



**SPC BENCHMARK 2™
EXECUTIVE SUMMARY**

**HEWLETT PACKARD ENTERPRISE
HPE 3PAR STORESERV 20840**

SPC-2™ V1.5

**Submitted for Review: February 29, 2016
Submission Identifier: B00077**

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Hewlett Packard Enterprise – http://www.hpe.com Bill McCormack – Bill.McCormack@hpe.com 4209 Technology Drive Fremont, CA 94538 Phone: (510) 344-4206
Test Sponsor Alternate Contact	Hewlett Packard Enterprise – http://www.hpe.com Chuck Paridon – Chuck.Paridon@hpe.com 8000 Foothills Blvd. M/S 5785 Roseville, CA 95747 Phone: (916) 472-8239
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-2 Specification revision number	V1.5
SPC-2 Workload Generator revision number	V1.2
Date Results were first used publicly	February 29, 2016
Date FDR was submitted to the SPC	February 29, 2016
Date the TSC will be available for shipment to customers	currently available
Date the TSC completed audit certification	February 26, 2016

Tested Storage Product (TSP) Description

HPE 3PAR StoreServ 20840 Converged Flash Storage is a new class of enterprise array delivering high performance, tier 1 data services and affordability for massive consolidation of today's most demanding workloads. Built on core architectural tenets including a mesh-active cluster, ASIC-based workload management, and multi-layer storage virtualization, HPE 3PAR StoreServ 20840 Converged Flash Storage provides enterprise storage options for on-demand and hybrid IT. The flash-optimized 3PAR architecture allows the HPE 3PAR StoreServ 20840 to deliver multi-petabyte scalability and industry leading data throughput. The HPE 3PAR StoreServ 20840 features the Gen5 Thin Express ASIC for silicon-based hardware acceleration of thin technologies, including inline deduplication, to reduce acquisition and operational costs. Enhanced Tier-1 storage capabilities for always-on data access and fine-grained Quality of Service (QoS) controls ensure predictable service levels for all workload types, while bi-directional data mobility enables virtually limitless elastic pools of storage to support the most rigorous on-demand infrastructure. The HPE 3PAR StoreServ 20840 also delivers true multi-protocol convergence with support of FC/iSCSI/FCoE/NFS/SMB and Object Access. Features like 3PAR Adaptive Sparing ensure SSD media endurance and the support for spinning disks also enables a low \$/GB, making flash-enabled configurations more affordable for any application.

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 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).

SPC-2 Price-Performance™ is the ratio of **Total Price** to **SPC-2 MBPS™**.

ASU (Application Storage Unit) Capacity represents the total storage capacity available to be read and written in the course of executing the SPC-2 benchmark.

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

Data Protection Level of Protected 2 using **Mirroring**, which 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-2 Data Repository.*

Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-2 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.

