SPC BENCHMARK 1™
EXECUTIVE SUMMARY

NETAPP, INC.
NETAPP EF560 STORAGE SYSTEM

SPC-1 V1.14

Submitted for Review: January 27, 2015
Submission Identifier: A00152

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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Revision Information and Key Dates

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SPC-1 Specification revision number	V1.14
SPC-1 Workload Generator revision number	V2.3.0
Date Results were first used publicly	January 27, 2015
Date the FDR was submitted to the SPC	January 27, 2015
Date the Priced Storage Configuration is available for shipment to customers	March 23, 2015
Date the TSC completed audit certification	January 25, 2015

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 extreme IOPS, sub millisecond response times, with industry leading bandwidth and enterprise-proven availability features. Additionally, the EF560 can be seamlessly expanded to 120 SSDs to a maximum raw capacity of 192TB.

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 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 Storage System	
Metric	**Reported Result**
SPC-1 IOPS™	245,011.76
SPC-1 Price-Performance™	$0.54/SPC-1 IOPS™
Total ASU Capacity	4,503.047 GB
Data Protection Level	Protected 2 *(mirroring)*
Total Price	$133,102.61
Currency Used	U.S. Dollars
Target Country for availability, sales and support	U.S.A.

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.*

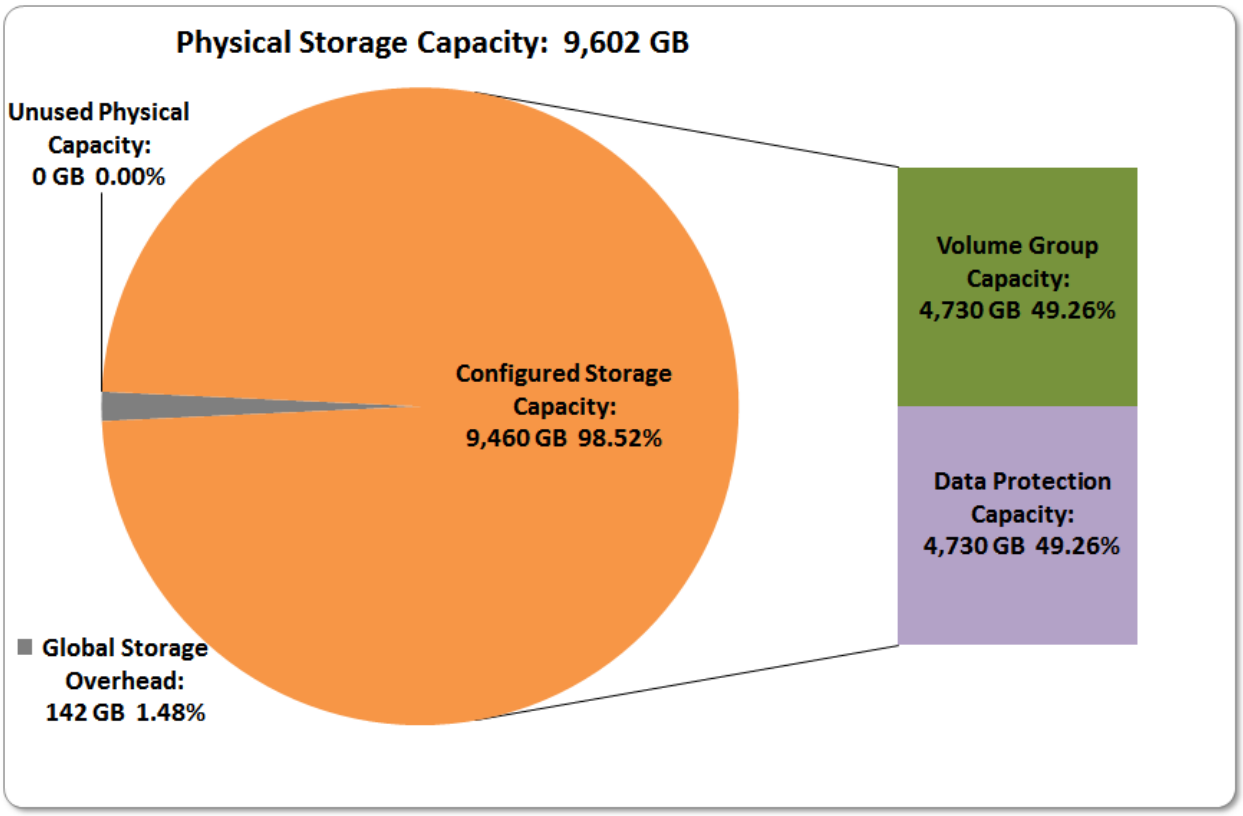
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 8.

