



**SPC BENCHMARK 1™
EXECUTIVE SUMMARY**

NETAPP, INC.

NETAPP® FAS8080 EX (*ALL-FLASH FAS*)

SPC-1 V1.14

Submitted for Review: April 22, 2015

Submission Identifier: A00154

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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

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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	April 22, 2015
Date the FDR was submitted to the SPC	April 22, 2015
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	April 21, 2015

Tested Storage Product (TSP) Description

NetApp's most powerful storage array, the NetApp® FAS8080 EX is purpose-built for business-critical workloads requiring massive performance, multi-PB scale, and leading flash integration—including all-flash configurations.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: NetApp® FAS8080 EX (<i>All-Flash FAS</i>)	
Metric	Reported Result
SPC-1 IOPS™	685,281.71
SPC-1 Price-Performance™	\$2.77/SPC-1 IOPS™
Total ASU Capacity	47,563.542 GB
Data Protection Level	Protected 2 (<i>RAID DP®</i>)
Total Price	\$1,897,999.00
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 RAID-DP®**, which provides double-parity RAID protection against data loss with negligible performance overhead and no cost penalty compared to single-parity RAID. Additional information is available at the following location: <http://www.netapp.com/us/products/platform-os/raid-dp.aspx>.

***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.

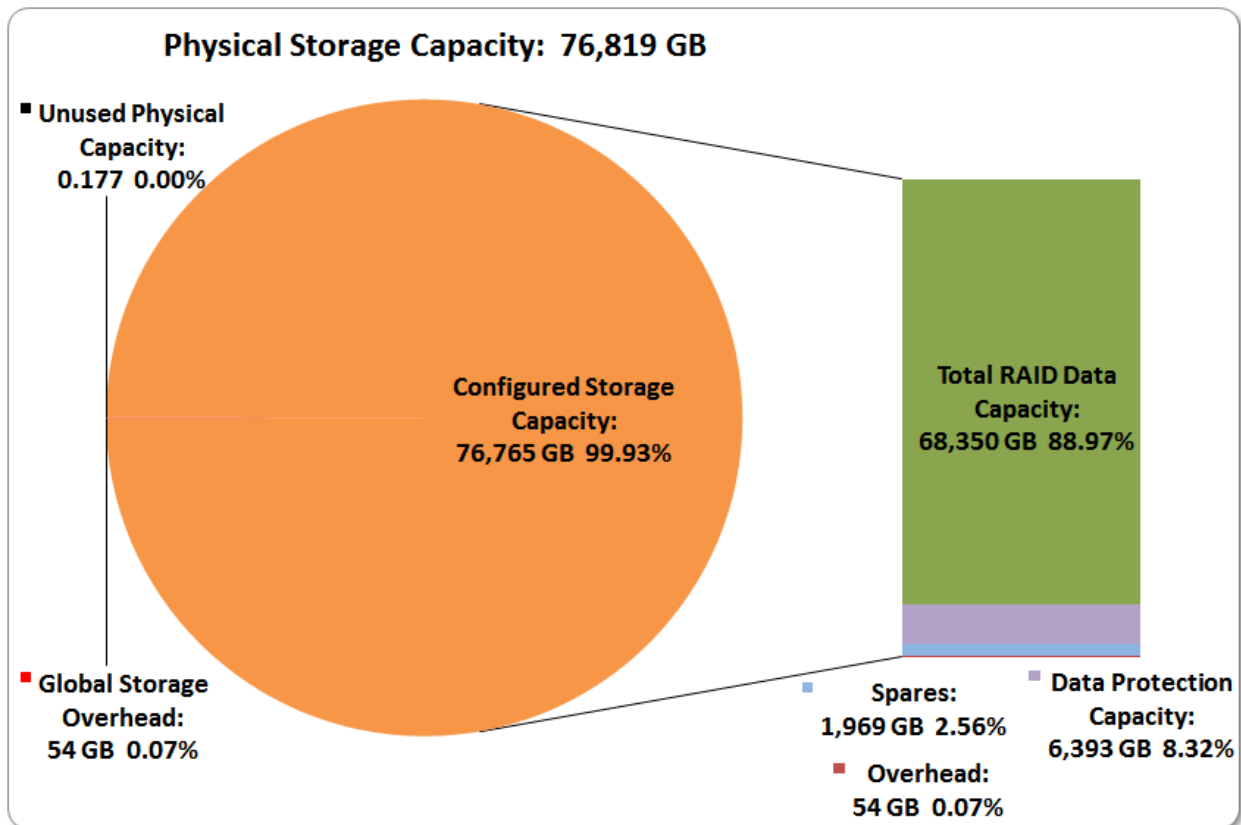
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country (*non-local currency*).