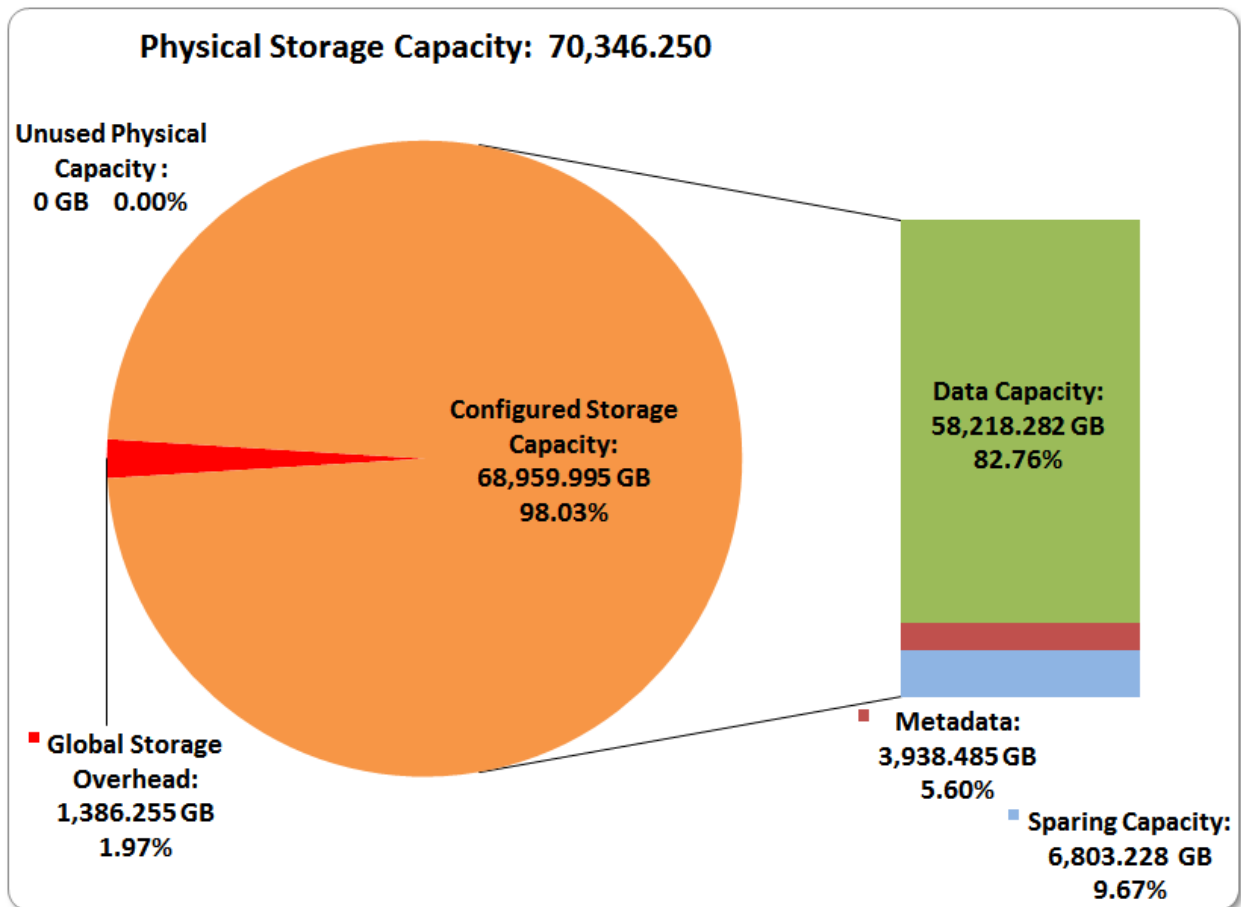
SPC-2 Reported Data (continued)

