SPC BENCHMARK 2™

EXECUTIVE SUMMARY

NETAPP, INC.

NETAPP EF570 ALL-FLASH ARRAY

SPC-2™ V1.7

SUBMITTED FOR REVIEW: SEPTEMBER 19, 2017

SUBMISSION IDENTIFIER: B12003

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	NetApp, Inc. – www.netapp.com Mark Regester – mark.regester@netapp.com
Auditor	InfoSizing – http://www.sizing.com/ Doug Johnson – doug@sizing.com

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-2 Specification revision number	V1.7
SPC-2 Workload Generator revision number	V1.3.0
Date Results were first used publicly	September 19, 2017
Date FDR was submitted to the SPC	September 19, 2017
Date the TSC will be available for shipment to customers	October 9, 2017
Date the TSC completed audit certification	September 18, 2017

Tested Storage Product Description

NetApp EF570 all flash system is a 4th generation all-flash array designed specifically for performance-intensive workloads such as big data analytics, technical computing and video surveillance. With extremely high throughput, and low latencies, the EF570 is designed to increase application responsiveness and accelerate modern enterprise applications. The system supports 367TB of raw flash capacity in a modular 2U building block that scales to 1.8PB

The EF570 also supports multiple high-speed host interfaces including a new 100Gb NVMe-over-InfiniBand – one of the first enterprise-class arrays with support for NVMe. SANtricity System Manager gives customers the flexibility to manage their NetApp EF570 systems wherever they are at all times through an easy-to-use, on-box, web-based interface. SANtricity Cloud Connector enables NetApp Data Fabric, or Hybrid Cloud capabilities, by providing cost-effective backup and recovery to the cloud.

NetApp E-Series arrays have a rich, 20+ year legacy of providing industry leading price/performance, value and reliability, with over 1 million systems installed.

SPC-2 Reported Data

SPC-2 Reported Data consists of three groups of information:

- The following SPC-2 Primary Metrics, which characterize the overall benchmark result:
  - SPC-2 MBPS™
  - SPC-2 Price Performance™
  - Application Storage Unit (ASU) Capacity
- Supplemental data to the SPC-2 Primary Metrics.
  - Total Price
  - Data Protection Level
  - Currency Used
  - Target Country
- Reported Data for each SPC Test: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand Delivery (VOD) Test.

SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

SPC-2 Price-Performance™ is the ratio of **Total Price** to **SPC-2 MBPS™**.

ASU *(Application Storage Unit)* **Capacity** represents the total storage capacity available to be read and written in the course of executing the SPC-2 benchmark.

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

Data Protection Level of **Protected 2** using ***Mirroring***, which 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-2 Data Repository.*

Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-2 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.

SPC-2 Reported Data				
NetApp EF570 All-Flash Array				
SPC-2 MBPS™	**SPC-2 Price-Performance**	**ASU Capacity (GB)**	**Total Price**	**Data Protection Level**
17,337.75	$3.69	12,708.137	$63,924.52	Protected 2 *(RAID-6)*
The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD).				
Currency Used:		**"Target Country":**		
U.S. Dollars		USA		

