SPC BENCHMARK 1™
EXECUTIVE SUMMARY

HEWLETT-PACKARD COMPANY
HP XP P9500 STORAGE
(WITH HP XP PERFORMANCE ACCELERATOR)

SPC-1 V1.14

Submitted for Review: November 1, 2013
Submission Identifier: A00138
Revised: December 4, 2013

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Hewlett-Packard Company – http://www.hp.com Chuck Paridon – chuck.paridon@hp.com 8000 Foothills Blvd. M/S 5218 Roseville, CA 95747 5785 Phone: (916) 785-5155
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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	November 1, 2013
Date the FDR was submitted to the SPC	November 1, 2013
Date revised FDR was submitted to the SPC Revised Tested Storage Product (TSP) name Revised pricing (page 7)	December 4, 2013
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	October 30, 2013

Tested Storage Product (TSP) Description

The HP XP P9500 is bulletproof storage for mission-critical Converged Infrastructure where constant access to data is required—even in the event of a disaster. Designed for organizations that cannot afford any downtime, the P9500 combines a high-performance, online scalable, fully redundant hardware platform with unique data replication capabilities integrated with clustering solutions for complete business continuity. In addition to market leading reliability and disaster recovery solutions, the platform also provides full data services, and superior performance with the most recent solid state flash memory technology.

The P9500 is the latest enterprise disk array product to come from HP's long-term, joint engineering and original equipment manufacturer relationship with Hitachi Limited of Japan.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: HP XP P9500 Storage *(with HP XP Performance Accelerator)*	
Metric	**Reported Result**
SPC-1 IOPS™	602,019.47
SPC-1 Price-Performance™	**$2.27/SPC-1 IOPS™**
Total ASU Capacity	11,610.843 GB
Data Protection Level	Protected 2 *(Mirroring)*
Total Price	**$1,367,637.40**
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 8.

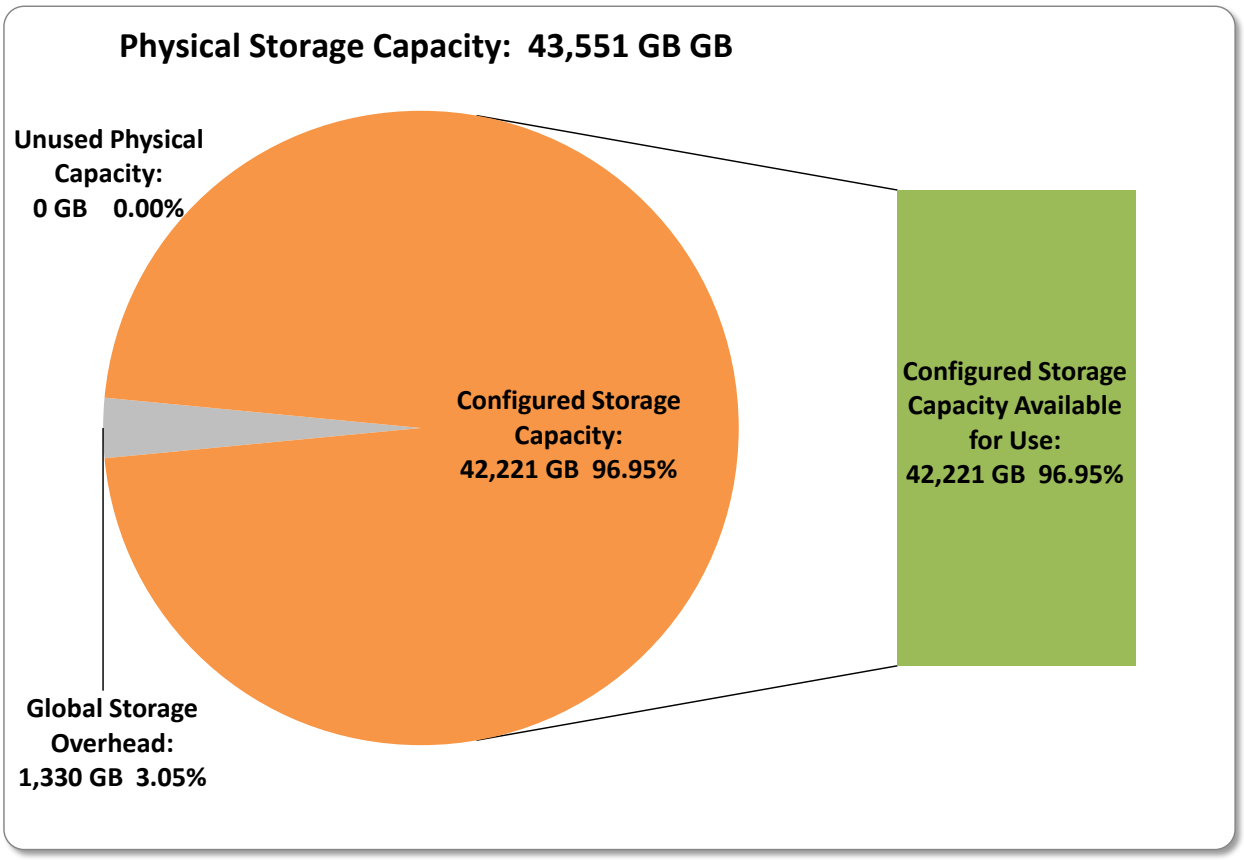
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

