SPC BENCHMARK 1™

EXECUTIVE SUMMARY

NETAPP, INC.

NETAPP® AFF A700S

SPC-1 V1.14

SUBMITTED FOR REVIEW: JANUARY 30, 2017

SUBMISSION IDENTIFIER: A02002

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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Auditor	InfoSizing – http://www.sizing.com/ Doug Johnson – doug@sizing.com 63 Lourdes Drive Leominster, MA 01453 Phone: (978) 343-6562

Revision Information and Key Dates

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SPC-1 Specification revision number	V1.14
SPC-1 Workload Generator revision number	V2.5.2
Date Results were first used publicly	January 30, 2017
Date the FDR was submitted to the SPC	January 30, 2017
Date the Priced Storage Configuration is available for shipment to customers	February 28, 2017
Date the Tested Storage Configuration completed audit certification	January 16, 2017

Tested Storage Product (TSP) Description

Designed specifically for flash, NetApp® All Flash FAS (AFF) A700s systems deliver industry-leading performance, capacity density, scalability, security and network connectivity in a dense form factor. At up to millions of IOPS and sub-millisecond latency per cluster, it is the fastest all-flash array built on a unified scale-out architecture. Therefore, the A700s is an ideal solution for business-critical workloads. The AFF A700s system allows customers to complete twice the work at half the latency as compared with the previous generation of AFF systems.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: NetApp® AFF A700s	
Metric	**Reported Result**
SPC-1 IOPS™	2,400,059.26
SPC-1 Price-Performance™	$0.62/SPC-1 IOPS™
Total ASU Capacity	77,504.698 GB
Data Protection Level	Protected 2 (*RAID DP*®)
Total Price	$1,493,103.71
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** is provided by using NetApp ***RAID DP®*** technology, which provides double-parity RAID protection against data loss with negligible performance overhead and no cost penalty compared to single-parity RAID.

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.*

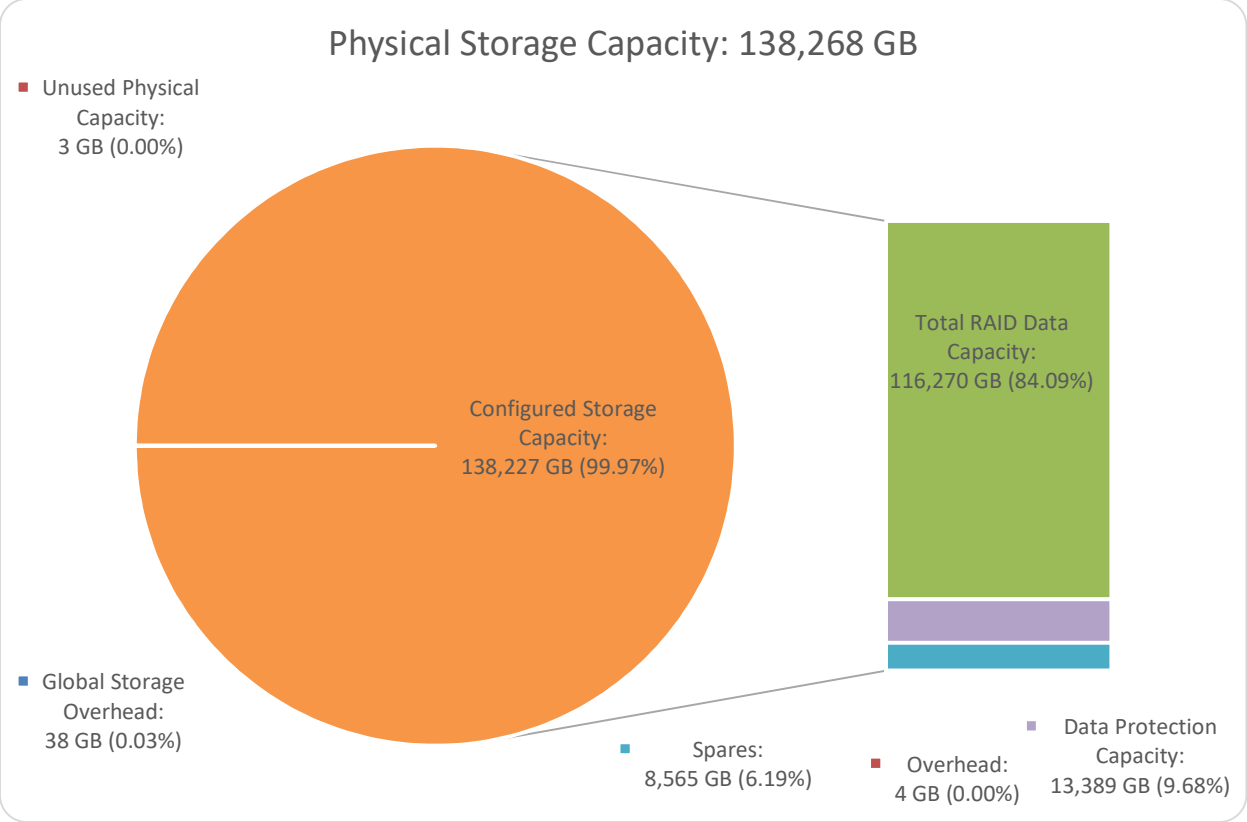
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support.