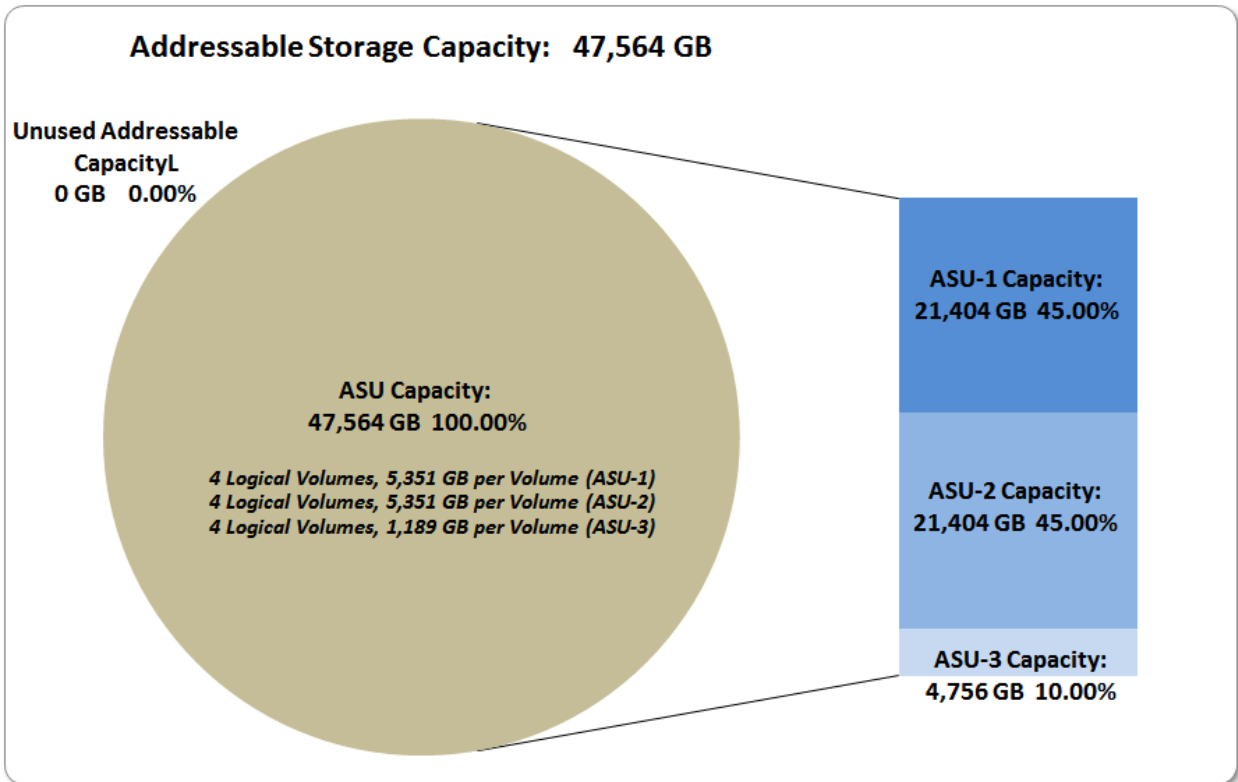
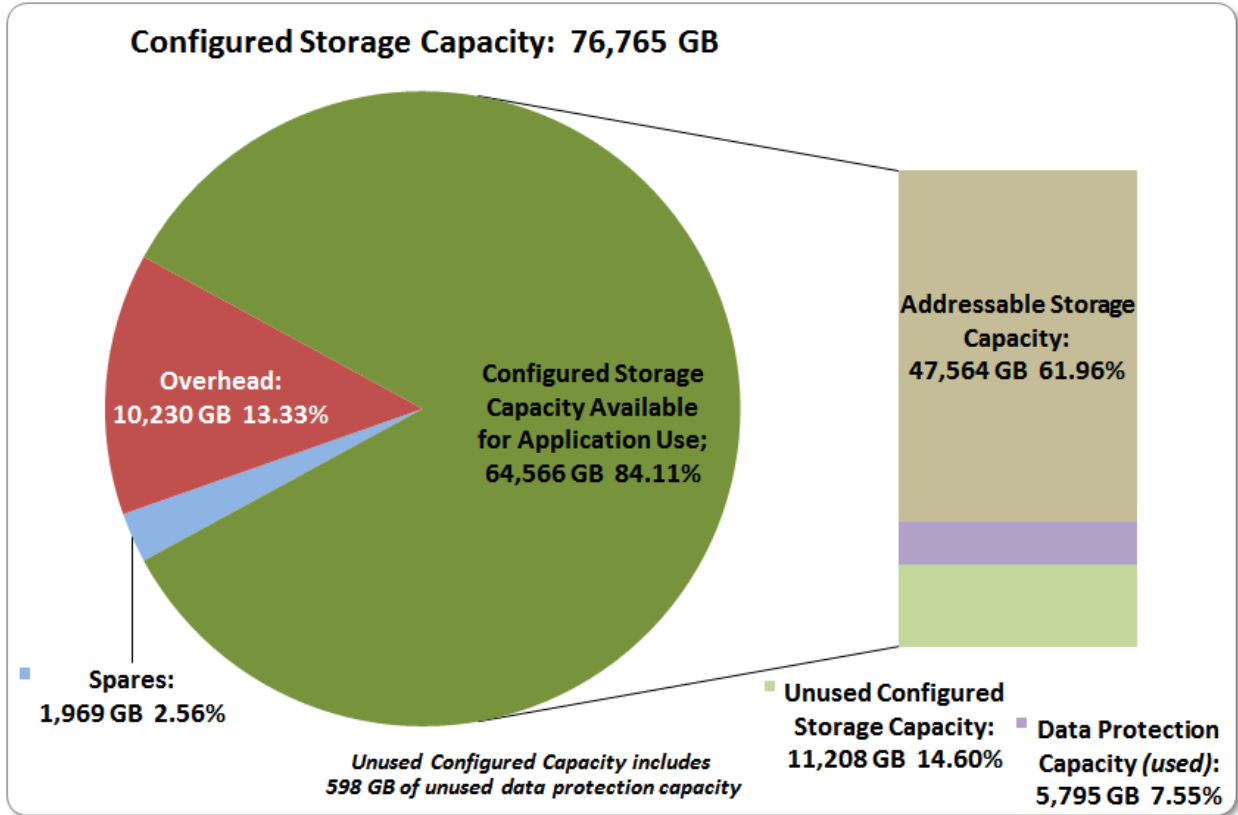
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