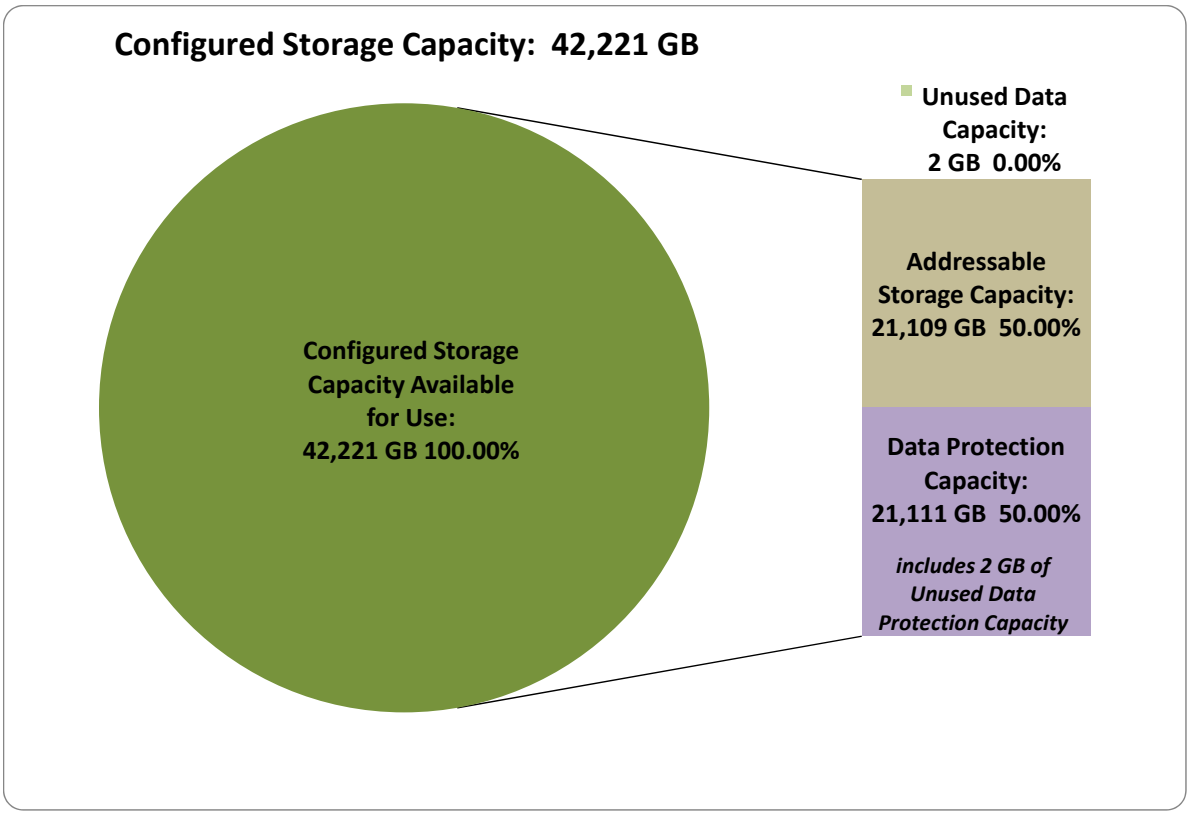
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

