



**SPC BENCHMARK 1™
EXECUTIVE SUMMARY**

**NETAPP, INC.
NETAPP EF560 ALL-FLASH ARRAY**

SPC-1 V1.14

**Submitted for Review: April 18, 2016
Submission Identifier: A00173**

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	NetApp, Inc. – http://www.netapp.com Mark Regester – mark.regester@netapp.com 3718 North Rock Road Wichita, KS 67226 Phone: (316) 636-8340
Test Sponsor Alternate Contact	NetApp, Inc. – http://www.netapp.com Mike Phelan – mike.phelan@netapp.com 5400 Airport Blvd., Suite 100 Boulder, CO 80301 Phone: (303) 544-5414
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	April 18, 2016
Date the FDR was submitted to the SPC	April 18, 2016
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	April 14, 2016

Tested Storage Product (TSP) Description

The NetApp® EF560 flash array is an all-SSD storage system that brings together extreme performance and enterprise-grade reliability to create a system optimized for latency-sensitive workloads. Designed for applications demanding the highest levels of performance, reliability, and availability and requiring just 2U of rack space, the EF560 flash array delivers consistent microsecond latency response times, and enterprise-proven availability features. Additionally, the EF560 can be seamlessly expanded to 120 SSDs to a maximum raw capacity of 384TB. The EF560's core architecture has been proven in the world's most demanding and complex computing environments. Its field-proven design is the culmination of over 20 years of industry knowledge focused on designing enterprise-class storage. The fully redundant EF-Series all-flash array is architected to provide the highest levels of reliability, availability, and data protection.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: NetApp EF560 All-Flash Array	
Metric	Reported Result
SPC-1 IOPS™	319,980.28
SPC-1 Price-Performance™	\$0.30/SPC-1 IOPS™
Total ASU Capacity	9,006.219 GB
Data Protection Level	Protected 2 (<i>Mirroring</i>)
Total Price	\$97,050.48
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.*

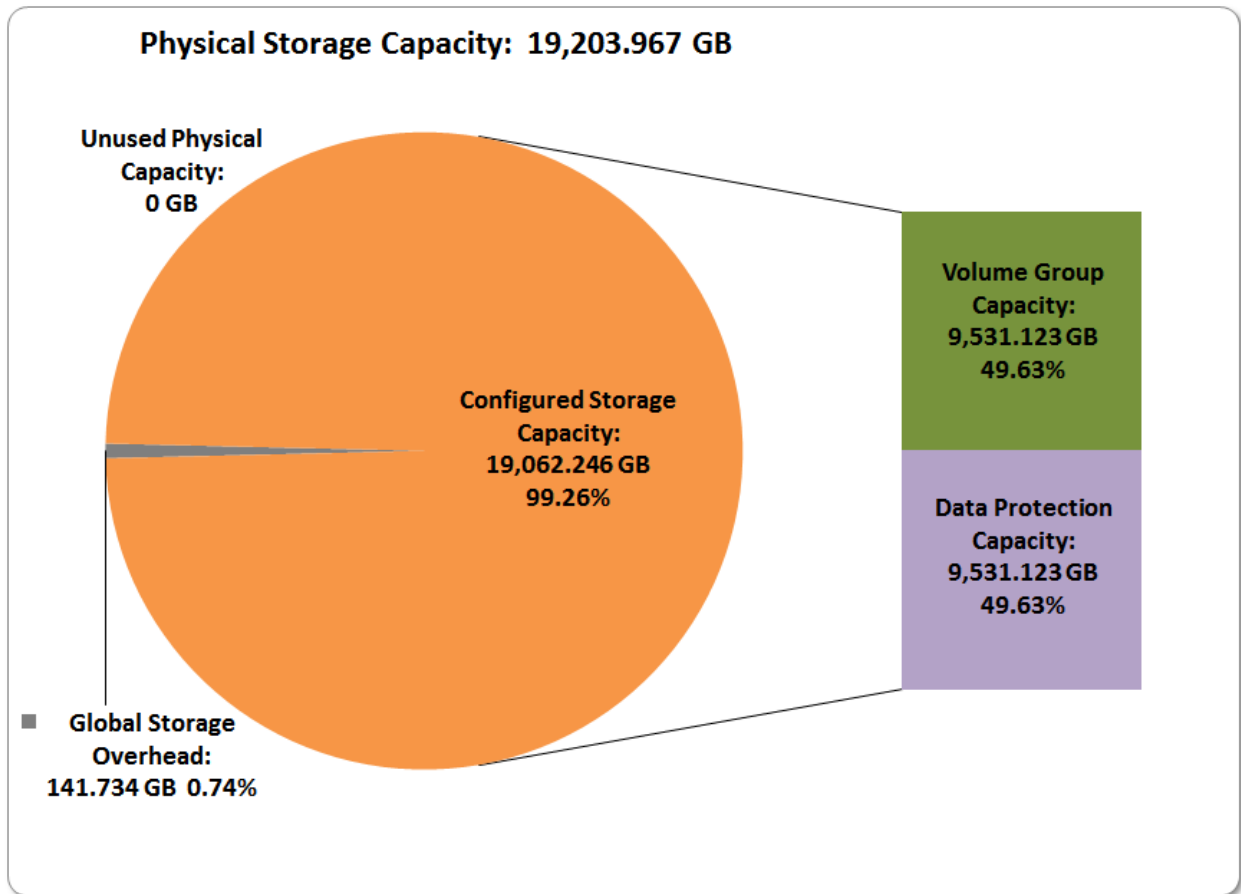
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page [8](#).

