SPC BENCHMARK 1™
EXECUTIVE SUMMARY

HEWLETT PACKARD ENTERPRISE
HPE 3PAR STORESERV 8450 STORAGE SYSTEM

SPC-1 V1.14

Submitted for Review: March 8, 2016
Submission Identifier: A00168
Revised: June 2, 2016

EXECUTIVE SUMMARY

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	March 8, 2016
Date the FDR was submitted to the SPC	March 8, 2016
Date the revised was submitted to the SPC The original Full Disclosure Report (FDR) included a segment of code, used in preliminary, internal measurements, but was not used in the final audited measurements. That code has been removed in this revision.	June 2, 2016
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	March 7, 2016

Tested Storage Product (TSP) Description

HPE 3PAR StoreServ 8450 Storage is an all-flash array that delivers affordable high performance with Tier-1 data services and quad-node resiliency. It offers the performance advantages of a purpose-built, flash-optimized architecture without compromising resiliency, efficiency, or data mobility. The flash-optimized 3PAR architecture allows the HPE 3PAR StoreServ 8450 to deliver unmatched versatility, performance, and density. The HPE 3PAR StoreServ 8450 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 8450 also enables 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 enable a low $/GB, making flash affordable for any application.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: HPE 3PAR StoreServ 8450 Storage System	
Metric	**Reported Result**
SPC-1 IOPS™	545,164.29
SPC-1 Price-Performance™	$0.23/SPC-1 IOPS™
Total ASU Capacity	5,267.598 GB
Data Protection Level	Protected 2 *(Mirroring)*
Total Price	$126,558.24
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 1:*** *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.*

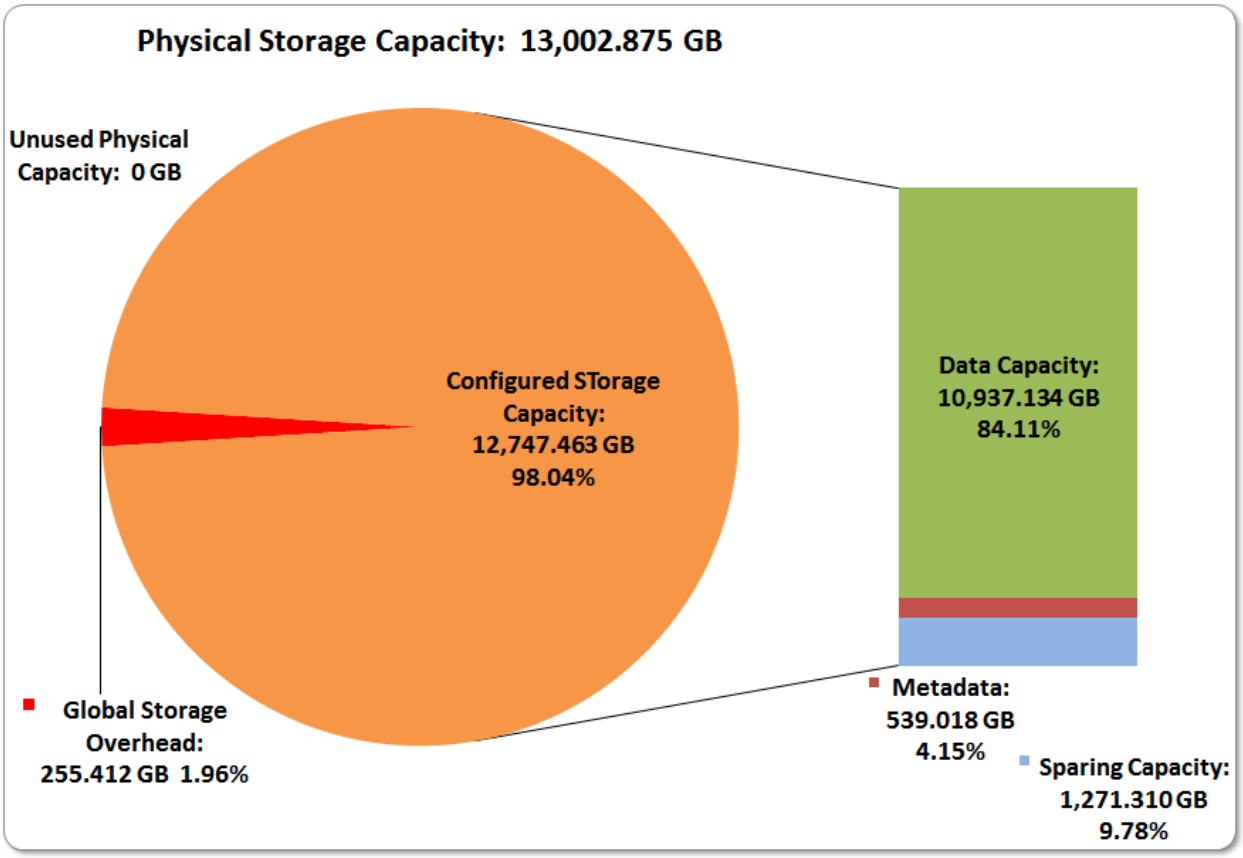
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 9.

