



**SPC BENCHMARK 1™  
EXECUTIVE SUMMARY**

**KAMINARIO, INC.  
KAMINARIO K2 (K2F00000700)**

**SPC-1 V1.14**

**Submitted for Review: October 17, 2013  
Submission Identifier: A00137**

## EXECUTIVE SUMMARY

### Test Sponsor and Contact Information

Test Sponsor and Contact Information	
<b>Test Sponsor Primary Contact</b>	Kaminario, Inc. – <a href="http://www.kaminario.com">www.kaminario.com</a> Eyal David – <a href="mailto:eyal.david@kaminario.com">eyal.david@kaminario.com</a> Haotzma 1 Hi-Tech Park Yoqneam 20692 Israel Phone: +972 72 222 4495 FAX: +972 4 959 05511
<b>Test Sponsor Alternate Contact</b>	Kaminario, Inc. – <a href="http://www.kaminario.com">www.kaminario.com</a> Gur Rosenl Haotzma 1 Hi-Tech Park Yoqneam 20692 Israel Phone: +972 72 222 7217 FAX: +972 4 959 -0551
<b>Auditor</b>	Storage Performance Council – <a href="http://www.storageperformance.org">http://www.storageperformance.org</a> Walter E. Baker – <a href="mailto:AuditService@StoragePerformance.org">AuditService@StoragePerformance.org</a> 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	
<b>SPC-1 Specification revision number</b>	V1.14
<b>SPC-1 Workload Generator revision number</b>	V2.3.0
<b>Date Results were first used publicly</b>	October 17, 2013
<b>Date the FDR was submitted to the SPC</b>	October 17, 2013
<b>Date the Priced Storage Configuration is available for shipment to customers</b>	currently available
<b>Date the TSC completed audit certification</b>	October 17, 2013

### Tested Storage Product (TSP) Description

Kaminario K2 is an enterprise class general purpose MLC Flash array that eliminates I/O and throughput bottlenecks and dramatically reduces latency to accelerate applications. The K2 is consistently fast, highly available, cost effective, and easy to deploy storage. The K2 is a fundamentally better way to store performance sensitive data.

## Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Kaminario K2 (K2F00000700)	
Metric	Reported Result
SPC-1 IOPS™	1,239,898.00
SPC-1 Price-Performance™	\$0.80/SPC-1 IOPS™
Total ASU Capacity	60,129.542 GB
Data Protection Level	Protected 2 (K-Raid)
Total Price	\$997,348.00
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** using **K-RAID**, which consists of RAID 10 during normal operation, where half of the SSD storage is allocated for data mirroring. During failures, the data is mirrored to the KMS storage capacity (HDDs).

***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.

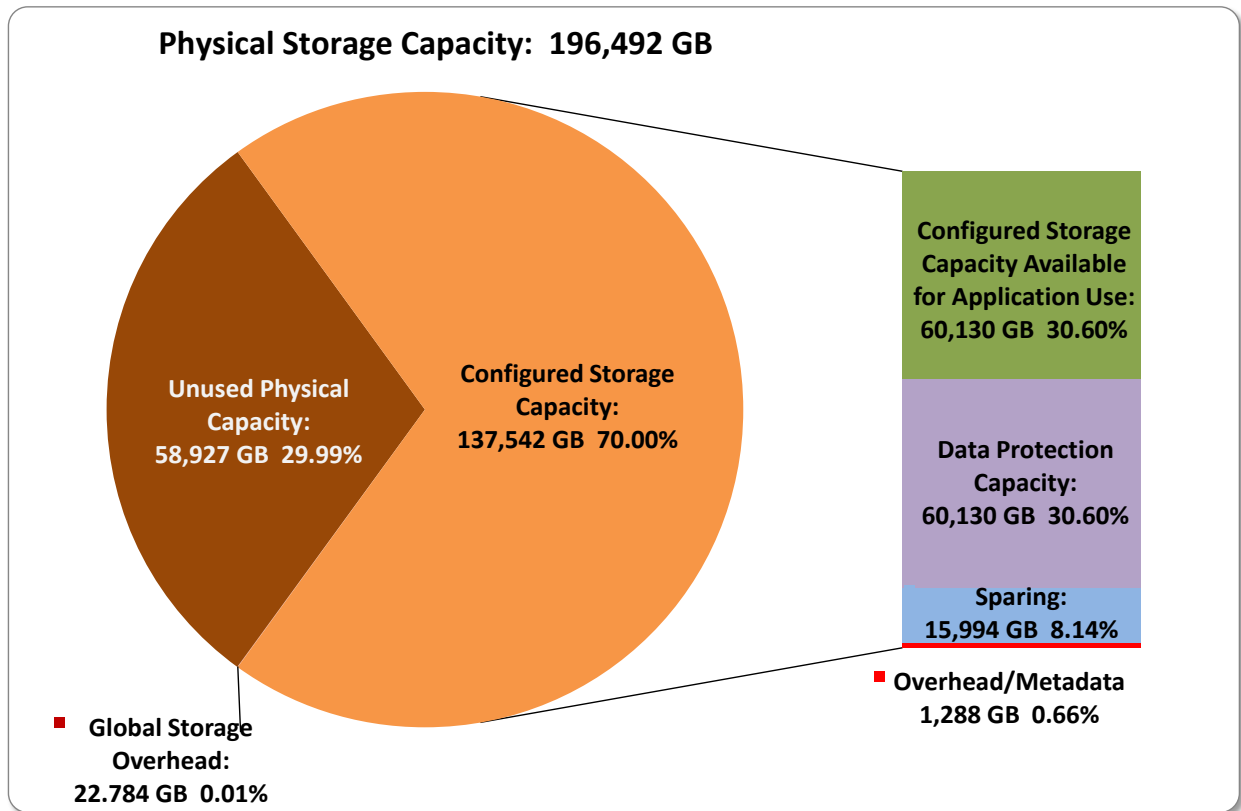
**Currency Used** is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country (*non-local currency*).