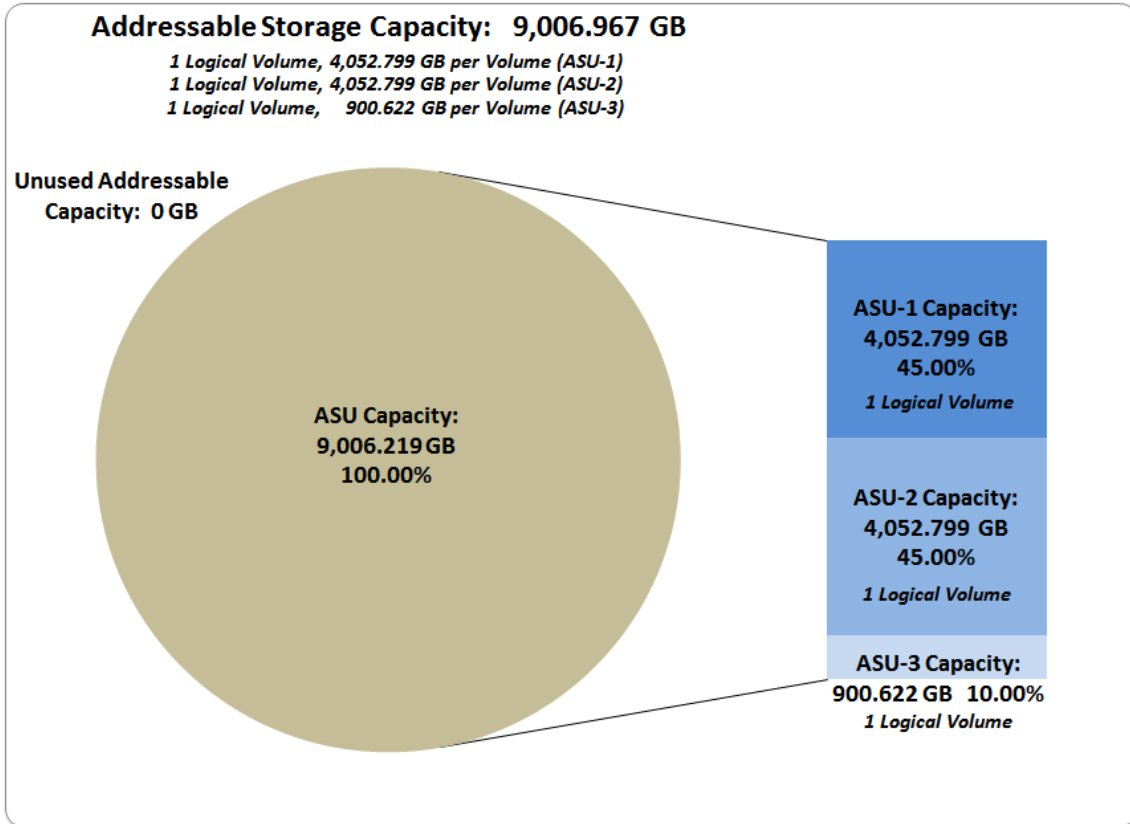
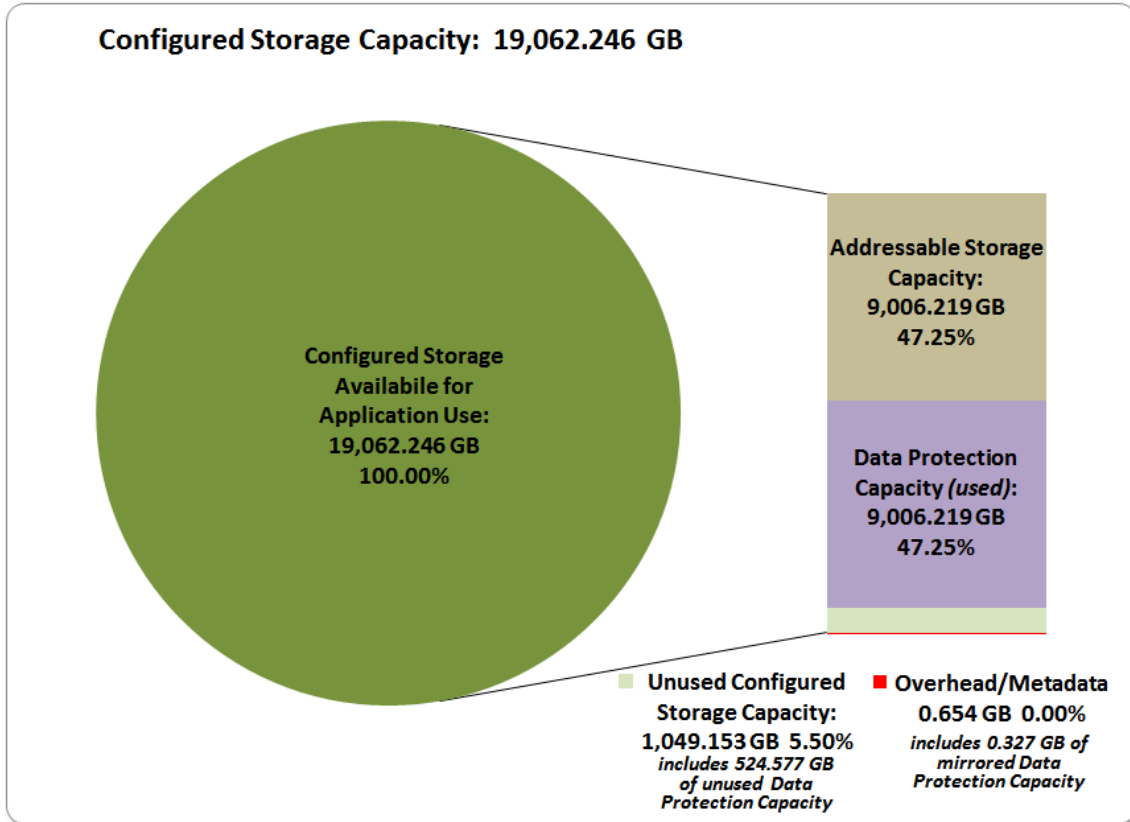
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country (*non-local currency*).