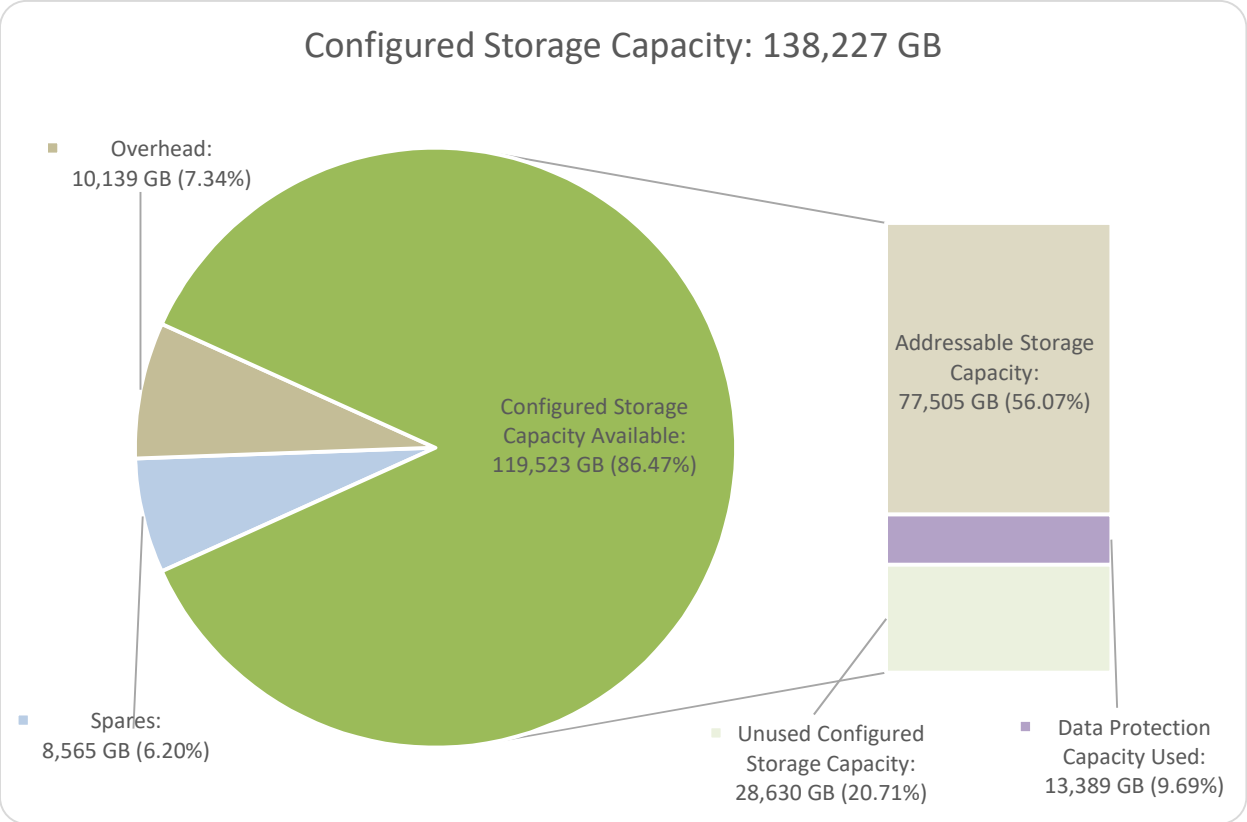
Currency Used is the formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