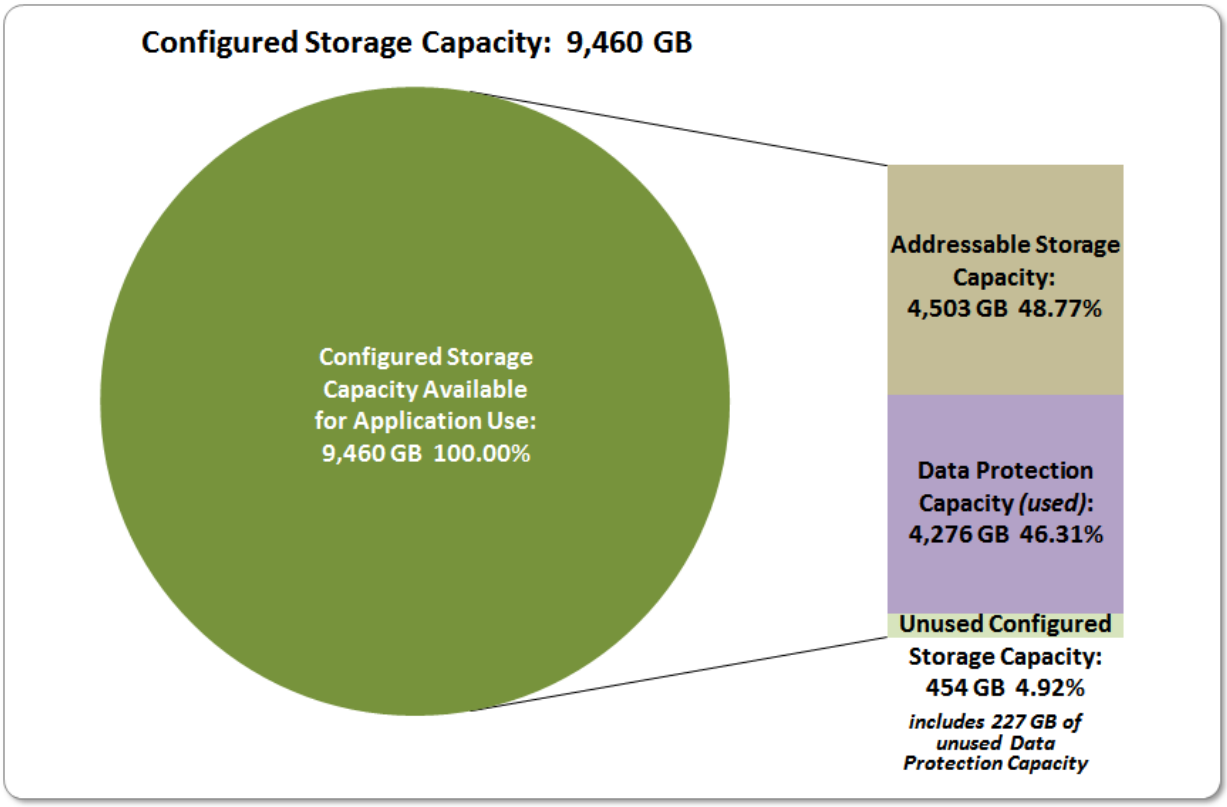
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