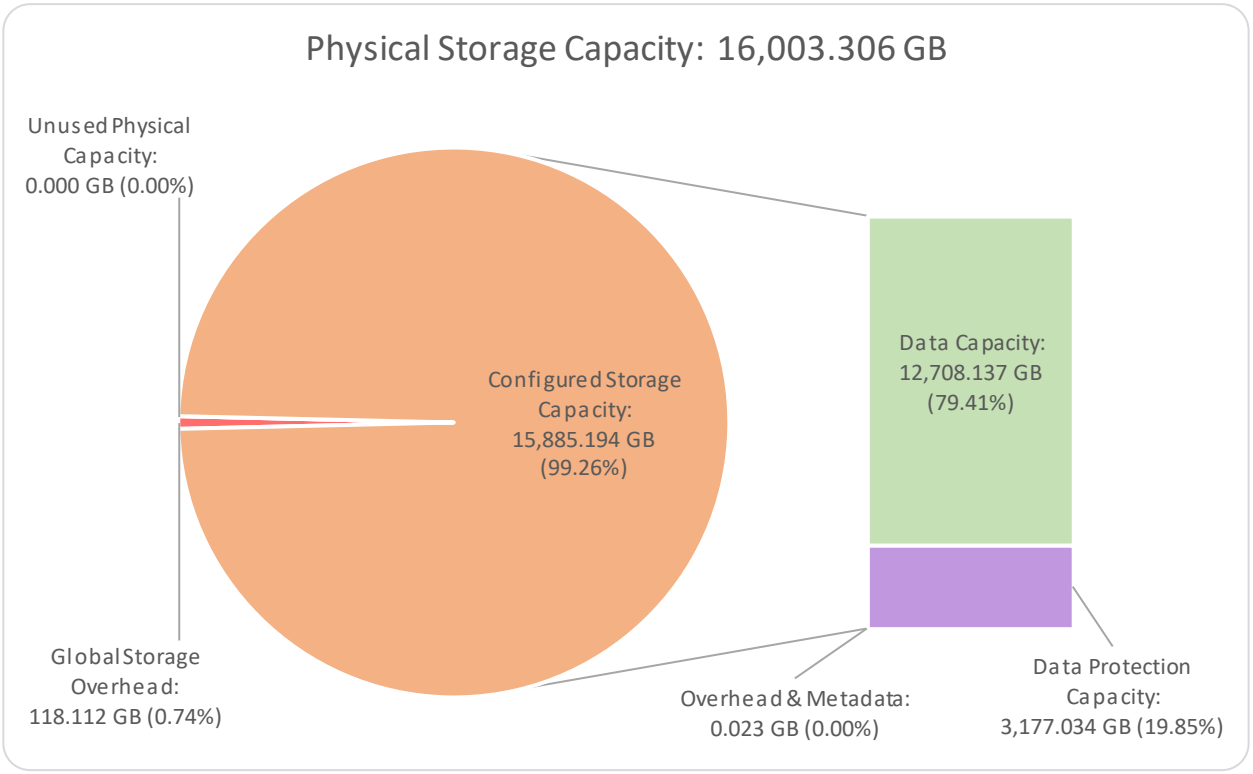
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate (MB/second)	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LFP Composite	12,919.90			$4.95
Write Only:				
1024 KiB Transfer	6,788.76	48	141.43	
256 KiB Transfer	6,507.65	48	135.58	
Read-Write:				
1024 KiB Transfer	10,993.32	48	229.03	
256 KiB Transfer	11,193.29	96	116.60	
Read Only:				
1024 KiB Transfer	20,995.07	96	218.70	
256 KiB Transfer	21,041.29	96	219.18	
The above SPC-2 Data Rate value for LFP Composite represents the aggregate performance of all three LFP Test Phases: (Write Only, Read-Write, and Read Only).				