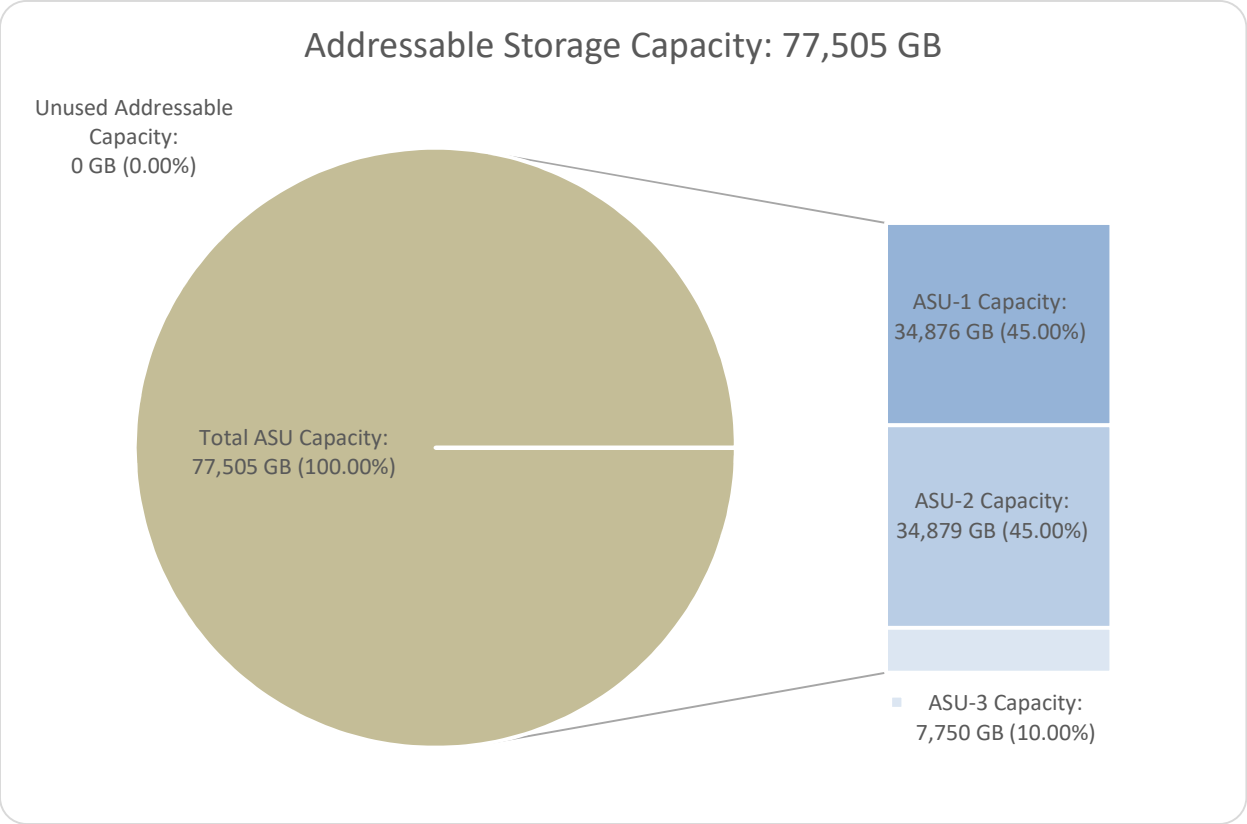
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly from a third-party supplier.