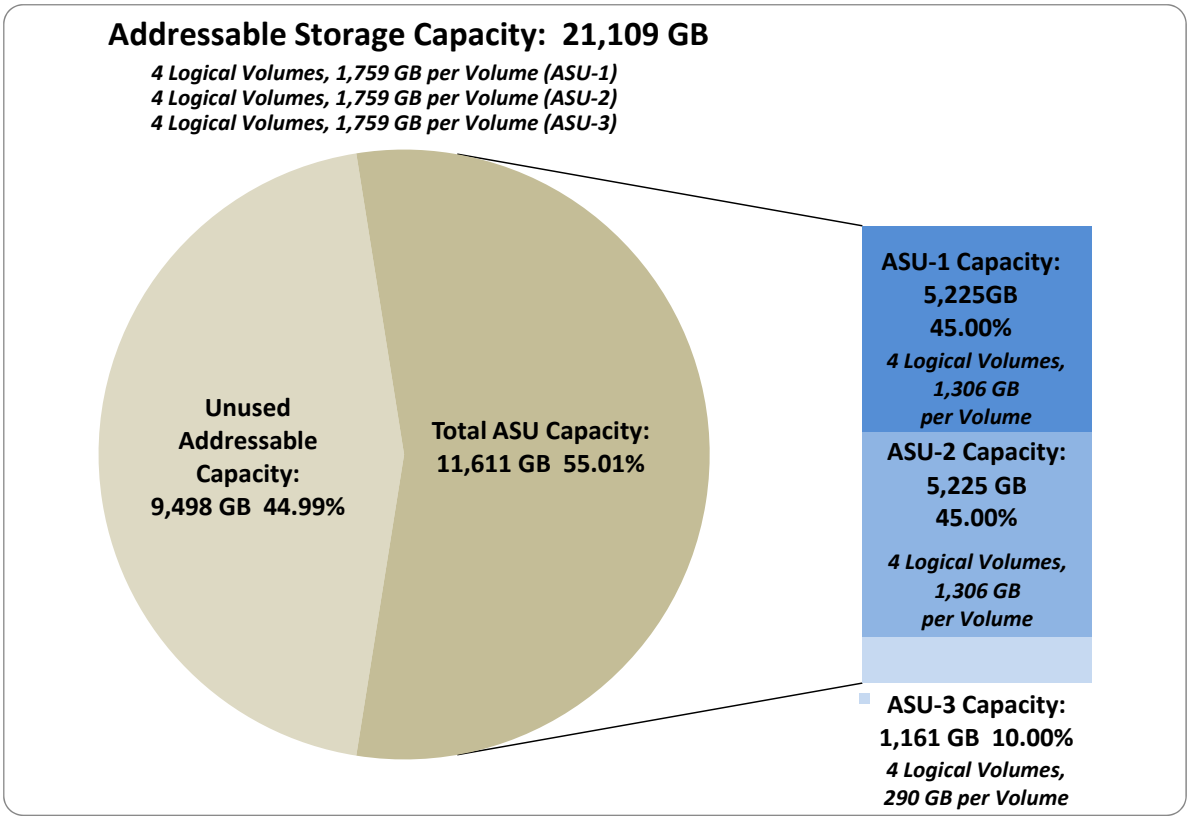
Storage Capacities, Relationships, and Utilization