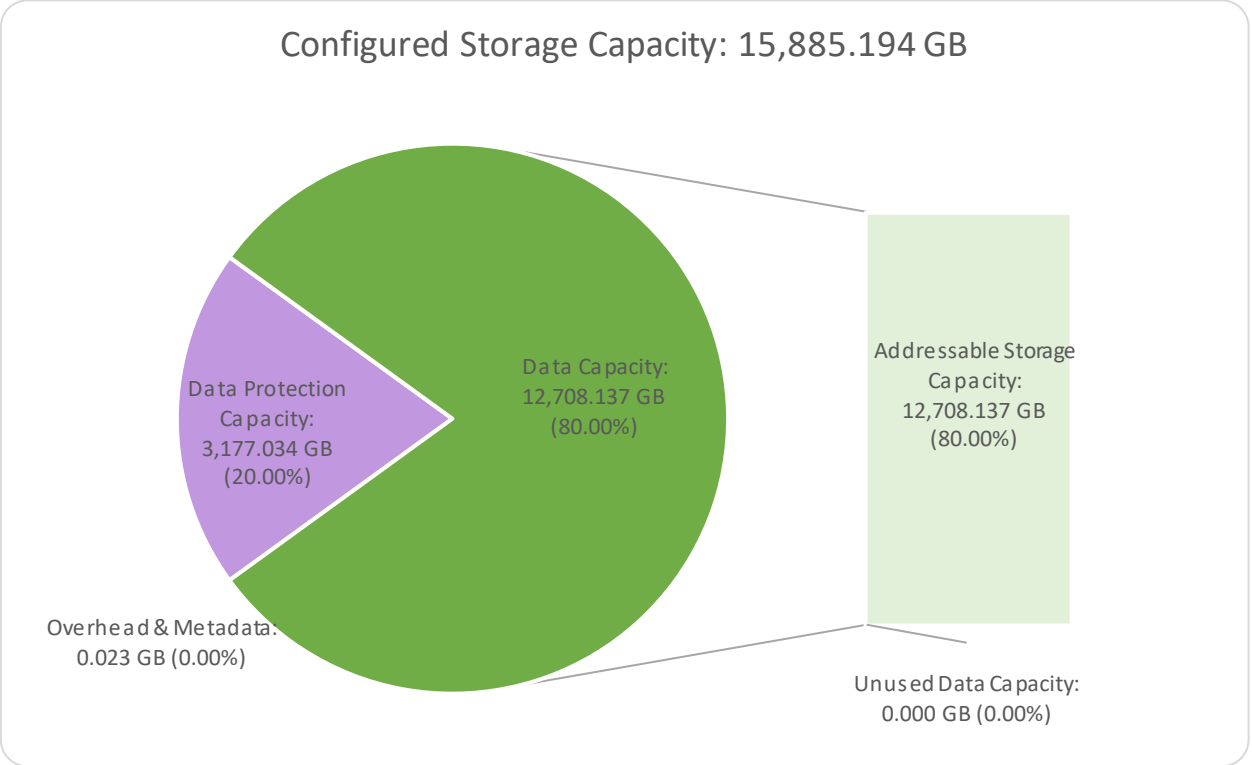
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate (MB/second)	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
LDQ Composite	21,005.36			$3.04
1024 KiB Transfer Size				
4 I/Os Outstanding	21,127.43	24	880.31	
1 I/O Outstanding	21,030.26	96	219.07	
64 KiB Transfer Size				
4 I/Os Outstanding	20,999.75	96	218.75	
1 I/O Outstanding	20,864.01	48	434.67	
The above SPC-2 Data Rate value for LDQ Composite represents the aggregate performance of the two LDQ Test Phases: (1024 KiB and 64 KiB Transfer Sizes).				