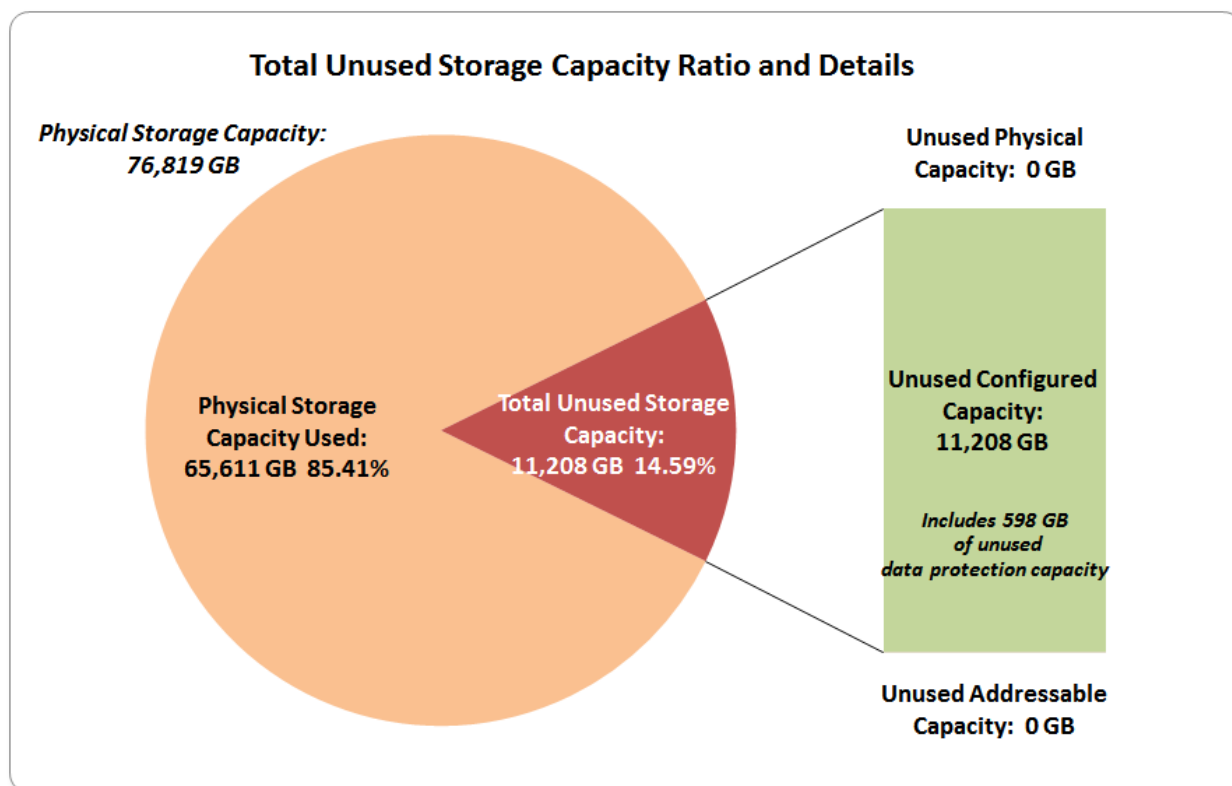
Storage Capacities, Relationships, and Utilization