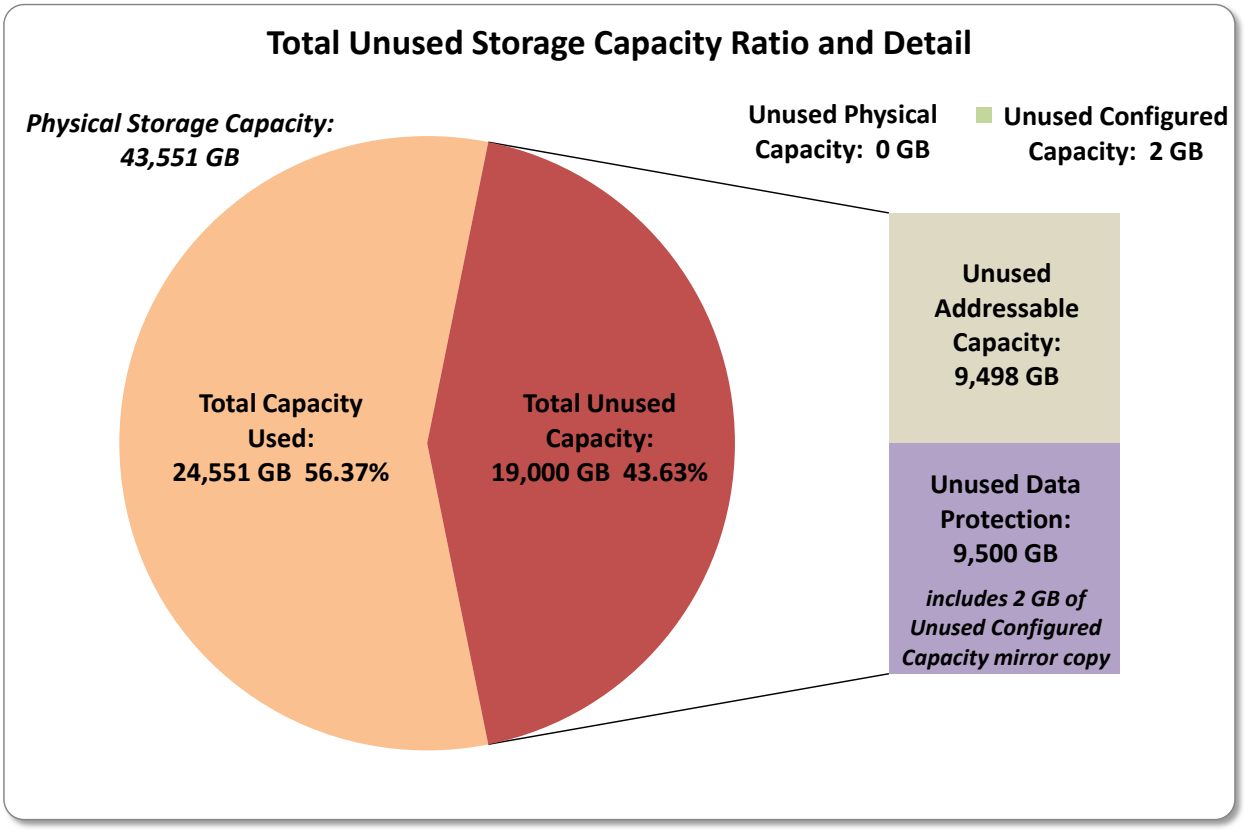
The following four charts and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.

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: 42,221 GB
Unused Data Capacity: 2 GB 0.00%
Addressable Storage Capacity: 21,109 GB 50.00%
Data Protection Capacity: 21,111 GB 50.00%
includes 2 GB of Unused Data Protection Capacity
Configured Storage Capacity Available for Use: 42,221 GB 100.00%


Addressable Storage Capacity: 21,109 GB
4 Logical Volumes, 1,759 GB per Volume (ASU-1)
4 Logical Volumes, 1,759 GB per Volume (ASU-2)
4 Logical Volumes, 1,759 GB per Volume (ASU-3)
ASU-1 Capacity: 5,225GB 45.00%
4 Logical Volumes, 1,306 GB per Volume
ASU-2 Capacity: 5,225 GB 45.00%
4 Logical Volumes, 1,306 GB per Volume
ASU-3 Capacity: 1,161 GB 10.00%
4 Logical Volumes, 290 GB per Volume
Unused Addressable Capacity: 9,498 GB 44.99%
Total ASU Capacity: 11,611 GB 55.01%



SPC-1 Storage Capacity Utilization	
Application Utilization	26.66%
Protected Application Utilization	53.32%
Unused Storage Ratio	43.63%

Application Utilization: Total ASU Capacity *(11,610.843 GB)* divided by Physical Storage Capacity *(43,550.927 GB)*.

Protected Application Utilization: Total ASU Capacity *(11,610.843 GB)* plus total Data Protection Capacity *(21,110.600 GB)* minus unused Data Protection Capacity *(9,499.757 GB)* divided by Physical Storage Capacity *(43,550.927 GB)*.