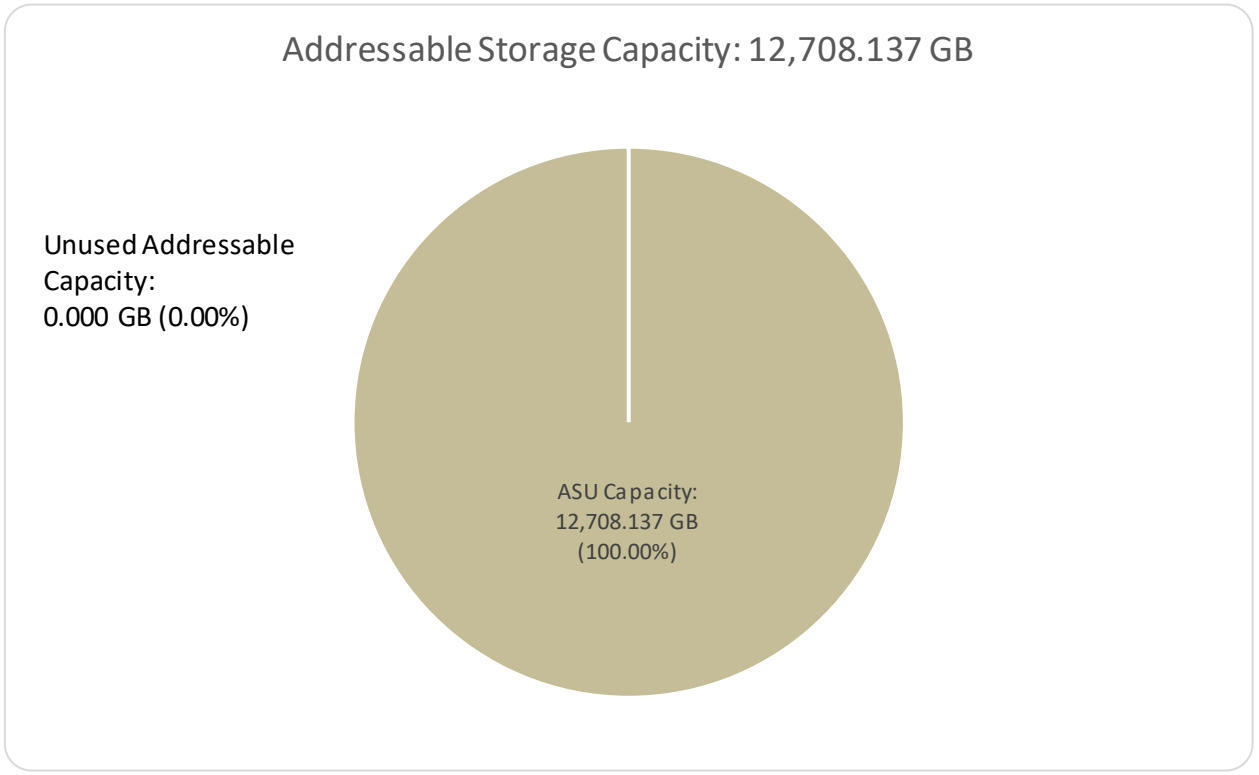
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate (MB/second)	**Number of Streams**	**Data Rate per Stream**	**Price-Performance**
	18,087.98	23,000	0.79	$3.53

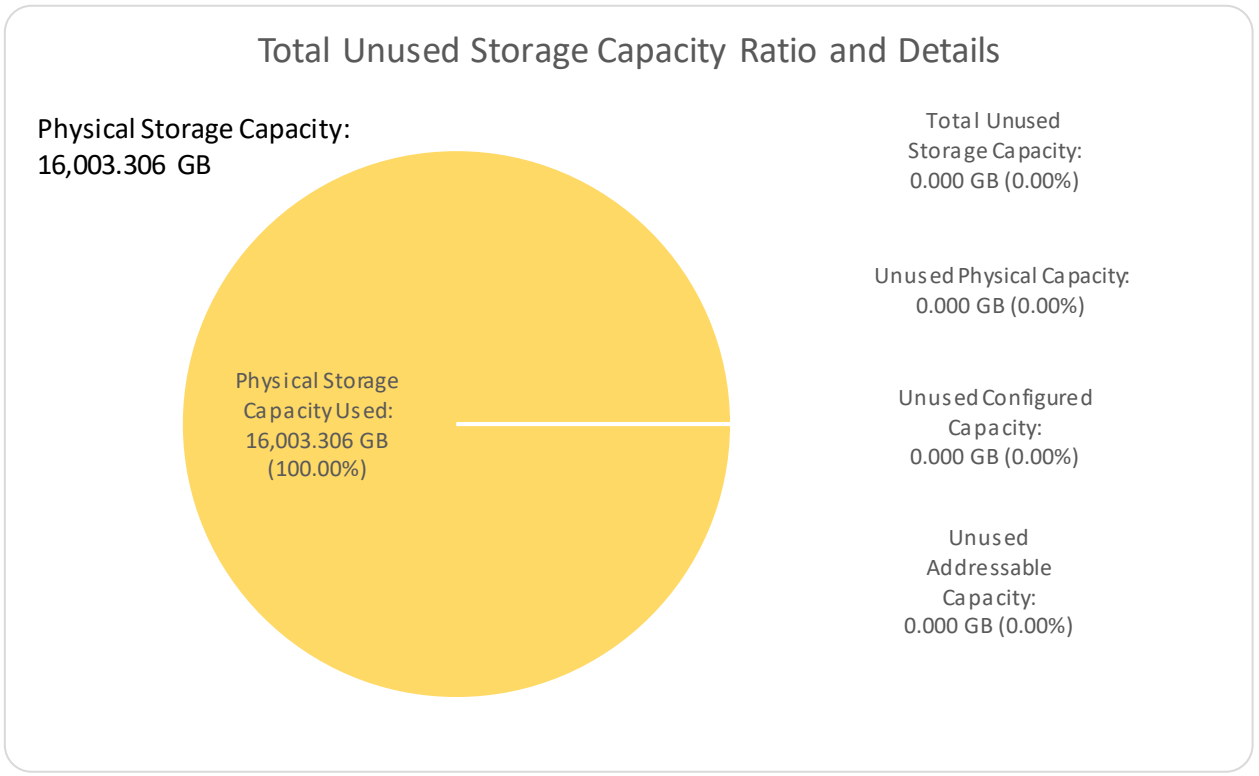
Storage Capacities, Relationships and Utilization