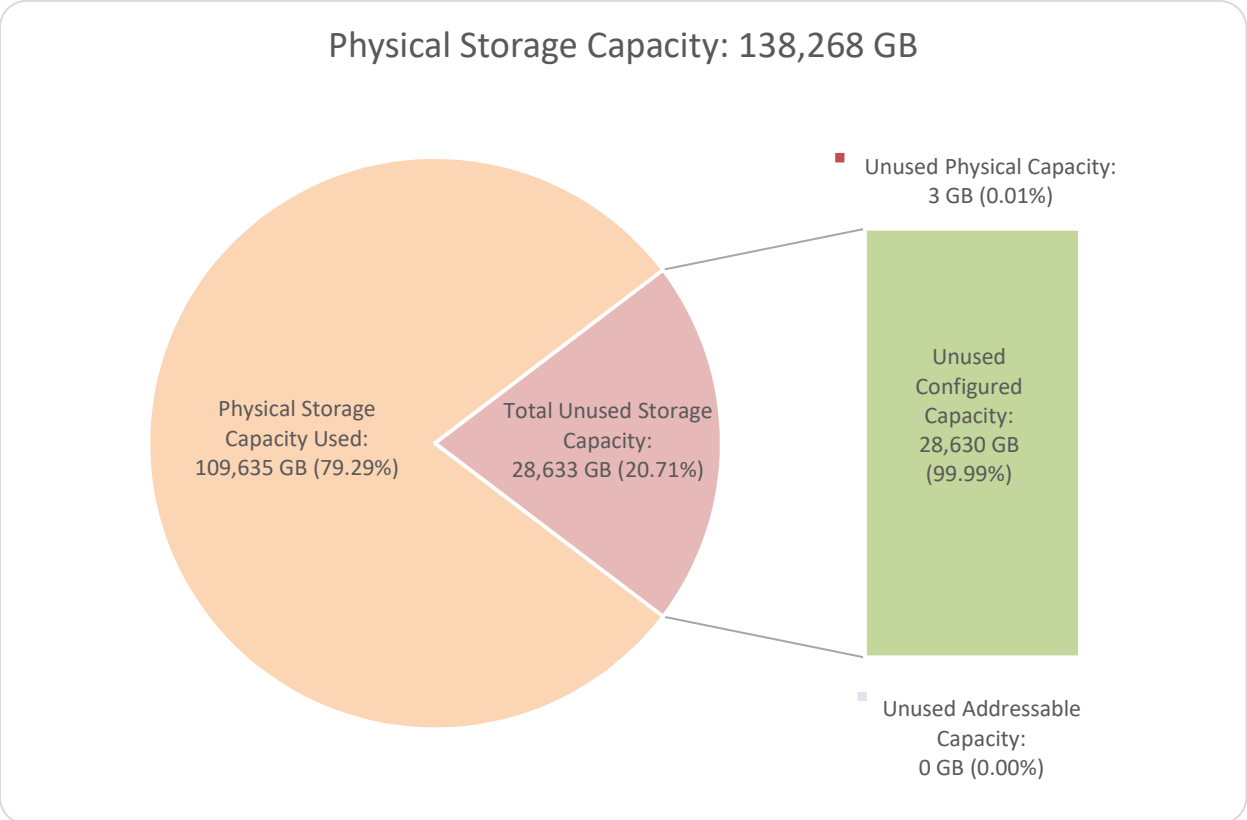
Storage Capacities, Relationships, and Utilization

The following four charts and the following table document the various storage capacities, used in this benchmark, their relationships, and the storage utilization values that must be reported. For the sake of readability, the capacity values in these charts are reported as integer values rather than the decimal values listed elsewhere in this document.


Physical Storage Capacity: 138,268 GB
Unused Physical Capacity: 3 GB (0.00%)
Configured Storage Capacity: 138,227 GB (99.97%)
Global Storage Overhead: 38 GB (0.03%)
Total RAID Data Capacity: 116,270 GB (84.09%)
Spares: 8,565 GB (6.19%)
Overhead: 4 GB (0.00%)
Data Protection Capacity: 13,389 GB (9.68%)


Configured Storage Capacity: 138,227 GB
Overhead: 10,139 GB (7.34%)
Configured Storage Capacity Available: 119,523 GB (86.47%)
Spares: 8,565 GB (6.20%)
Addressable Storage Capacity: 77,505 GB (56.07%)
Unused Configured Storage Capacity: 28,630 GB (20.71%)
Data Protection Capacity Used: 13,389 GB (9.69%)


Addressable Storage Capacity: 77,505 GB
Unused Addressable Capacity: 0 GB (0.00%)
Total ASU Capacity: 77,505 GB (100.00%)
ASU-1 Capacity: 34,876 GB (45.00%)
ASU-2 Capacity: 34,879 GB (45.00%)
ASU-3 Capacity: 7,750 GB (10.00%)