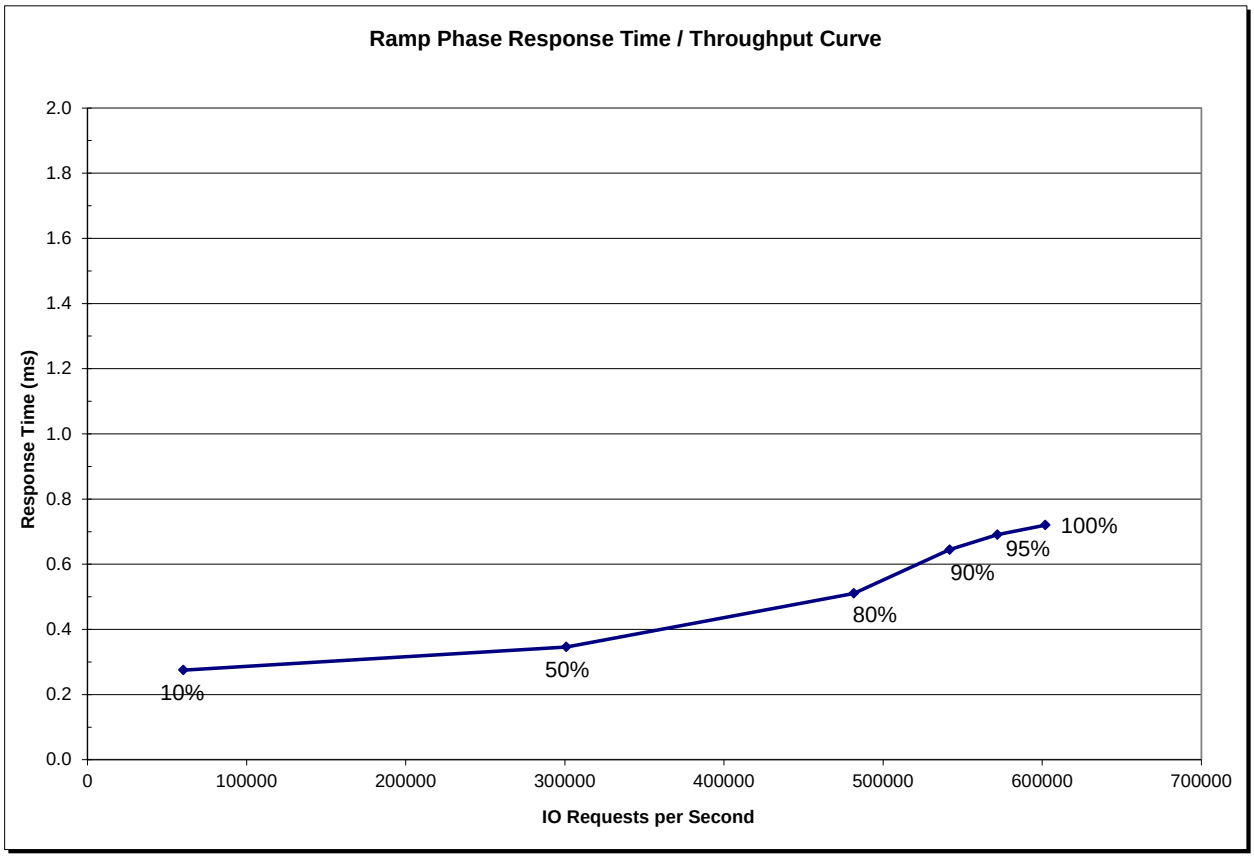
Unused Storage Ratio: Total Unused Capacity *(18,999.514 GB)* divided by Physical Storage Capacity *(43,550.927 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 30-31 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	60,202.66	301,004.02	481,596.47	541,844.78	571,915.98	602,019.47
Average Response Time (ms):						
All ASUs	0.28	0.35	0.51	0.64	0.69	0.72
ASU-1	0.29	0.29	0.46	0.60	0.65	0.68
ASU-2	0.27	0.36	0.65	0.88	0.96	1.02
ASU-3	0.25	0.47	0.56	0.64	0.67	0.67
Reads	0.35	0.30	0.57	0.77	0.85	0.90
Writes	0.23	0.37	0.47	0.56	0.59	0.61