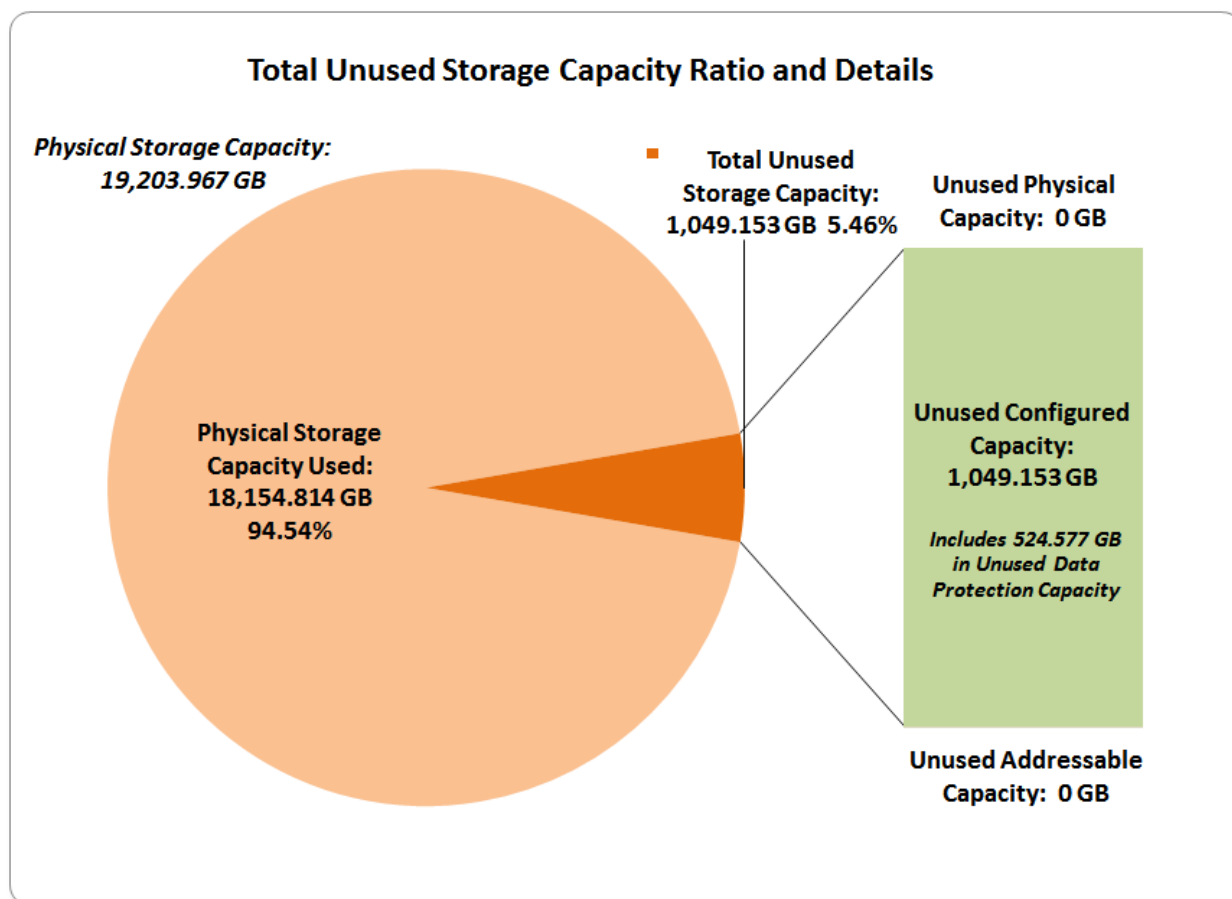
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