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.






Addressable Storage Capacity: 12,708.137 GB
Unused Addressable Capacity: 0.000 GB (0.00%)
ASU Capacity: 12,708.137 GB (100.00%)


Total Unused Storage Capacity Ratio and Details
Physical Storage Capacity: 16,003.306 GB
Physical Storage Capacity Used: 16,003.306 GB (100.00%)
Total Unused Storage Capacity: 0.000 GB (0.00%)
Unused Physical Capacity: 0.000 GB (0.00%)
Unused Configured Capacity: 0.000 GB (0.00%)
Unused Addressable Capacity: 0.000 GB (0.00%)

SPC-2 Storage Capacity Utilization	
Application Utilization	79.41%
Protected Application Utilization	99.26%
Unused Storage Ratio	0.00%

Application Utilization: Total ASU Capacity *(12,708.137 GB)* divided by Physical Storage Capacity *(16,003.306 GB)*.

Protected Application Utilization: Total ASU Capacity *(12,708.137 GB)* plus total Data Protection Capacity *(3,177.034 GB)* minus unused Data Protection Capacity *(0.000 GB)* divided by Physical Storage Capacity *(16,003.306 GB)*.

Unused Storage Ratio: Total Unused Capacity *(0.000 GB)* divided by Physical Storage Capacity *(16,003.306 GB)* and may not exceed 45%.

Priced Storage Configuration Pricing

Part Number	Description	Quantity	Unit List Price	Extended LP
E-X5722A-0E-C	Enclosure,2U-24,DE224C,Empty,2PSU,913W,0E,-C	1	$ 2,400.00	$ 2,400.00
EF570A-64GB-FC-0E-C	EF570A,64GB Cntrlr,No HIC,16Gb FC,2-pt,-C	2	$ 26,950.00	$ 53,900.00
X-56027-00-0E-C	HIC,E2800,12Gb SAS,4-ports,-C	2	$ 1,200.00	$ 2,400.00
E-X4086A-0E-C	SSD,800GB,12Gb,Non-FDE,DE224C,-0E,-C	20	$ 2,165.00	$ 43,300.00
OS-SANTRICITY1-CAP3-0E-C	OS Enable,Per-0.1TB,SANTRCTY,Ultra-Stor,0E,-C	160	$ 150.00	$ 24,000.00
X-50540-00-C	Blank,Dsk Drv Filler,DE224C,-C	4	$ 25.00	$ 100.00
	NetApp Hardware/Software Subtotal			$ 126,100.00

CS-A2-4R-VA	Support, 3-yr 24/7, 4 hour on-site	1	$ 10,261.05	$ 10,261.05

CDW 3818102	LSI SAS 9300-8e / SAS 12Gb/s / PCIe 3	4	$ 449.99	$ 1,799.96
CDW 3877041	Supermicro SAS external cable - 6.6ft	8	$ 69.99	$ 559.92
CDW Tax & Shipping	CDW Tax and Shipping	1	$ 202.17	$ 202.17
	Third-Party Subtotal			$ 2,562.05