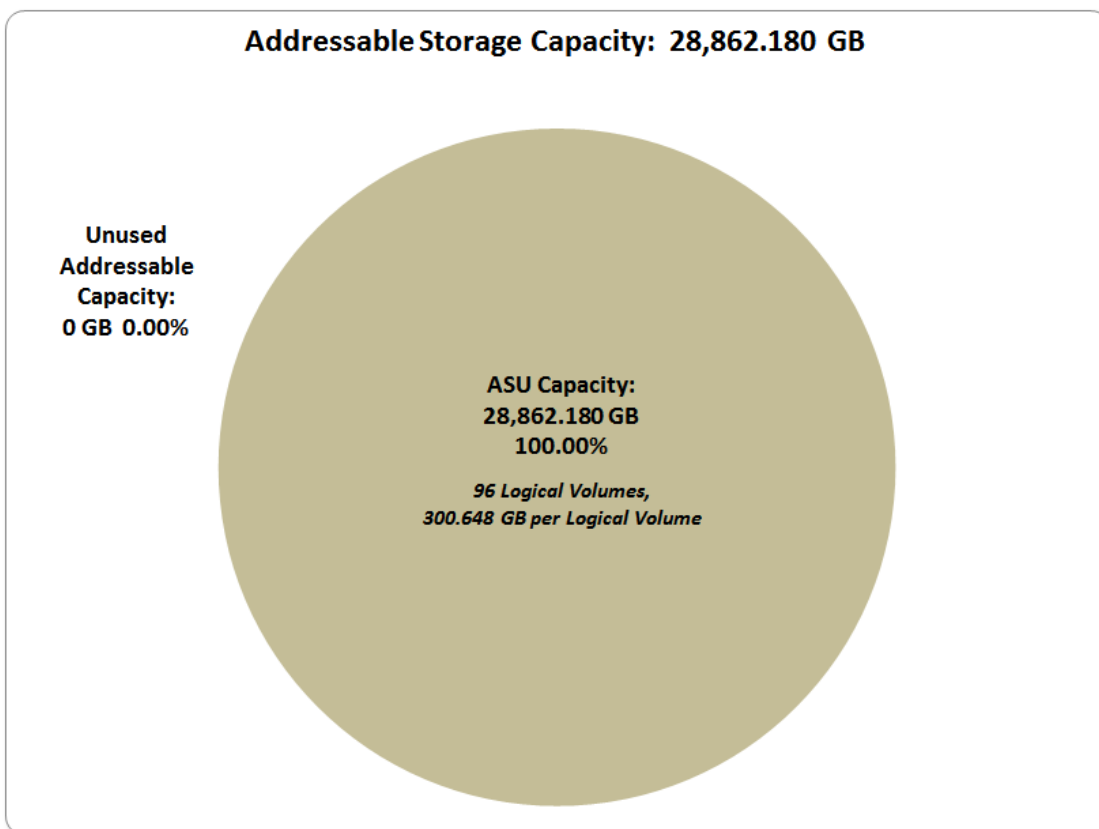
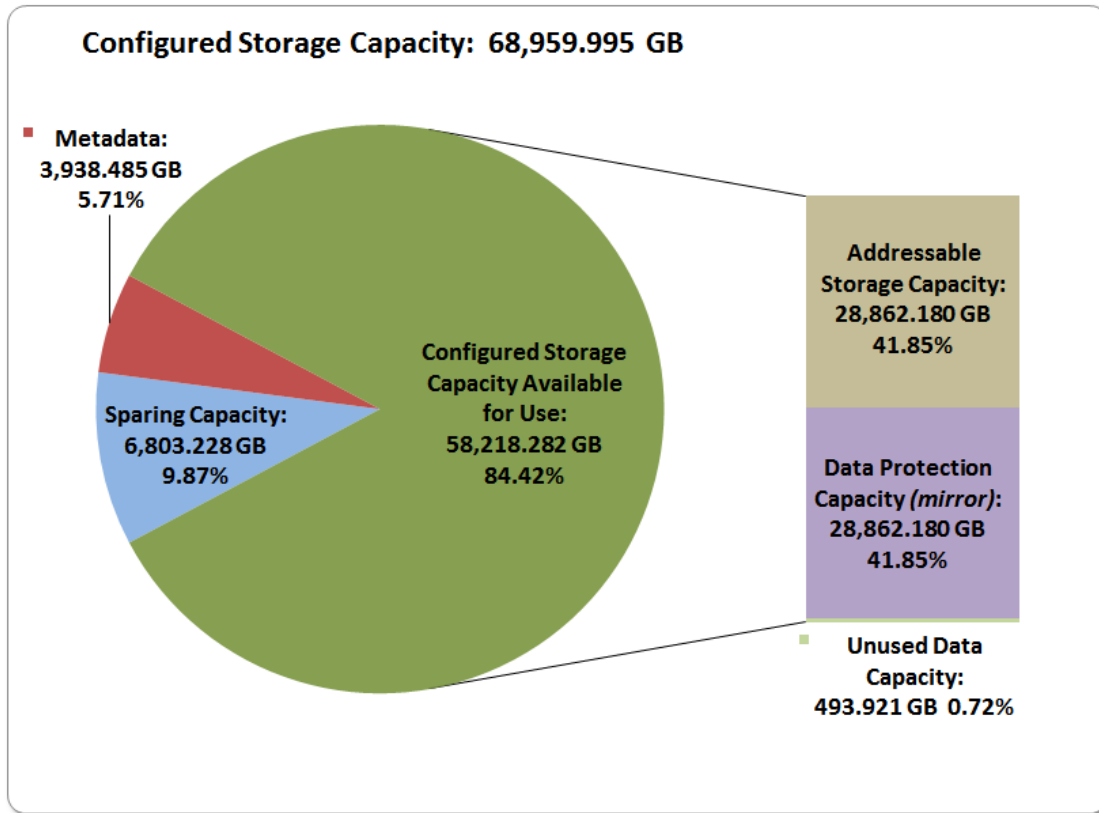
SPC-2 Reported Data				
HPE 3PAR StoreServ 20840				
SPC-2 MBPS™	SPC-2 Price-Performance	ASU Capacity (GB)	Total Price	Data Protection Level
62,844.45	\$19.93	28,862.180	\$1,252,723.54	Protected 2 (Mirroring)
<i>The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD)</i>				
Currency Used:		"Target Country":		
U.S. dollars		USA		
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LFP Composite	38,490.17			\$32.55
Write Only:				
1024 KiB Transfer	11,706.48	124	94.41	
256 KiB Transfer	12,011.74	124	96.87	
Read-Write:				
1024 KiB Transfer	19,953.88	248	80.46	
256 KiB Transfer	20,182.66	248	81.38	
Read Only:				
1024 KiB Transfer	83,550.65	2,300	36.33	
256 KiB Transfer	83,535.59	2,300	36.32	
<i>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).</i>				
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LDQ Composite	75,332.47			\$16.63
1024 KiB Transfer Size				
4 I/Os Outstanding	74,779.73	1,953	38.29	
1 I/O Outstanding	74,918.92	1,953	38.36	
64 KiB Transfer Size				
4 I/Os Outstanding	76,658.87	2,697	28.42	
1 I/O Outstanding	74,972.38	2,697	27.80	
<i>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).</i>				
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
	74,710.71	95,000	0.79	\$16.77