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.







SPC-1 Storage Capacity Utilization	
Application Utilization	46.90%
Protected Application Utilization	93.80%
Unused Storage Ratio	5.46%

Application Utilization: Total ASU Capacity (9,006.219 GB) divided by Physical Storage Capacity (19,203.967 GB).

Protected Application Utilization: (Total ASU Capacity (9,006.219 GB) plus total Data Protection Capacity (9,531.123 GB) minus unused Data Protection Capacity (524.577 GB)) divided by Physical Storage Capacity (19,203.967 GB).

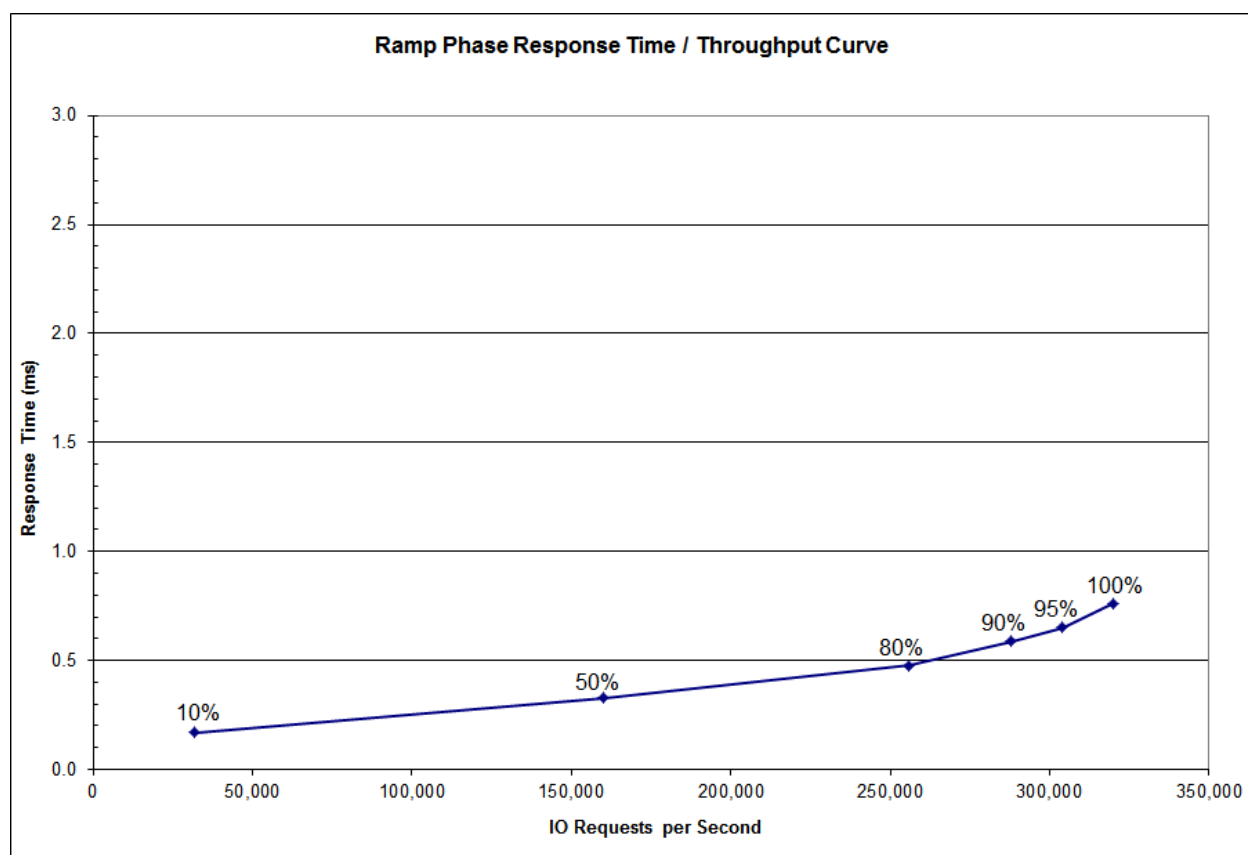
Unused Storage Ratio: Total Unused Capacity (1,049.153 GB) divided by Physical Storage Capacity (19,203.967 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 23-24 of the associated 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	31,982.88	159,978.55	256,013.33	288,013.89	303,978.03	319,980.28
Average Response Time (ms):						
All ASUs	0.17	0.33	0.48	0.59	0.65	0.76
ASU-1	0.16	0.31	0.44	0.53	0.59	0.68
ASU-2	0.17	0.32	0.46	0.56	0.61	0.71
ASU-3	0.18	0.38	0.57	0.72	0.81	0.96
Reads	0.19	0.32	0.43	0.49	0.53	0.57
Writes	0.16	0.33	0.51	0.65	0.73	0.88

Priced Storage Configuration Pricing

Part Number	Description	Quantity	Unit List Price	Extended LP
EF-X5681A-R6-C	Enclosure,EF5X0,Empty,2PSU,-C	1	\$ 3,880.00	\$ 3,880.00
EF-X561202A-R6-C	EF560A,12GB Controller,16Gb FC,4-ports,-C	2	\$ 21,925.00	\$ 43,850.00
EF-X4041C-C	SSD,800GB,Non-FDE,EF5X0,-C	24	\$ 2,705.00	\$ 64,920.00
OS-SANTRCTY-CAP3-EF-C	OS Enable,Per-0.1TB,SANTRCTY,Ultra-Stor,EF,-C	192	\$ 284.00	\$ 54,528.00
X-48895-00-R6-C	SFP,10Gb iSCSI/16Gb FC,Unified,E-Series,-C	8	\$ 600.00	\$ 4,800.00
	NetApp Hardware/Software Subtotal			\$ 171,978.00