Description	Extended LP	Discount	Discounted Price
NetApp Hardware/Software Subtotal	$126,100.00	55%	$ 56,745.00
Support	$ 10,261.05	55%	$ 4,617.47
Third-Party Subtotal	$ 2,562.05	0%	$ 2,562.05
Totals	$138,923.10		$ 63,924.52

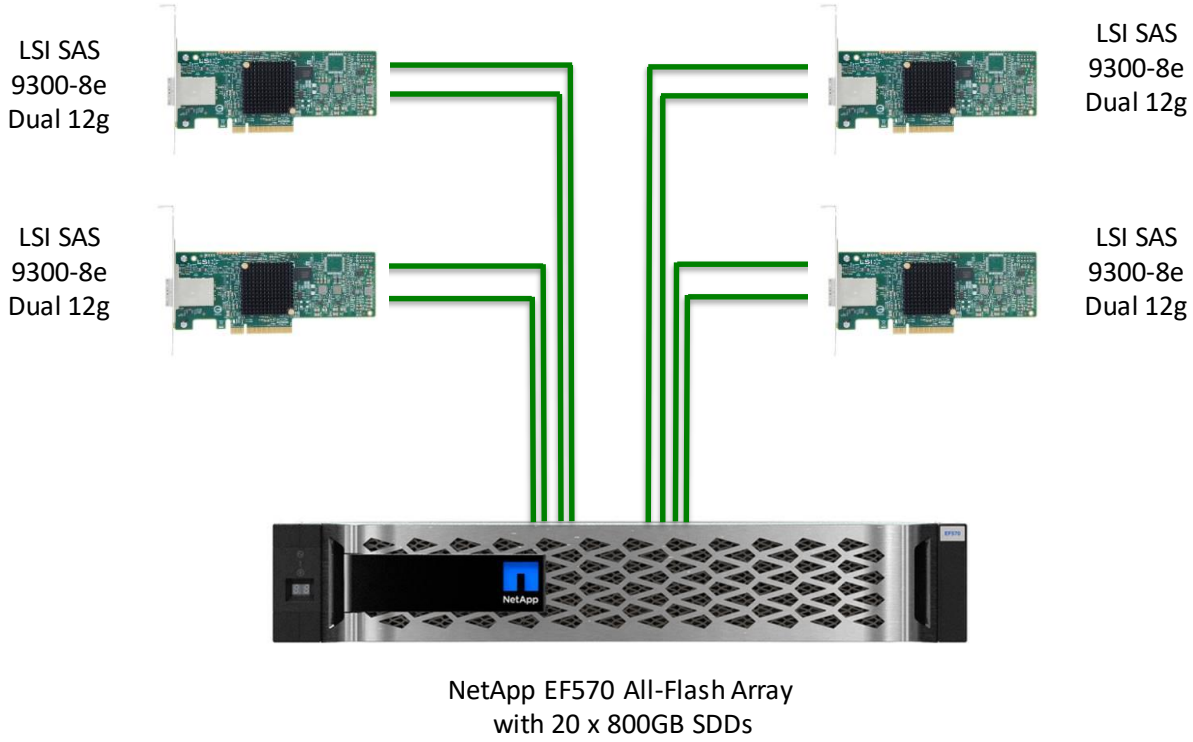
The above pricing includes the following:

- Acknowledgement of new and existing hardware and/or software problems within four hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration component.

Differences between Tested Storage Configuration and Priced Storage Configuration

There were no differences between the TSC and Priced Storage Configuration.

Priced Storage Configuration Diagram



NetApp EF570 All-Flash Array
with 20 x 800GB SDDs

Priced Storage Configuration Components

Priced Storage Configuration
4 – LSI SAS 9300-8e HBAs (2 x 12Gb SAS links / HBA)
NetApp EF570 All-Flash Array 2 – controllers, each with: 64 GB cache (128 Gb total) 4 - 12gb SAS (8 total; used in test) 2 – 16gb Fibre Channel (4 total; not used in test) Internal to drive tray: 24 x dual ported 12 gb SAS
20 – 800 GB non-FDE SSDs