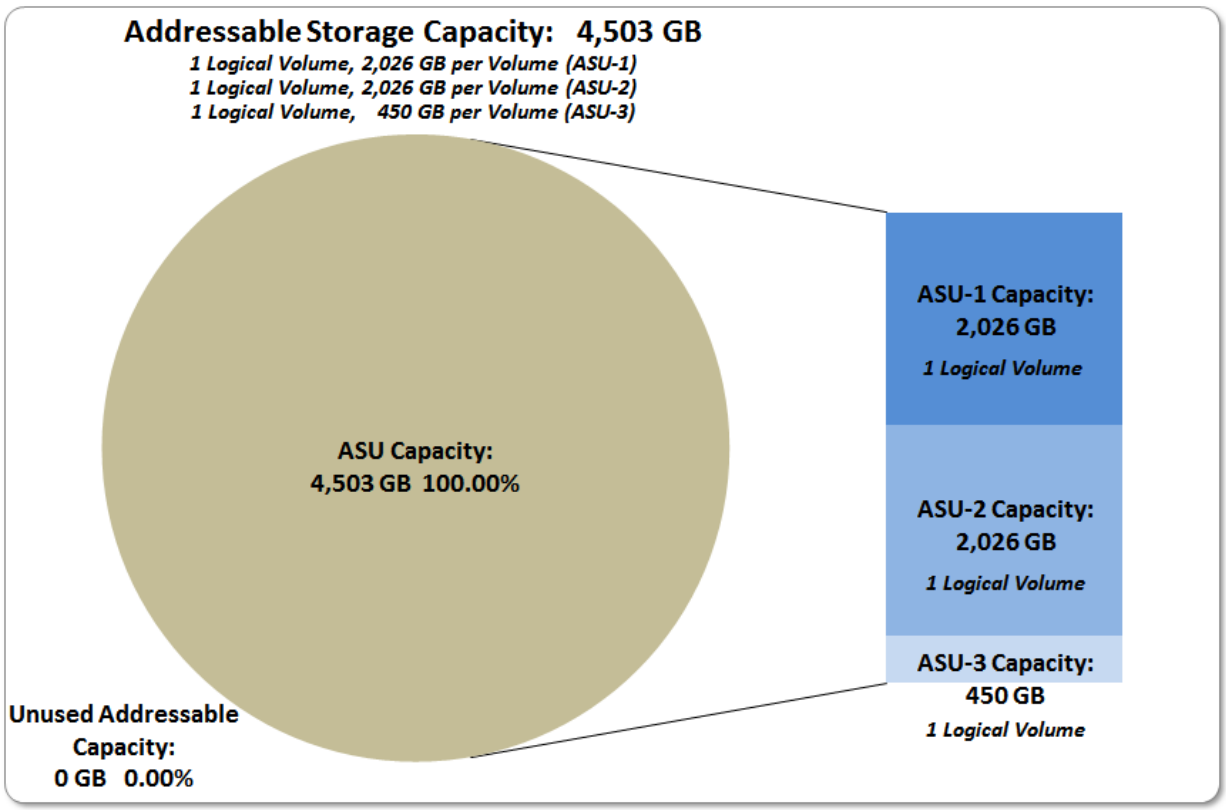
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