CS-A2-4R-VA	Support, 3-yr 24/7, 4 hour on-site	1	\$ 11,355.12	\$ 11,355.12
-------------	------------------------------------	---	--------------	--------------

ServerSupply QLE2672-CK	QLE2672-CK Qlogic HBA, 16Gb FC, 2-ports	4	\$ 1,300.00	\$ 5,200.00
CDW 1148024	Tripp Lite, OM3 Optical cable, 2	8	\$ 22.99	\$ 183.92
	Third-Party Subtotal			\$ 5,383.92

Description	Extended LP	Discount	Discounted Price
NetApp Hardware/Software Subtotal	\$ 171,978.00	50%	\$ 85,989.00
Support	\$ 11,355.12	50%	\$ 5,677.56
Third-Party Subtotal	\$ 5,383.92	0%	\$ 5,383.92
Totals	\$ 188,717.04		\$ 97,050.48

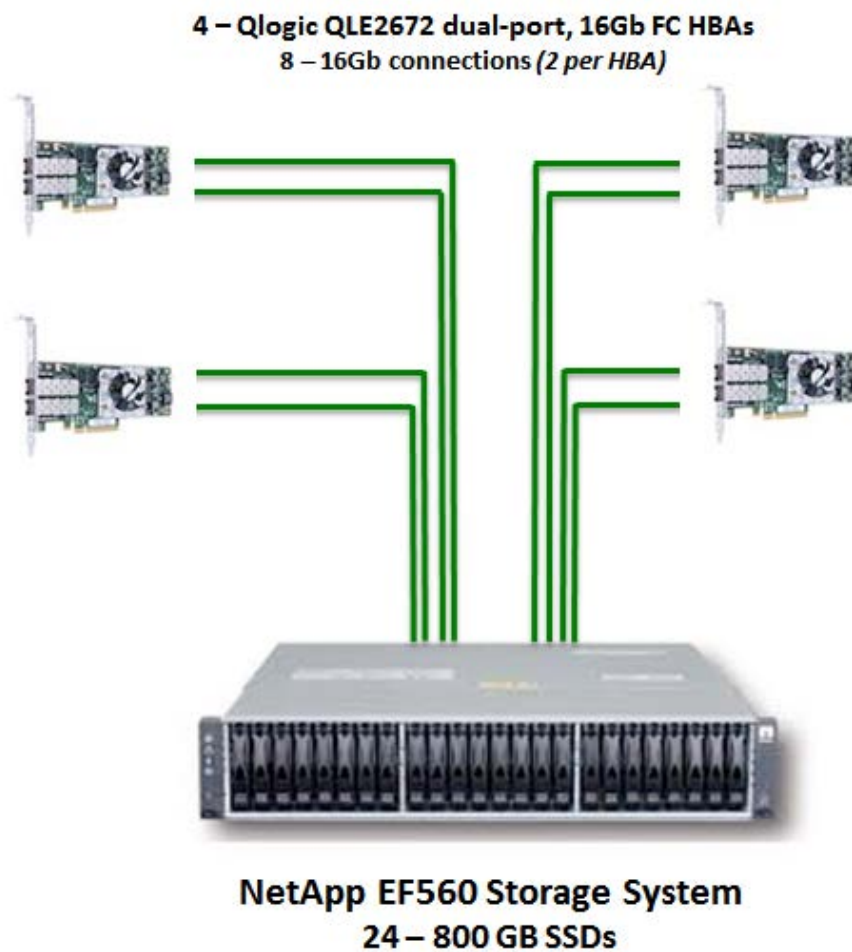
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- 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
4 – QLogic QLE2672-CK dual-port, 16Gb, FC HBAs
NetApp EF560 All-Flash Array 1 – Base Enclosure with 2 – controllers, each controller includes: 12 GB cache (24 GB total) 4 – 16 Gb FC front-end connections (8 total) 2 – 4 x 6Gb SAS backend connections (4 total) 24 – 800GB non FDE SSDs