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.







SPC-1 Storage Capacity Utilization	
Application Utilization	61.92%
Protected Application Utilization	69.46%
Unused Storage Ratio	14.59%

Application Utilization: Total ASU Capacity (46,563.542 GB) divided by Physical Storage Capacity (76,819.065 GB).

Protected Application Utilization: Total ASU Capacity (46,563.542 GB) plus total Data Protection Capacity (6,392.581 GB) minus unused Data Protection Capacity (597.883 GB) divided by Physical Storage Capacity (76,819.065 GB).

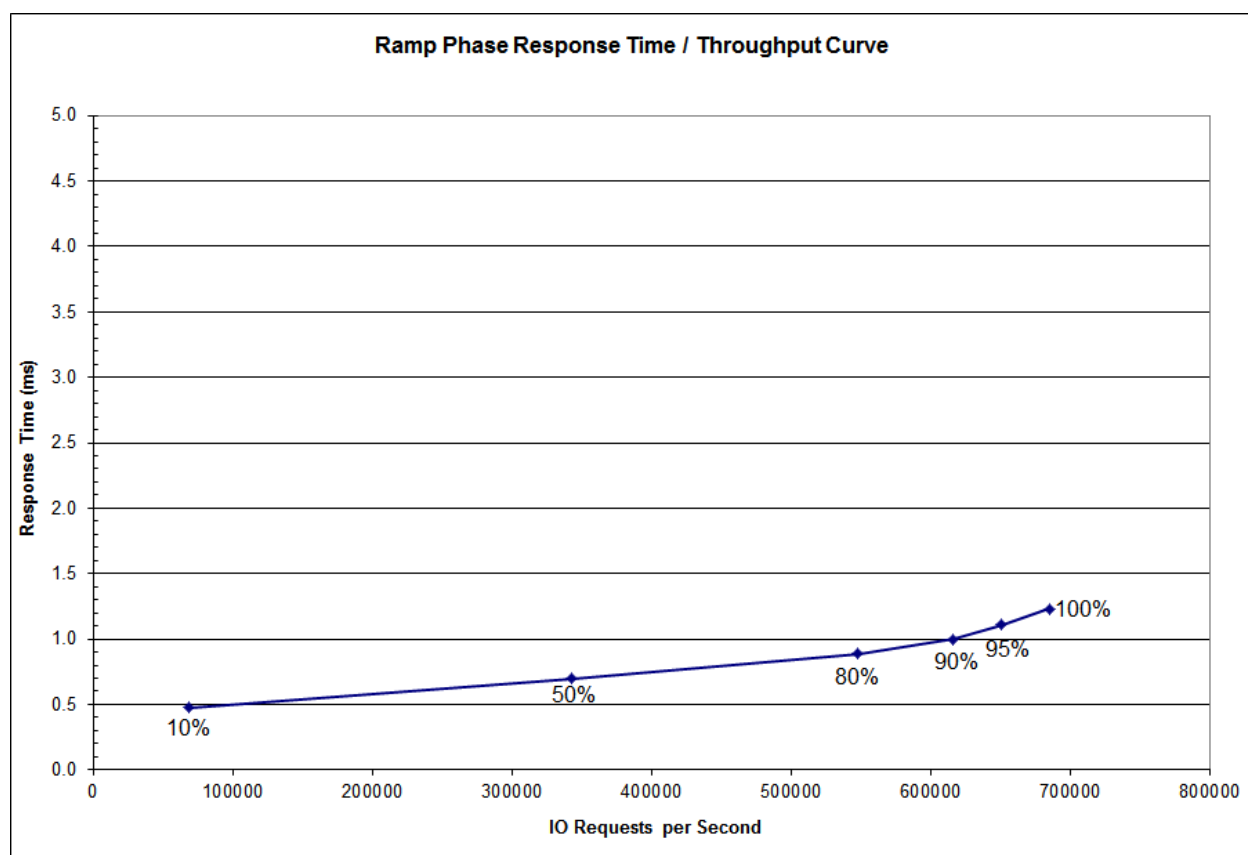
Unused Storage Ratio: Total Unused Capacity (11,208.123 GB) divided by Physical Storage Capacity (76,819.065 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 24-25 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	68,497.10	342,546.55	548,211.09	616,717.59	650,962.80	685,281.71
Average Response Time (ms):						
All ASUs	0.48	0.70	0.89	1.00	1.11	1.23
ASU-1	0.43	0.65	0.85	0.97	1.09	1.23
ASU-2	0.51	0.74	0.92	1.02	1.13	1.23
ASU-3	0.56	0.78	0.95	1.05	1.15	1.24
Reads	0.36	0.57	0.76	0.87	0.98	1.14
Writes	0.56	0.78	0.97	1.09	1.20	1.29