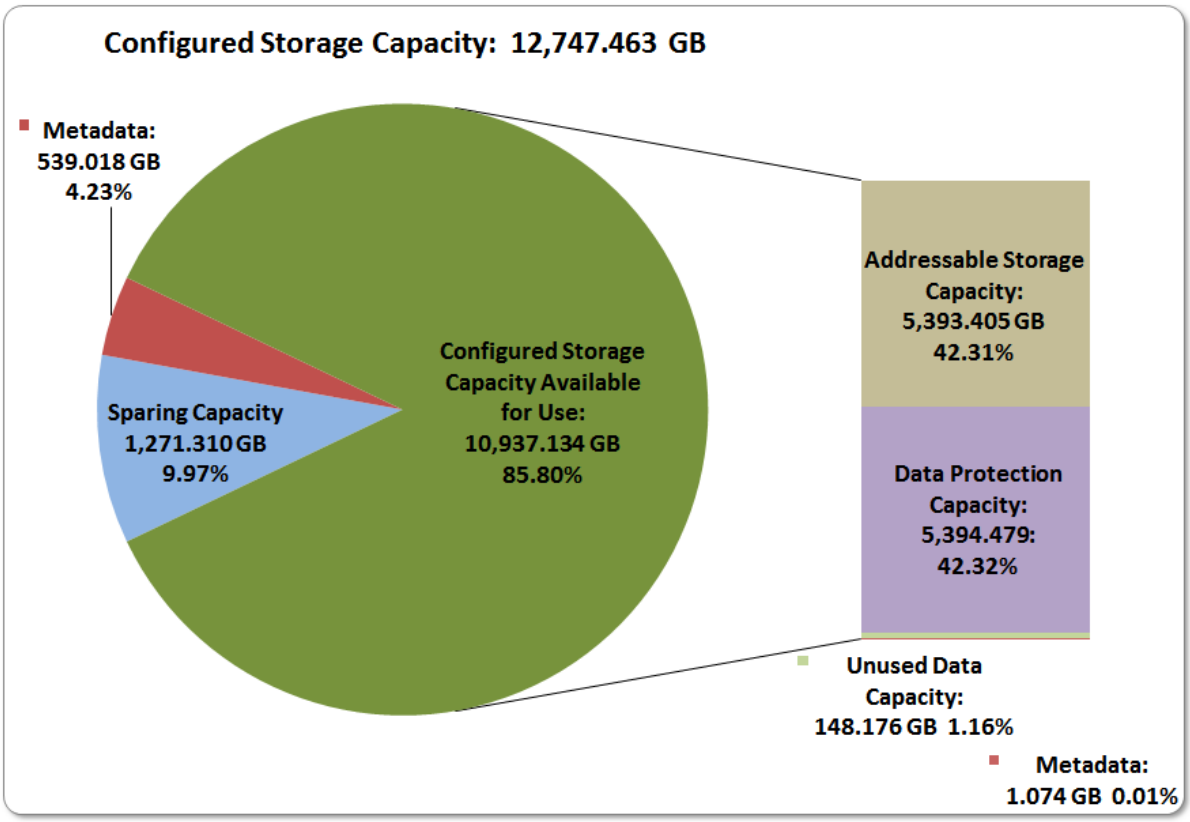
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