Physical Storage Capacity: 138,268 GB
Unused Physical Capacity: 3 GB (0.01%)
Physical Storage Capacity Used: 109,635 GB (79.29%)
Total Unused Storage Capacity: 28,633 GB (20.71%)
Unused Configured Capacity: 28,630 GB (99.99%)
Unused Addressable Capacity: 0 GB (0.00%)

SPC-1 Storage Capacity Utilization	
Application Utilization	56.05%
Protected Application Utilization	65.74%
Unused Storage Ratio	20.71%

Application Utilization: Total ASU Capacity *(*77,504.698 *GB)* divided by Physical Storage Capacity *(138,268.335 GB).*

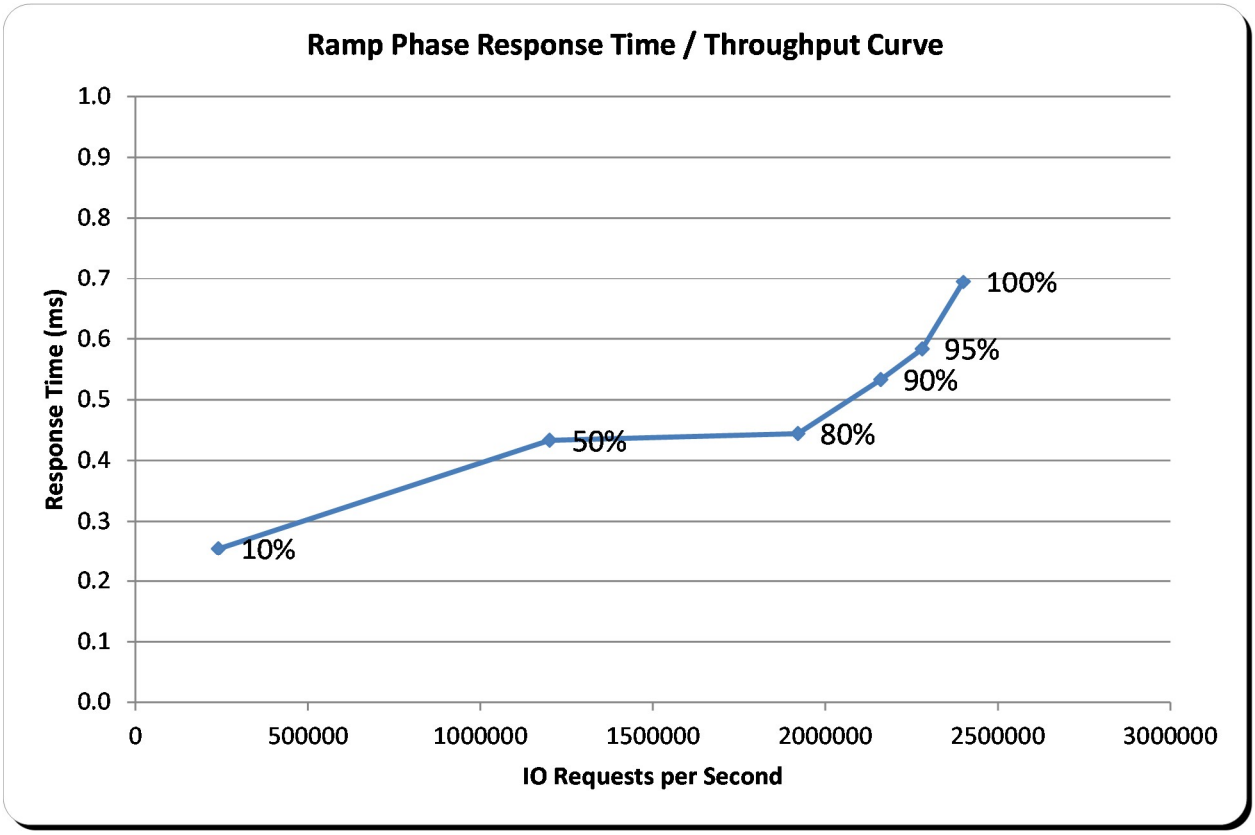
Protected Application Utilization: (Total ASU Capacity *(*77,504.698 *GB)* plus total Data Protection Capacity *(13,388.822 GB)* minus unused Data Protection Capacity *(0.000 GB)*) divided by Physical Storage Capacity *(138,268.335 GB).*

Unused Storage Ratio: Total Unused Capacity *(28,633.083 GB)* divided by Physical Storage Capacity *(138,268.335 GB)* and may not exceed 45%.