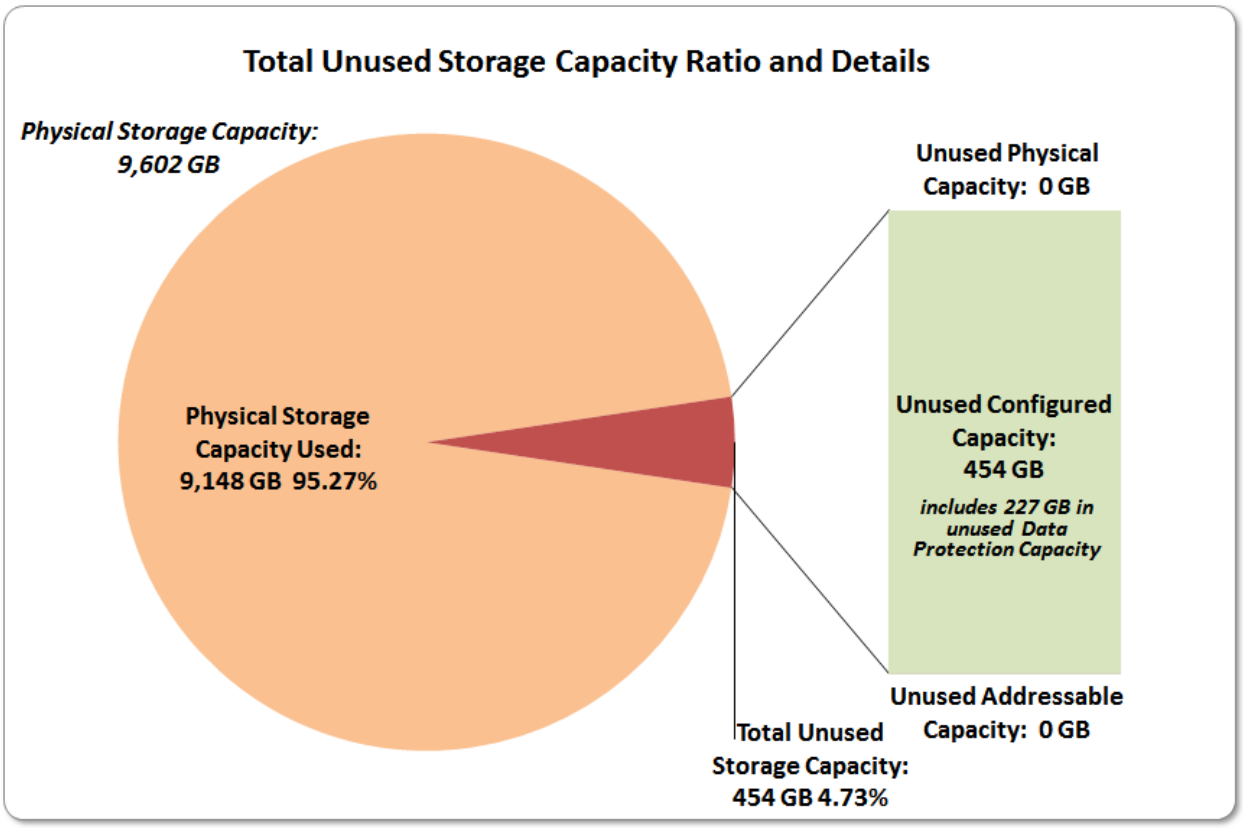
Storage Capacities, Relationships, and Utilization

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.




Configured Storage Capacity: 9,460 GB
Configured Storage Capacity Available for Application Use: 9,460 GB 100.00%
Addressable Storage Capacity: 4,503 GB 48.77%
Data Protection Capacity (used): 4,276 GB 46.31%
Unused Configured Storage Capacity: 454 GB 4.92%
includes 227 GB of unused Data Protection Capacity


Addressable Storage Capacity: 4,503 GB
1 Logical Volume, 2,026 GB per Volume (ASU-1)
1 Logical Volume, 2,026 GB per Volume (ASU-2)
1 Logical Volume, 450 GB per Volume (ASU-3)
ASU Capacity: 4,503 GB 100.00%
ASU-1 Capacity: 2,026 GB
1 Logical Volume
ASU-2 Capacity: 2,026 GB
1 Logical Volume
ASU-3 Capacity: 450 GB
1 Logical Volume
Unused Addressable Capacity: 0 GB 0.00%



SPC-1 Storage Capacity Utilization	
Application Utilization	49.90%
Protected Application Utilization	93.79%
Unused Storage Ratio	4.73%

Application Utilization: Total ASU Capacity *(4,503.047 GB)* divided by Physical Storage Capacity *(9,602.112 GB)*.

Protected Application Utilization: Total ASU Capacity *(4,503.047 GB)* plus total Data Protection Capacity *(4,730.192 GB)* minus unused Data Protection Capacity *(227.146 GB)* divided by Physical Storage Capacity *(9,602.112 GB)*.