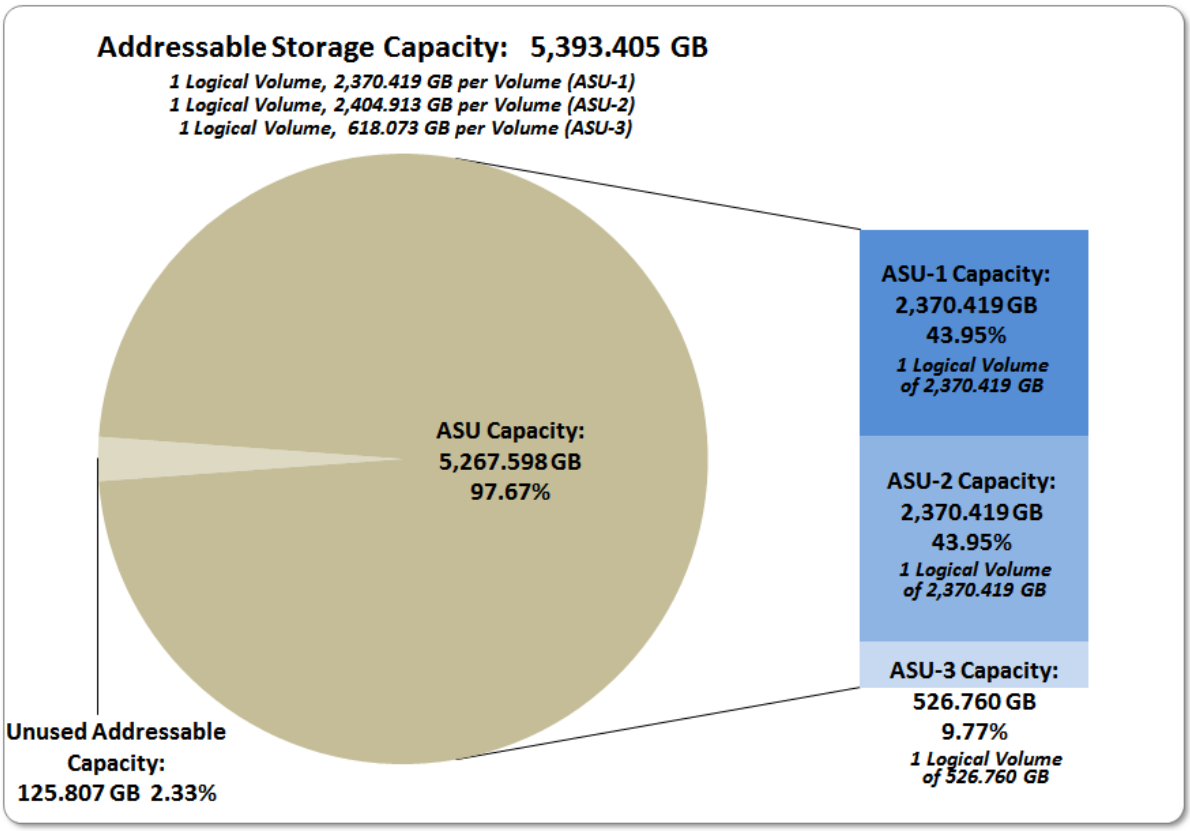
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