Priced Storage Configuration Pricing

	Description	List Price per UNIT	Quantity	Extended List
FAS8080AE-F-002-19.2TB-R6	FAS8080 HA System w/IOXM,19.2TB 48x200GB SSDs,1x4-port 3/6 Gb SAS card	\$ 89,000.00	8	\$ 712,000.00
SW-2-8080A-FCP	SW-2,FCP,8080A	\$ 26,550.00	8	\$ 212,400.00
OS-ONTAP-CAP3-OP-C	OS Enable,Per-0.1TB,ONTAP,Ultra-Stor,OP,-C	\$ 780.00	768	\$ 599,040.00
X-6510-48-16G-R6-C	Switch,Brocade 6510 48-Pt FF w/8G SWL SFPs	\$ 48,715.00	2	\$ 97,430.00
X-SFP-H10GB-CU3M-R6	Cisco N5020 10GBase Copper SFP+cable, 1m, -C, R6 (Cluster interconnect)	\$ 112.00	32	\$ 3,584.00
X1967-R6	ClusterNet Interconnect,48Pt,10Gb	\$ 34,500.00	2	\$ 69,000.00
X6524-R6	Cable,Cntlr-Shelf/Switch,2m,Pair,LC/LC,Op	\$ 125.00	50	\$ 6,250.00
Third-Party	QLogic QLE2672 16Gig 2port HBA for servers	\$ 1,250.00	9	\$ 11,250.00
X2065A-EN-R6-C	HBA SAS 4-Port Copper 3/6 Gb QSFP PCIe,EN,-C	\$ 1,400.00	8	\$ 11,200.00
X6558-EN-R6-C	Cable, SAS Cntlr-Shelf/Shelf-Shelf/HA, 2m, -C, 16 per cluster, 4 x 16	\$ 125.00	64	\$ 8,000.00
X8712C-EN-R6-C	PDU, 1-Phase, 24 Outlet, 30A, NEMA, -C, R6	\$ 550.00	4	\$ 2,200.00
X870D-EN-R6-C	Cab,Deep,HeavyDuty,Empty,No PDU,No Rail,EN,-C	\$ 3,595.00	2	\$ 7,190.00
X8778-R6-C	Mounting Bracket, Tie-Down, 32X0, -C, R6	\$ 50.00	8	\$ 400.00
CS-A2-4R	SupportEdge Standard Replace 4hr, Hardware Support: 3 years			\$ 81,591.00
SW Support	SW Support 3 years			\$ 76,464.00
Total (\$) LIST				\$ 1,897,999.00