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 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	240,006.77	1,200,037.20	1,919,996.60	2,160,087.79	2,280,031.04	2,400,059.26
Avg. Response Time (ms)						
All ASUs	0.25	0.43	0.44	0.53	0.58	0.69
ASU-1	0.24	0.41	0.43	0.52	0.58	0.69
ASU-2	0.26	0.41	0.42	0.49	0.53	0.61
ASU-3	0.29	0.49	0.48	0.57	0.62	0.74
Reads	0.21	0.36	0.38	0.46	0.50	0.60
Writes	0.28	0.48	0.49	0.58	0.63	0.76

Priced Storage Configuration Pricing

Part Number	Description	Source	US List Price per Unit	Discount	Price per Unit	Quantity	Total Price
AFF-A700S-101-C	AFF A700s HA + 24x960GB SSD drives (HA pair + 24x960GB SSD internal drives)	NetApp	$ 265,070.00	50%	$ 132,535.00	6	$ 795,210.00
SW-FLASH-BASE-BUNDLE-C	ONTAP,Per-0.1TB,Flash,BASEBNDL,Ult-Perf,-C (BASE BNDL pricing for AFFA700s - OS + Protocols)	NetApp	$ 654.00	50%	$ 327.00	1382	$ 452,044.80
X-6510-48-16G-R6	Switch,Brocade 6510 48-Pt FF Ent 16G SWL SFPs	NetApp	$ 48,715.00	50%	$ 24,357.50	2	$ 48,715.00
X190001	Cisco Nexus 3132Q-X, 32 QSFP+ ports, low power, latency	NetApp	$ 13,000.00	50%	$ 6,500.00	2	$ 13,000.00
X66100-1	Cable,Direct Attach CU SFP+,40Gb,1m	NetApp	$ 250.00	50%	$ 125.00	2	$ 250.00
Panduit FX2ERLNLNSNM002	Cable,Cntlr-Switch,2m,Pair,LC/LC,Op (Fiber)	3rd Party Quote	$ 20.65		$ 20.65	48	$ 991.20
Panduit FX2ERLNLNSNM010	Cable,Host-Switch,10m,Pair,LC/LC,Op (Fiber)	3rd Party Quote	$ 34.25		$ 34.25	30	$ 1,027.50
X66031A	Cable,12Gb,Mini SAS HD to HD,1m (NVRAM10p to NVRAM10p HSL Link)	NetApp	$ 26.72	50%	$ 13.36	12	$ 160.32
Qlogic 2672-CK	Qlogic 16Gig 2port HBA for servers	3rd Party Quote	$ 1,290.00		$ 1,290.00	15	$ 19,350.00
X66100-5	Cable,Direct Attach CU SFP+,40Gb,5m	NetApp	$ 375.00	50%	$ 187.50	24	$ 4,500.00
X8712C-EN-R6-C	PDU, 1-Phase, 24 Outlet, 30A, NEMA, -C, R6	NetApp	$ 550.00	50%	$ 275.00	2	$ 550.00
X870E-EN-R6-C	Cab,Lighted,Empty,No PDU,No Rails,EN,-C	NetApp	$ 5,680.00	50%	$ 2,840.00	1	$ 2,840.00
X8778-R6-C	Mounting Bracket, Tie-Down, 32X0, -C, R6	NetApp	$ 50.00	50%	$ 25.00	12	$ 300.00
CS-O2-4HR- VA	HW Support,Premium2,4hr,y	NetApp	$ 49,701	50%	$ 24,850.32	6	$ 149,101.89
PS-TM-CONSULT-NB-DY-TE-ZA	Consulting Day+TE NonBus,ZA Exp. 1yr. from PO	NetApp	$ 5,063.00		$ 5,063.00	1	$ 5,063.00
Total ($)							$ 1,493,103.71