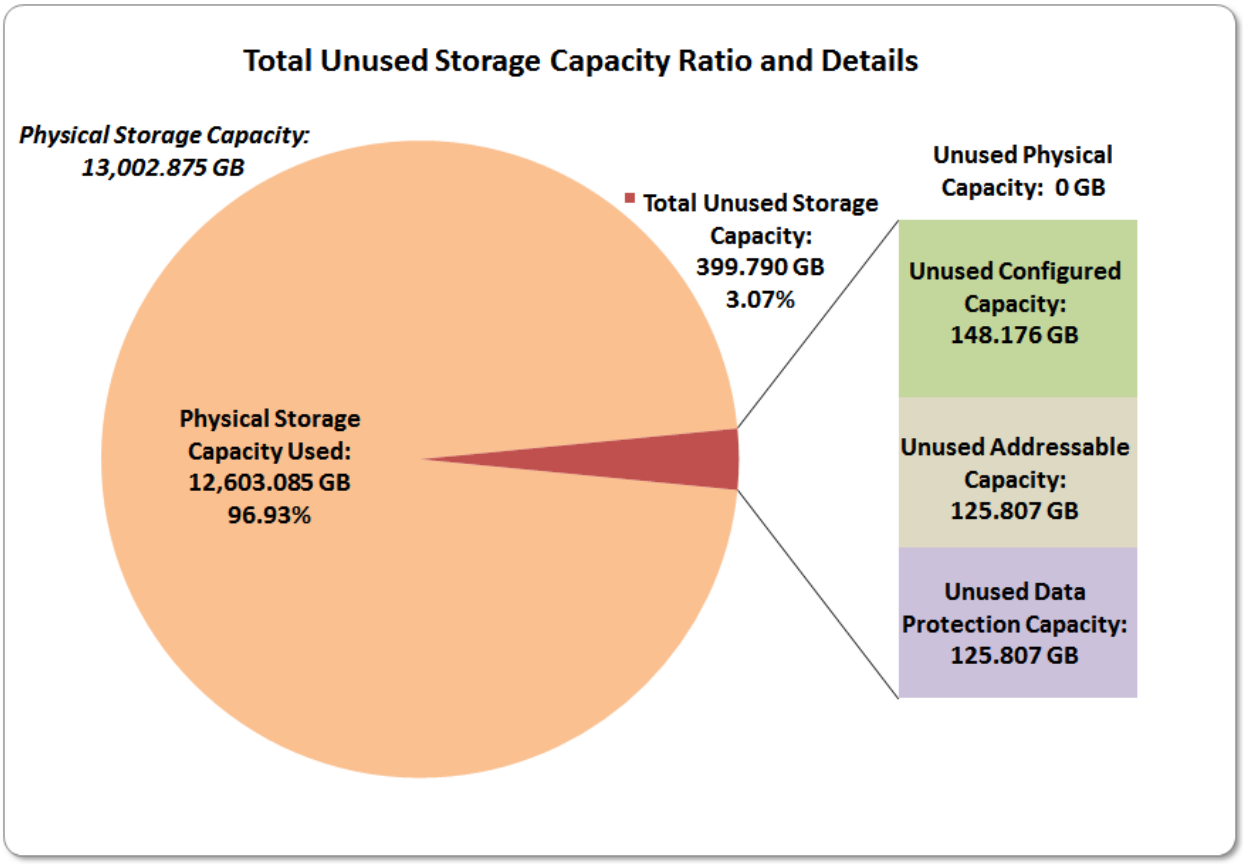
Storage Capacities, Relationships, and Utilization

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.