Priced Storage Configuration Pricing

QTY	P/N		DESCRIPTION	UNIT PRICE	EXTENDED PRICE	PERCENT DISCOUNT	DISCOUNTED PRICE
1	AV399A		HP P9500 Disk Array	1.00	1.00	50	0.50
1	AV400B		HP XP P9500 DKC Module-0 Base Rack	69,909.00	69,909.00	50	34,954.50
4	AV406A		HP P9500 1-phase 24A 60Hz w/Cords PDU	2,950.00	11,800.00	50	5,900.00
1	AV411B		HP XP P9500 Base 2.5in Drive Chassis	12,765.00	12,765.00	50	6,382.50
1	AV375A		HP XP P9500 Flash Module Chassis	60,008.00	60,008.00	50	30,004.00
1	AV415A		HP P9500 60Hz DKC Jumper Cable Kit	495.00	495.00	50	247.50
1	AV416A		HP P9500 60Hz DKU Jumper Cable Kit	495.00	495.00	50	247.50
1	AV377A		HP XP P9500 60Hz Flash Jumper Cable Kit	2,300.00	2,300.00	50	1,150.00
4	AV424B		HP XP P9500 16-port 2-8Gbps FC CHA Pair	16,148.00	64,592.00	50	32,296.00
1	AV440B		HP XP P9500 Processor Blade Pair	19,639.00	19,639.00	50	9,819.50
1	AV443A		HP P9500 2nd SVP High Reliability Kit	8,731.00	8,731.00	50	4,365.50
3	AV444A		HP P9500 Cache Memory Adapter Pair	62,187.00	186,561.00	50	93,280.50
16	AV448B		HP XP P9500 32GB Cache Memory Module	4,364.00	69,824.00	50	34,912.00
4	AV452A		HP P9500 128GB Cache Backup Module	46,370.00	185,480.00	50	92,740.00
2	AV455A		HP P9500 SAS DKA Drive Adapter Pair	12,323.00	24,646.00	50	12,323.00
1	AV458A		HP P9500 Express Switch Adapter Pair	23,448.00	23,448.00	50	11,724.00
1	AV459A		HP P9500 Additional DKC-DKU Power Supply	6,536.00	6,536.00	50	3,268.00
1	AV381A		HP XP P9500 Std DKC-Flash Chassis Cable	7,300.00	7,300.00	50	3,650.00
1	AV382A		HP XP P9500 Perf DKC-Flash Chassis Cable	7,300.00	7,300.00	50	3,650.00
12	AV392A		HP XP P9500 1.6TB Flash Module	29,934.00	359,208.00	50	179,604.00
1	AV401B		HP XP P9500 DKC Module-1 Base Rack	86,275.00	86,275.00	50	43,137.50
4	AV406A		HP P9500 1-phase 24A 60Hz w/Cords PDU	2,950.00	11,800.00	50	5,900.00
1	AV411B		HP XP P9500 Base 2.5in Drive Chassis	12,765.00	12,765.00	50	6,382.50
1	AV375A		HP XP P9500 Flash Module Chassis	60,008.00	60,008.00	50	30,004.00
1	AV415A		HP P9500 60Hz DKC Jumper Cable Kit	495.00	495.00	50	247.50
1	AV416A		HP P9500 60Hz DKU Jumper Cable Kit	495.00	495.00	50	247.50
1	AV377A		HP XP P9500 60Hz Flash Jumper Cable Kit	2,300.00	2,300.00	50	1,150.00
4	AV424B		HP XP P9500 16-port 2-8Gbps FC CHA Pair	16,148.00	64,592.00	50	32,296.00
1	AV440B		HP XP P9500 Processor Blade Pair	19,639.00	19,639.00	50	9,819.50
1	AV442A		HP P9500 DKC Hub Kit	13,196.00	13,196.00	50	6,598.00
3	AV444A		HP P9500 Cache Memory Adapter	62,187.00	186,561.00	50	93,280.50
16	AV448B		HP XP P9500 32GB Cache Memory Module Pair	4,364.00	69,824.00	50	34,912.00
4	AV452A		HP P9500 128GB Cache Backup Module	46,370.00	185,480.00	50	92,740.00
2	AV455A		HP P9500 SAS DKA Drive Adapter Pair	12,323.00	24,646.00	50	12,323.00
1	AV458A		HP P9500 Express Switch Adapter Pair	23,448.00	23,448.00	50	11,724.00
1	AV459A		HP P9500 Additional DKC-DKU Power Supply	6,536.00	6,536.00	50	3,268.00
1	AV460A		HP P9500 Inter-controller Cable	7,600.00	7,600.00	50	3,800.00
1	AV381A		HP XP P9500 Std DKC-Flash Chassis Cable	7,300.00	7,300.00	50	3,650.00
1	AV382A		HP XP P9500 Perf DKC-Flash Chassis Cable	7,300.00	7,300.00	50	3,650.00
12	AV392A		HP XP P9500 1.6TB Flash Module	29,934.00	359,208.00	50	179,604.00
1	AE242A		HP P9500/XP No Remote Device Access Supp	1.00	1.00	35	0.65
2	TB502A		HP P9000 Inter-Controller Cable LTU	63,011.00	126,022.00	50	63,011.00
1	TB514AA		HP P9000 Array Manager SW Base LTU	309.00	309.00	50	154.50
1	HA114A1		HP Installation and Startup Service	0.00	0.00	35	0.00
1	HA114A1	55U	HP Startup P9000 Array DKC Mod-0 SVC	22,125.00	22,125.00	35	14,381.25
1	HA114A1	55V	HP Startup P9000 Array DKC/DKU Exp SVC	1,775.00	1,775.00	35	1,153.75
8	HA114A1	55W	HP Startup P9000 Array Expansion SVC	900.00	7,200.00	35	4,680.00
1	HA114A1	5PK	HP Startup P9000 Software Type 1 SVC	1,525.00	1,525.00	35	991.25
20	TB514AB		HP P9000 Array Mgr SW 1TB 0-30TB LTU	2,730.00	54,600.00	50	27,300.00
1	HA110A3		HP 3y Support Plus 24 SVC	0.00	0.00	35	0.00
20	HA110A3	2LD	P9000 Array Mgr SW 1TB 0-30TB LTU SWSupp	725.00	14,500.00	35	9,425.00
1	TB521A		HP XP P9000 Perf Acc SW LTU	21,614.00	21,614.00	50	10,807.00
2	T5520A		HP 8/80 SAN Switch 8Gb 16-port Upgr LTU	18,775.00	37,550.00	50	18,775.00
2	AM871B		HP 8/80 Base 48-ports Enabled SAN Switch	55,099.00	110,198.00	50	55,099.00