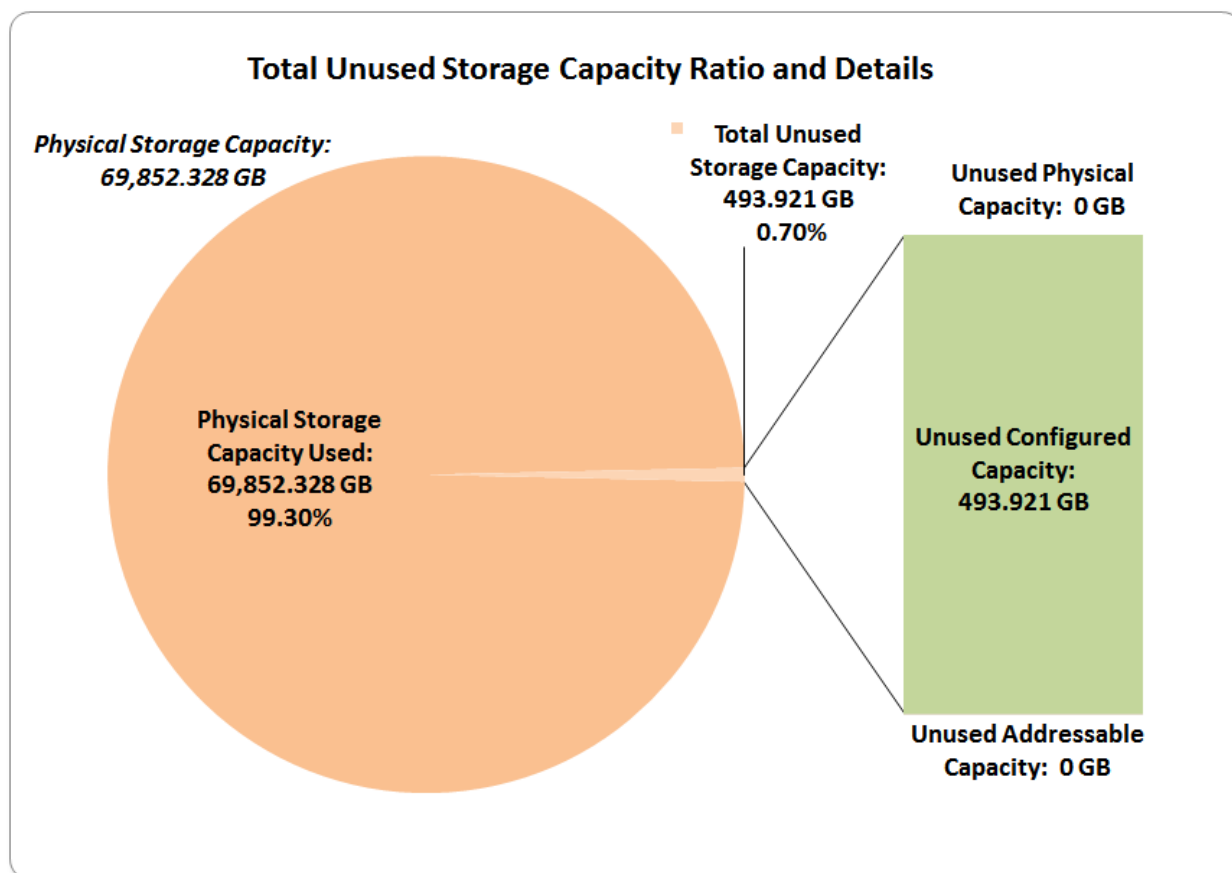
Storage Capacities and Relationships

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-2 Storage Capacity Utilization	
Application Utilization	41.03%
Protected Application Utilization	82.06%
Unused Storage Ratio	0.70%

Application Utilization: Total ASU Capacity (28,862.180 GB) divided by Physical Storage Capacity (70,346.250 GB).

Protected Application Utilization: Total ASU Capacity (28,862.180 GB) plus total Data Protection Capacity (28,862.180 GB) minus unused Data Protection Capacity 0.000 GB) divided by Physical Storage Capacity (70,346.250 GB).

Unused Storage Ratio: Total Unused Capacity (GB) divided by Physical Storage Capacity (70,346.250 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.

Priced Storage Configuration Pricing

Quantity	Model #	Description	List Price	Extended List Price
1	C8S83A	HP 3PAR StoreServ 20000 8N Config Base	84,000.00	84,000.00
2	TK808A	HP Rack Front Door Cover Kit	2.00	4.00
2	M0T19A	HP 3PAR Rack Accessories Kit	285.00	570.00
8	N9Y49A	HP 3PAR 20840 192GB CC/256GB DC Node	65,000.00	520,000.00
32	C8S92A	HP 3PAR 20000 4p 16Gbps FC HBA	8,700.00	278,400.00
24	C8S93A	HP 3PAR 20000 4p 12Gbps SAS HBA	3,600.00	86,400.00
24	E7Y20A	HP 3PAR 20000 24d 2U SFF Drive Enclosure	3,200.00	76,800.00
144	K2Q50A	HP 3PAR 20000 480GB SFF SSD	8,930.00	1,285,920.00
1	K2R29A	HP 3PAR StoreServ RPS Service Processor	6,620.00	6,620.00
12	716197-B21	HP Ext 2.0m MiniSAS HD to MiniSAS HD Cbl	129.00	1,548.00
36	E7V95A	HP 10m Mini SAS HD Active Optical Cable	2,800.00	100,800.00
Hardware Subtotal				2,441,062.00