Configured Storage Capacity: 12,747.463 GB
Metadata:
539.018 GB
4.23%
Sparing Capacity
1,271.310 GB
9.97%
Configured Storage Capacity Available for Use:
10,937.134 GB
85.80%
Addressable Storage Capacity:
5,393.405 GB
42.31%
Data Protection Capacity:
5,394.479:
42.32%
Unused Data Capacity:
148.176 GB 1.16%
Metadata:
1.074 GB 0.01%


Addressable Storage Capacity: 5,393.405 GB
1 Logical Volume, 2,370.419 GB per Volume (ASU-1)
1 Logical Volume, 2,404.913 GB per Volume (ASU-2)
1 Logical Volume, 618.073 GB per Volume (ASU-3)
ASU Capacity:
5,267.598 GB
97.67%
Unused Addressable Capacity:
125.807 GB 2.33%
ASU-1 Capacity:
2,370.419 GB
43.95%
1 Logical Volume of 2,370.419 GB
ASU-2 Capacity:
2,370.419 GB
43.95%
1 Logical Volume of 2,370.419 GB
ASU-3 Capacity:
526.760 GB
9.77%
1 Logical Volume of 526.760 GB



SPC-1 Storage Capacity Utilization	
Application Utilization	40.51%
Protected Application Utilization	81.03%
Unused Storage Ratio	3.07%

Application Utilization: Total ASU Capacity *(5,267.598 GB)* divided by Physical Storage Capacity *(13,002.875 GB)*.

Protected Application Utilization: (Total ASU Capacity *(5,267.598 GB)* plus total Data Protection Capacity *(5,394.479 GB)* minus unused Data Protection Capacity *(125.807 GB)*) divided by Physical Storage Capacity *(13,002.875 GB)*.

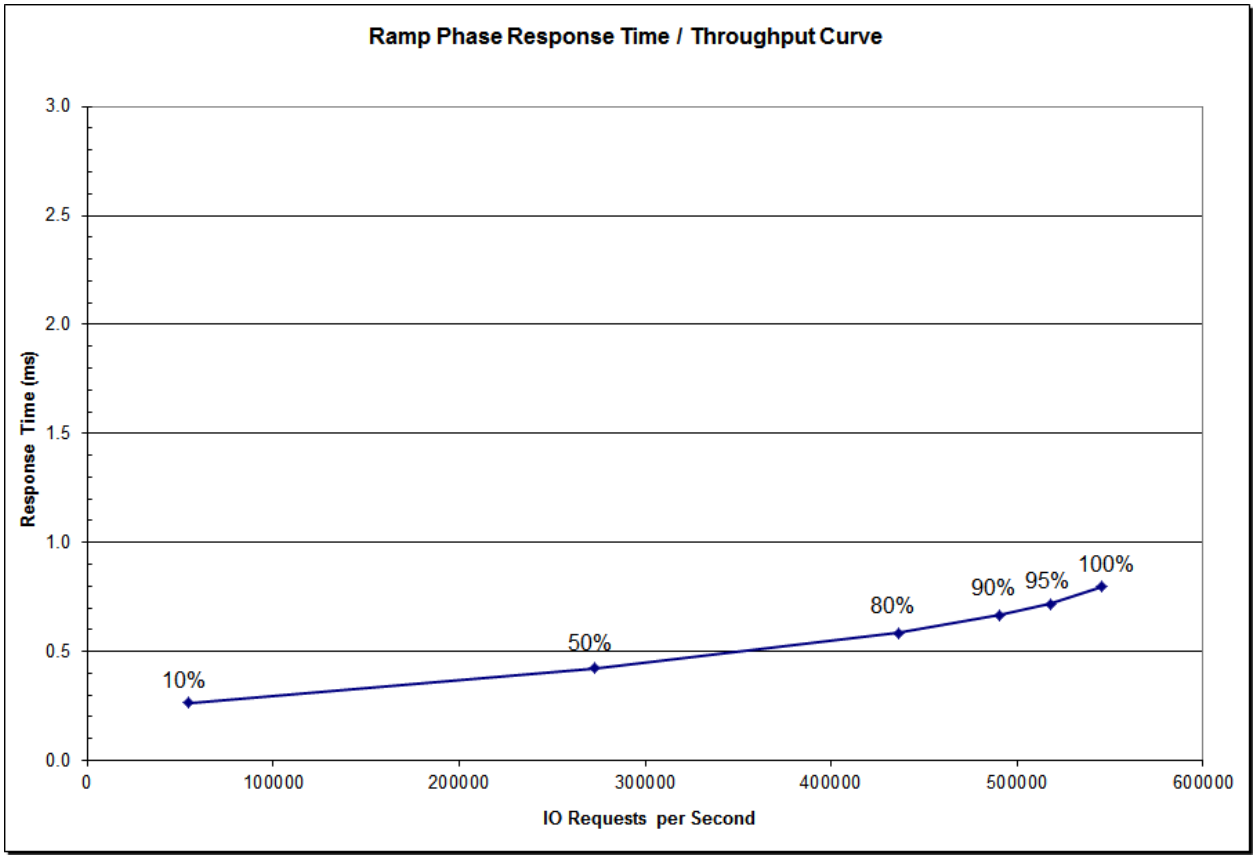
Unused Storage Ratio: Total Unused Capacity *(GB)* divided by Physical Storage Capacity *(13,002.875 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 26-27 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	54,502.28	272,608.21	436,137.70	490,636.32	517,873.90	545,164.29
Average Response Time (ms):						
All ASUs	0.27	0.42	0.58	0.67	0.72	0.80
ASU-1	0.27	0.46	0.65	0.74	0.79	0.86
ASU-2	0.29	0.50	0.69	0.78	0.83	0.91
ASU-3	0.25	0.31	0.39	0.46	0.52	0.62
Reads	0.32	0.64	0.94	1.07	1.14	1.24
Writes	0.23	0.28	0.35	0.40	0.44	0.51