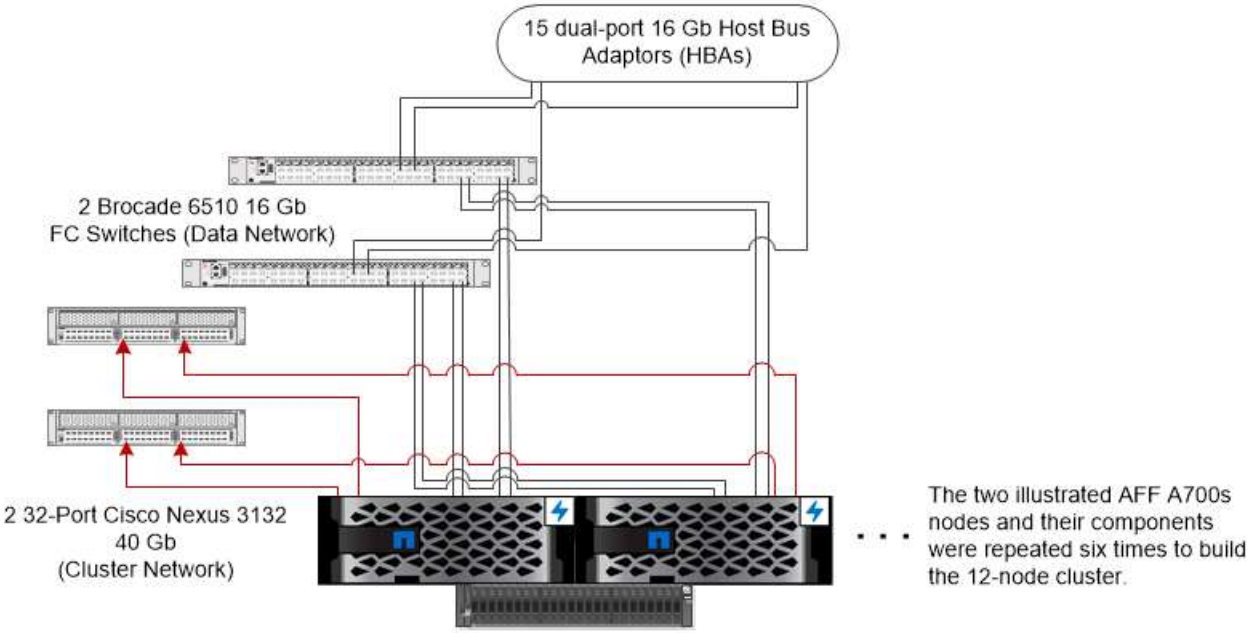
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- 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 Price Storage Configuration that can be remedied by the repair or replacement of a Priced Storage Configuration component.

Differences between Tested Storage Configuration and Priced Storage Configuration

There are no differences between the Tested Storage Configuration and the Priced Storage Configuration.

Priced Storage Configuration Diagram



NetApp AFF A700s Storage System
6 HA controller pairs (NetApp AFF A700s) (12 controller nodes total)
Each node includes:

- 512 GB memory/cache
- Internal SSDs – 24 x 960 GB SAS SSDs per HA pair
- 4 FC 32 Gb FC front-end connections (48 total) in a multipath high availability (HA) configuration
- 2 Cisco Nexus 3132 40 Gb 32-port switches (cluster network)
- 2 Brocade 6510 16 Gb 48-port switches (data network)
- 144 internal 960 GB solid state drives

Priced Storage Configuration Components

Priced Storage Configuration
15 QLogic QLE2672 dual-port 16 GB HBAs
2 Brocade 6510 16 GB, 48-port FC switches (data network)

NetApp® AFF A700s
• 6 HA controller pairs in 4RU chassis
• 2 controller nodes per chassis
• 12 controller nodes total. Each node includes:
  o 512 GB memory/cache (6144 GB total)
  o 4 32 GB FC front-end connections (48 total and used)
  o Internal 12 GB SAS (no cards, no cables)

2 Cisco Nexus 3132Q-X 40 GB 32 QSFP+ ports (cluster network)
144 960 GB Solid State Drives (SSDs) (24 SSDs per HA controller pair)
1 Cabinet – deep, heavy, no PDU, no rail
2 PDUs – 1-phase, 24 outlet, 30A NEMA