1	L7E06A	HP 3PAR 20840 OS Suite Base LTU	32,427.00	32,427.00
144	L7E07A	HP 3PAR 20840 OS Suite Drive LTU	1,353.00	194,832.00
1	BD362AAE	HP 3PAR StoreServ Mgmt/Core SW E-Media	20.00	20.00
1	BD363AAE	HP 3PAR OS Suite E-Media	20.00	20.00
1	BD373AAE	HP 3PAR Reporting Suite E-Media	20.00	20.00
Software Subtotal				227,319.00
2	BW904A 001	HP Factory Express Base Racking Service	300.00	600.00
2	HA113A1 5BY	Rack and Rack Options Installation	550.00	1,100.00
24	H1K92A3 YNE	HP 3PAR 20000 24d 2U SFF Enclosure Supp	77.00	1,848.00
1	H1K92A3 YNH	HP 3PAR StoreServ 20000 8N Base Supp	1,839.00	1,839.00
8	H1K92A3 XEF	HP 3PAR 20840 192GBCC/256GB DC Node Supp	562.00	4,496.00
32	H1K92A3 YNN	HP 3PAR 20000 4p 16Gbps FC HBA Supp	81.00	2,592.00
24	H1K92A3 YNQ	HP 3PAR 20000 4p 12Gbps SAS HBA Supp	81.00	1,944.00
1	H1K92A3 YNW	HP 3PAR StoreServ RPS Service Proc Supp	132.00	132.00
144	H1K92A3 YPB	HP 3PAR 20000 480GB SSD Supp	99.00	14,256.00
1	H1K92A3 XEH	HP 3PAR 20840 OS Suite Base Supp	111,873.00	111,873.00
144	H1K92A3 XEJ	HP 3PAR 20840 OS Suite Drive Supp	560.00	80,640.00
1	HA124A1	HP Technical Installation Startup SVC	0.00	0.00
1	HA124A1 5WZ	HP Startup 3PAR 20K 8N Base Fact Int SVC	7,438.00	7,438.00
1	HA124A1 5X1	HP Startup 3PAR 20K Exp Rck Fact Int SVC	1,094.00	1,094.00
Services/Support Subtotal				229,852.00
2	BW904A	HP 642 1075mm Shock Intelligent Rack	1,899.00	3,798.00
2	BW932A	HP 600mm Rack Stabilizer Kit	229.00	458.00
2	BW906A	HP 42U 1075mm Side Panel Kit	399.00	798.00
4	252663-D74	HP 24A HV Core Only Corded PDU	259.00	1,036.00
4	H5M58A	HP 4.9kVA 208V 20out NA/JP bPDU	279.00	1,116.00
Additional Storage Hardware Subtotal				7,206.00