Priced Storage Configuration Pricing

Quantity	Model #	Description
Hardware		
1	H6Z24A	HP 3PAR StoreServ 8450 4N Fld Int Base
4	H6Z00A	HP 3PAR 8000 4-pt 16Gb FC Adapter
32	N9Y06A	HPE 3PAR 8000 400GB SAS SFF SSD
2	E7Y71A	HP 3PAR 8000 SFF(2.5in) Fld Int Drv Encl
24	QK733A	HP Premier Flex LC/LC OM4 2f 2m Cbl
Software		
1	L7C17A	HP 3PAR 8450 OS Suite Base LTU
32	L7C18A	HP 3PAR 8450 OS Suite Drive LTU
1	BD362AAE	HP 3PAR StoreServ Mgmt/Core SW E-Media
1	BD363AAE	HP 3PAR OS Suite Latest E-Media
Services/Support		
1	H1K92A3	HPE 3Y Proactive Care 24x7 Service
1	H1K92A3 YTG	HP 3PAR StoreServ 8450 4N Base Supp
2	H1K92A3 YTJ	HP 3PAR 8000 Drive Encl Supp
4	H1K92A3 YTL	HP 3PAR 8000 4-pt 16Gb FC Adapter Supp
32	H1K92A3 XE0	HPE 3PAR 8000 400GB SFF SSD Supp
1	H1K92A3 YWH	HP 3PAR 8450 OS Suite Base Supp
32	H1K92A3 YWJ	HP 3PAR 8450 OS Suite Drive Supp
Third-Party		
12	Third Party	EMULEX SN1100E 16Gb 2P FC HBA

Product Category	Price
HPE Total	$114,942.24
3rd Party Total	$11,616.00
Grand Total	**$126,558.24**