Priced Storage Configuration Pricing *(continued)*

1	AM871B	ABA	U.S. - English localization	0.00	0.00	50	0.00
1	HA110A3		HP 3y Support Plus 24 SVC	0.00	0.00	50	0.00
1	HA110A3	9LM	HP B-Series 8/80 SAN Switch Support	6,028.00	6,028.00	50	3,014.00
64	AJ836A		HP 5m Multi-mode OM3 LC/LC FC Cable	95.00	6,080.00	50	3,040.00
64	AJ716B		HP 8Gb Short Wave B-Series SFP+ 1 Pack	180.00	11,520.00	50	5,760.00
16	AJ763B		HP 82E 8Gb Dual-port PCI-e FC HBA	1,849.00	29,584.00	50	14,792.00
TOTAL PRICE					*2,721,137.00*		1,367,637.40

NOTE:
*** The price for support items that are bundled into the top level product are displayed as "-".**

DKC-0 Rack Assembly including:
• 19" 42U custom rack • Controller Chassis • Processor Blade
• Express Switch Adapter • Cache Memory Adapter • Service Processor SPV-0
• One Drive Chassis equipped to support up to 128 drives
• One Drive Chassis Base without DKUPS, SSWs and HDDPWR
• Std Performance Device I/F cabling to 1st Disk Chassis
• 4GB USB memory stick with lanyard
• LAN Cable 14ft(Version B Rack)

DKC-0 and DKC-1 are independently configurable with HW.
SW is configured at the System level (DKC-0 and DKC-1 combined).

DKC-1 Rack Assembly including:
• 19" 42U custom rack • Controller Chassis • Processor Blade
• Express Switch Adapter
• Cache Memory Adapter • Hub kit
• One Drive Chassis equipped to support up to 128 drives
• One Drive Chassis Base without DKUPS, SSWs and HDDPWR
• Std Performance Inter-controller Cable to connect to DKC Module-0 Rack