Priced Storage Configuration Pricing (continued)

64	710608-B21	HP QMH2672 16Gb FC HBA	1,099.00	70,336.00
8	C8S47A	Brocade 16Gb/28c PP+ Embedded SAN Switch	17,599.00	140,792.00
8	H1K92AE#9LS	B-Series 8/24c Switch Power Pack c-Class	3,753.00	30,024.00
96	QK724A	HP B-series 16Gb SFP+SW XCVR	405.00	38,880.00
96	QK735A	HP Premier Flex LC/LC OM4 2f 15m Cbl	162.00	15,552.00
SAN Hardware/Support Subtotal				295,584.00

Product Category	List Price	Discount	Discounted Price
Hardware Subtotal	\$2,441,062.00	62.0%	\$927,603.56
Software Subtotal	\$227,319.00	62.0%	\$86,381.22
Services/Support Subtotal	\$229,852.00	62.0%	\$87,343.76
Additional Storage Hardware Subtotal	\$7,206.00	50.0%	\$3,603.00
SAN Hardware/Support Subtotal	\$295,584.00	50.0%	\$147,792.00
Grand Total	\$3,201,023.00		\$1,252,723.54

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.

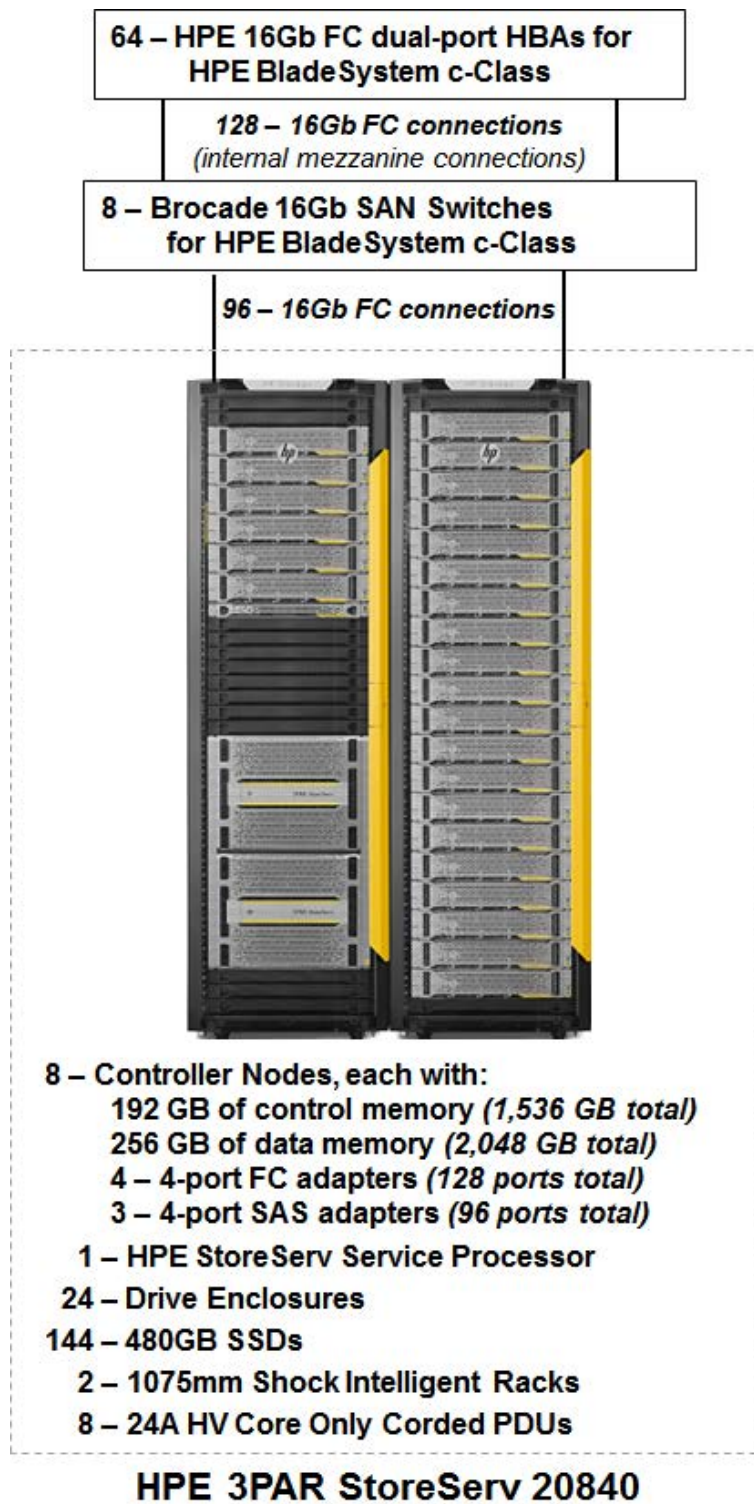
Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The HPE 3PAR StoreServ 20840 uses the same controllers as the HPE 3PAR StoreServ 20850.

The HPE 3PAR StoreServ 20840 Priced Storage Configuration differs from the HPE 3PAR StoreServ 20850 Tested Storage Configuration as follows:

- The factory programmed BIOS model identifier is set to the value representing the HPE 3PAR StoreServ 20840 model.
- The HPE 3PAR StoreServ 20840 optionally supports HDD storage devices and the HPE 3PAR StoreServ 20850 does not.

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration
64 – HPE 16Gb FC dual-port HBAs for HPE Blade System c-Class
8 – Brocade 16Gb SAN Switches for HPE Blade System c-Class
HPE 3PAR StoreServ 20840
8 – Controller Nodes, each with 192 GB of control memory (<i>1,536 GB total</i>) 256 GB of data memory (<i>2,048 GB total</i>) 4 – 4-port FC adapters (<i>16 ports per node, 128 ports total and 96 ports used</i>) 3 – 4-port SAS adapters (<i>12 ports per node, 96 ports total and 48 ports used</i>)
1 – HPE StoreServ Service Processor
96 – 16GB SFPs
24 – Drive Enclosures
144 – 480GB SSDs (<i>6 SSDs per enclosure</i>)
2 – 1075mm Shock Intelligent Racks
8 – 24A HV Core Only Corded PDUs