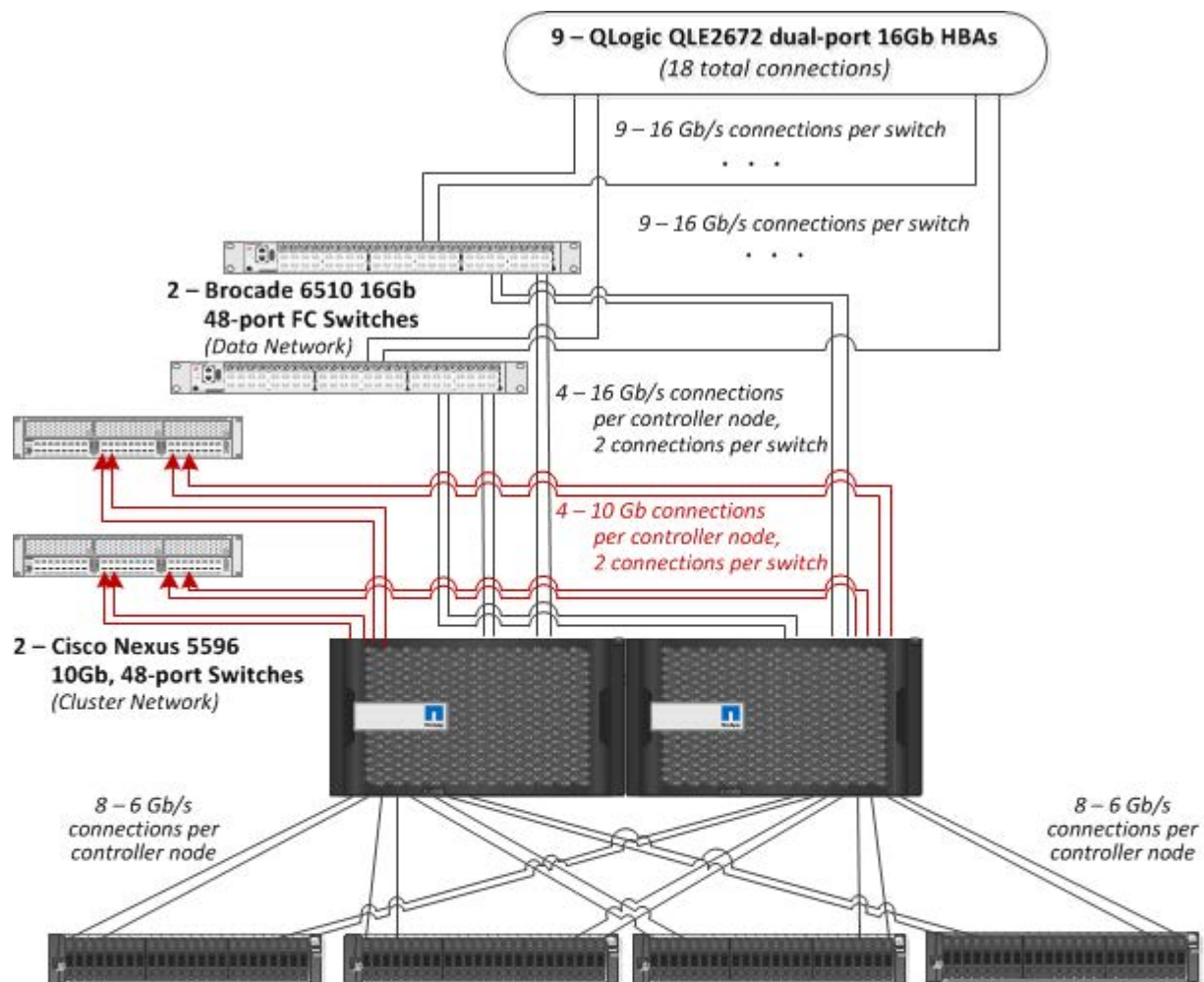
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- 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



NetApp® FAS8080 EX Storage System (All Flash FAS)

4 HA controller pairs, 2 controller nodes per pair
(1 HA controller pair, 2 controller nodes illustrated above)

8 controller nodes total

each controller node includes:

128 GB memory/cache (1024 GB total)

4 – 16Gb FC front-end connections (32 total and used)

2 – 4-port 6Gb SAS cards (16 cards total)

8 – 6Gb SAS backend connections (64 total and used)

16 – Disk Shelves (2 per controller node)

384 – 200GB eMLC Solid State Drives (SSDs)

(24 SSDs per disk shelf)

Priced Storage Configuration Components

Priced Storage Configuration
9 – QLogic QLE2672 dual-port 16Gb HBAs
2 – Brocade 6510 16Gb 48-port FC switches (<i>data network</i>)
NetApp® FAS8080 EX (All-Flash FAS)
4 HA controller pairs 2 controller nodes per pair 8 controller nodes total each controller node includes: 128 GB memory/cache (<i>1024 GB total</i>) 4 – 16Gb FC front-end connections (<i>32 total and used</i>) 8 – 6Gb SAS backend connections (<i>64 total and used</i>) (<i>in a Multipath, High Availability (HA) configuration</i>) 2 – 4-port SAS cards (<i>16 cards total</i>) 8 – SAS backend ports (<i>64 ports total</i>)
2 – Cisco Nexus 5596 10Gb 48-port switches (<i>cluster network</i>)
16 – DS2426 Disk Shelves
384 – 200GB eMLC Solid State Drives (SSDs) (<i>24 SSDs per disk shelf</i>)
2 – Cabinets – deep, heavy, no PDU, no rail
4 – PDUs – 1-phase, 24 outlet, 30A NEMA (<i>2 PDUs per cabinet</i>)