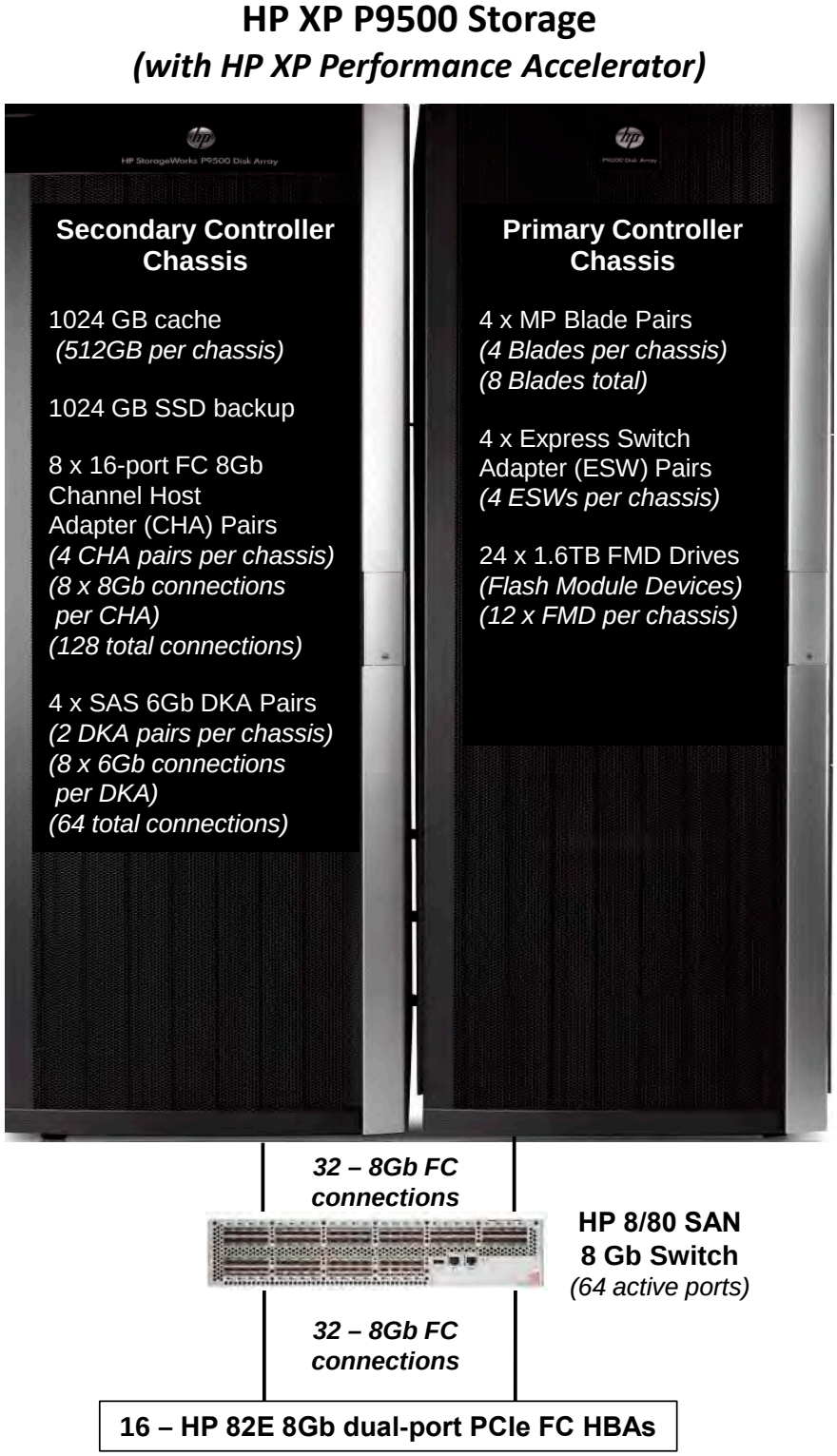
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- Acknowledgement of new and existing problems with 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 64-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**.
- Logos, cabinetry and paneling are cosmetically different in the Priced Storage Configuration to reflect an HP product.

Priced Storage Configuration Diagram



Priced Storage Configuration Components

Priced Storage Configuration:
16 – HP 82E 8Gb dual-port PCIe HBAs
2 – HP 8/80 SAN Switch with SFPs *(64 active ports)* *(the second switch was included as a spare)*
HP XP P9500 Storage ***(with HP XP Performance Accelerator)*** Primary and Second Controller Chassis 8 Express Switch Adapters (ESW) in 4 pairs *(4 ESWs per chassis)* 8 MP Blades in 4 pairs *(4 Blades per chassis)* 16 Cache Memory Adapters (CMAs) in 8 pairs *(8 CMAs per chassis)* 32 Cache Memory Modules *(32 GB per module)* *(1024 GB memory/cache, 512 GB per chassis)* 8 Cache Flash Memory Modules *(128 GB per module)* *(1024 GB backup flash)* 8 FC 8Gb Channel Host Adapter (CHA) pairs *(16 CHAs, 8 CHAs per chassis)* *(8x8Gb connections per CHA, 128 total connections)* *(32 connections used)* 4 SAS 6Gb DKA pairs *(8 DKAs, 4 DKAs per chassis)* *(8x6Gb connections per DKA, 64 total connection)* *(64 connections used)*
1 – Additional Controller PS
2 – Flash Module Drive Chassis
24 – 1.6 TB Flash Module Drives (FMDs) *(12 FMDs per controller chassis)*
1 – Service Processor
8 – 1Phase 208V 30A PDUs
2 – 42U racks