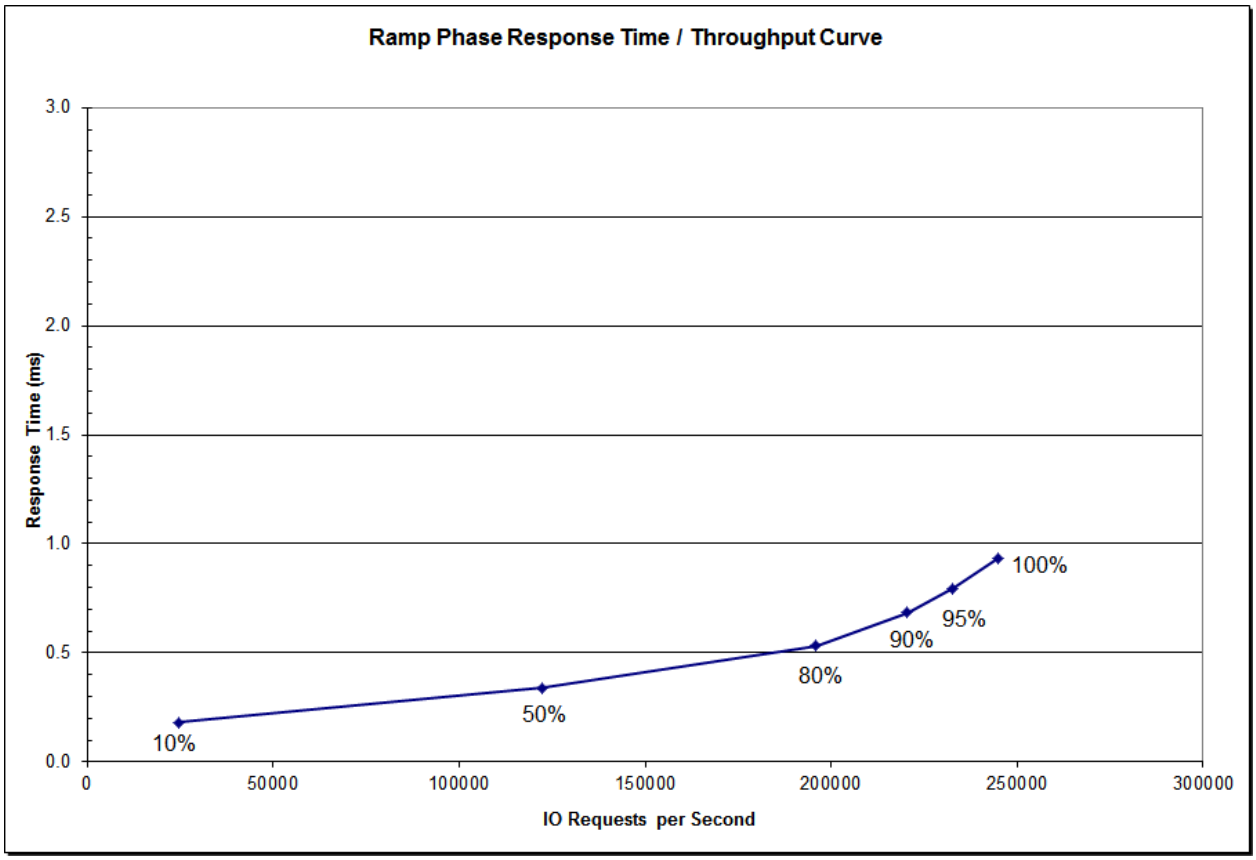
Unused Storage Ratio: Total Unused Capacity *(9,602.112 GB)* divided by Physical Storage Capacity *(454.065 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 22-23 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	24,501.04	122,491.97	196,008.41	220,508.87	232,761.95	245,011.76
Average Response Time (ms):						
All ASUs	0.18	0.34	0.53	0.69	0.79	0.93
ASU-1	0.18	0.35	0.54	0.67	0.77	0.89
ASU-2	0.19	0.35	0.55	0.69	0.78	0.91
ASU-3	0.17	0.32	0.52	0.71	0.86	1.04
Reads	0.23	0.42	0.61	0.71	0.78	0.86
Writes	0.15	0.29	0.49	0.67	0.81	0.98