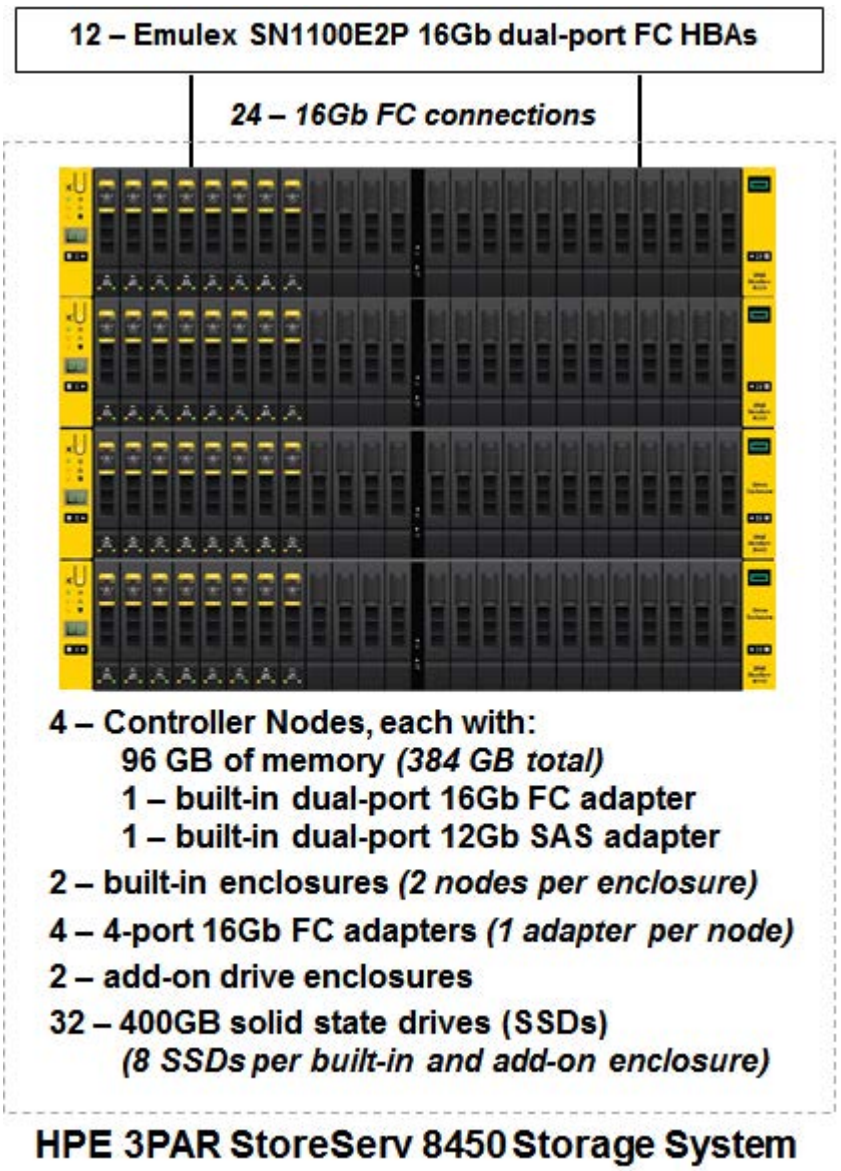
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- 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 Tested Storage Configuration and the Priced Storage Configuration.

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration
12 – Emulex SN1100E2P 16Gb dual-port FC HBAs
HPE 3PAR StoreServ 8450 Storage System 4 – Controller Nodes, each with 96 GB of memory *(384 GB total)* 1 – built-in dual-port 16Gb FC adapter *(4 adapters total)* *(2 ports per node, 8 ports total and used)* 1 – built-in dual-port 12 Gb SAS adapter *(4 adapters total)* *(2 ports per node, 8 ports total and used)*
2 – built-in enclosures *(2 nodes per enclosure)*
4 – 4-port 16Gb FC adapters *(1 adapter per node)* *(4 ports per node, 16 ports total and used)*
2 – add-on drive enclosures
32 – 400 GB solid state drive (SSDs) *(8 SSDs per built-in and add-on enclosure)*