controller connecting kit 2 – Hubs (<i>1 Hub per chassis</i>) 16 Virtual Storage Directors (VSDs) in 6 pairs (<i>8 VSDs per chassis</i>) 4 – Cache Path Control Adapter pairs (<i>2 adapter pairs per chassis</i>) 64 – Cache Memory Modules (<i>32 GB per module</i>) (<i>2048 GB memory/cache, 1024 GB per chassis</i>) 8 Cache Flash Memory Modules (<i>256 GB per module</i>) (<i>2048 GB backup flash</i>) 4 FC Front End Director (FED) pairs (<i>8 FEDs, 4 FEDs per chassis</i>) (<i>8x8Gb connections per FED, 64 total connections</i>) (<i>64 connections used</i>) 4 SAS Back End Director (BED) pairs (<i>8 BEDs, 4 BEDs per chassis</i>) (<i>4x6Gb ports per BED, 32 total ports</i>) (<i>4 – 1x6 Gbps links per port, 16 links per BED</i>) (<i>128 total links, 128 links used</i>)
2 – Flash Module Drive Chassis
64 – 1.6 TB Flash Module Drives (FMDs) (<i>24 FMDs per chassis</i>)
8 – 12xC13 1Phase 208V 30A NEMA PDUs
2 – 42U 600x1200x2010mm (<i>WxDxH</i>) racks