Priced Storage Configuration Pricing

Part #	Description	Quantity	Unit Price	Extended Price
EF560-0001-R6	EF560, dual controller, 24x400GB SSD non FDE, 8 x 16Gb ports, SFP's, Base	1	115,321.50	115,321.50
CS-A2-4R-VA	Support, 3-yr 24/7, 4 hour on-site	1	10,109.23	10,109.23
CDW 286059	Qlogic QLE2672-CK dual-port 16Gb HBA	4	1,871.99	7,487.96
CDW 1148024	Tripp Lite 2 meter optical cable	8	22.99	183.92
	Total			**133,102.61**

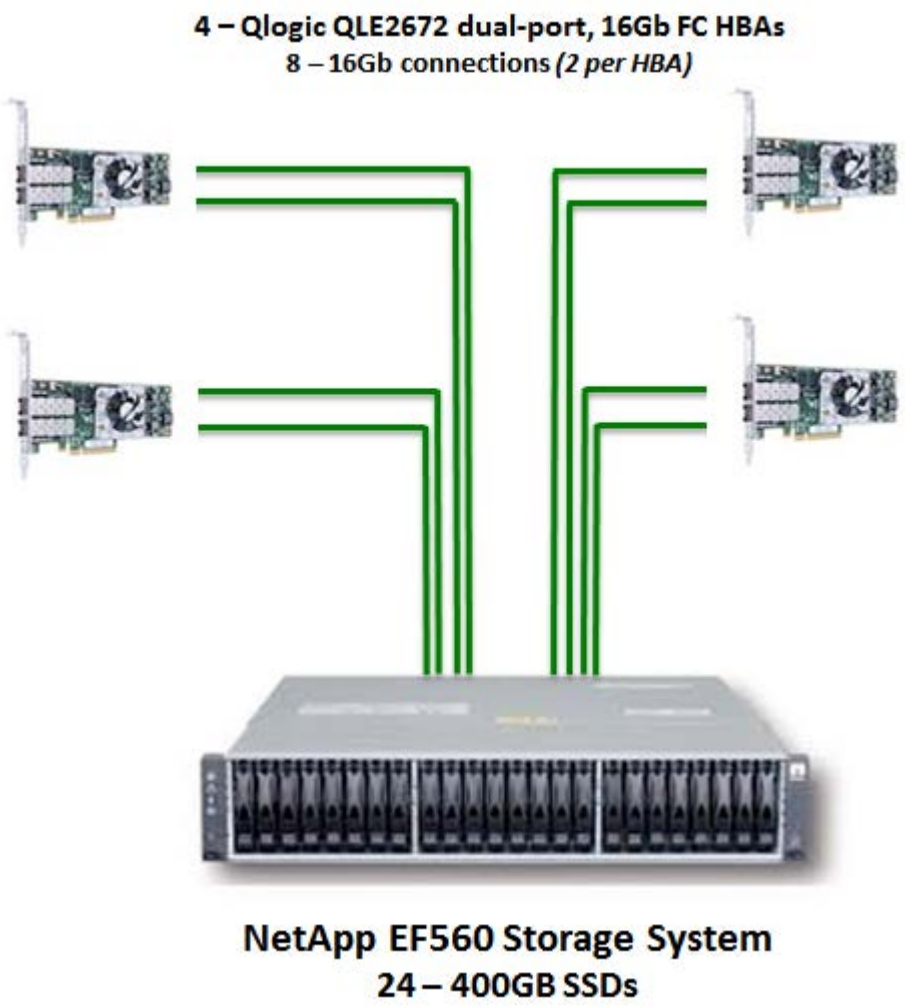
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- 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 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 Storage System 1 – Base Enclosure with 2 – controllers, each controller includes: 12 GB cache *(24 GB total)* 4 – 16 Gb FC front-end connection *(8 total)* 2 – 4 x 6Gb SAS backend connection *(4 total)* 24 – 400GB non FDE SSDs