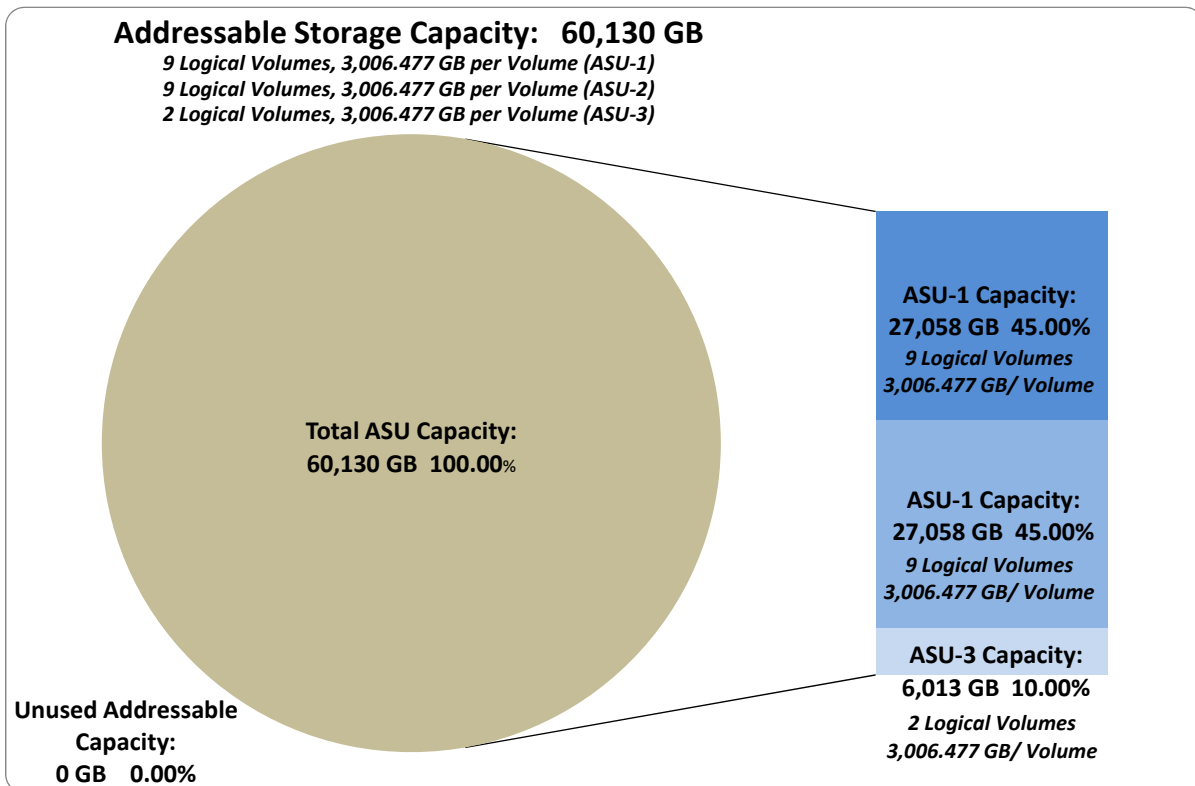
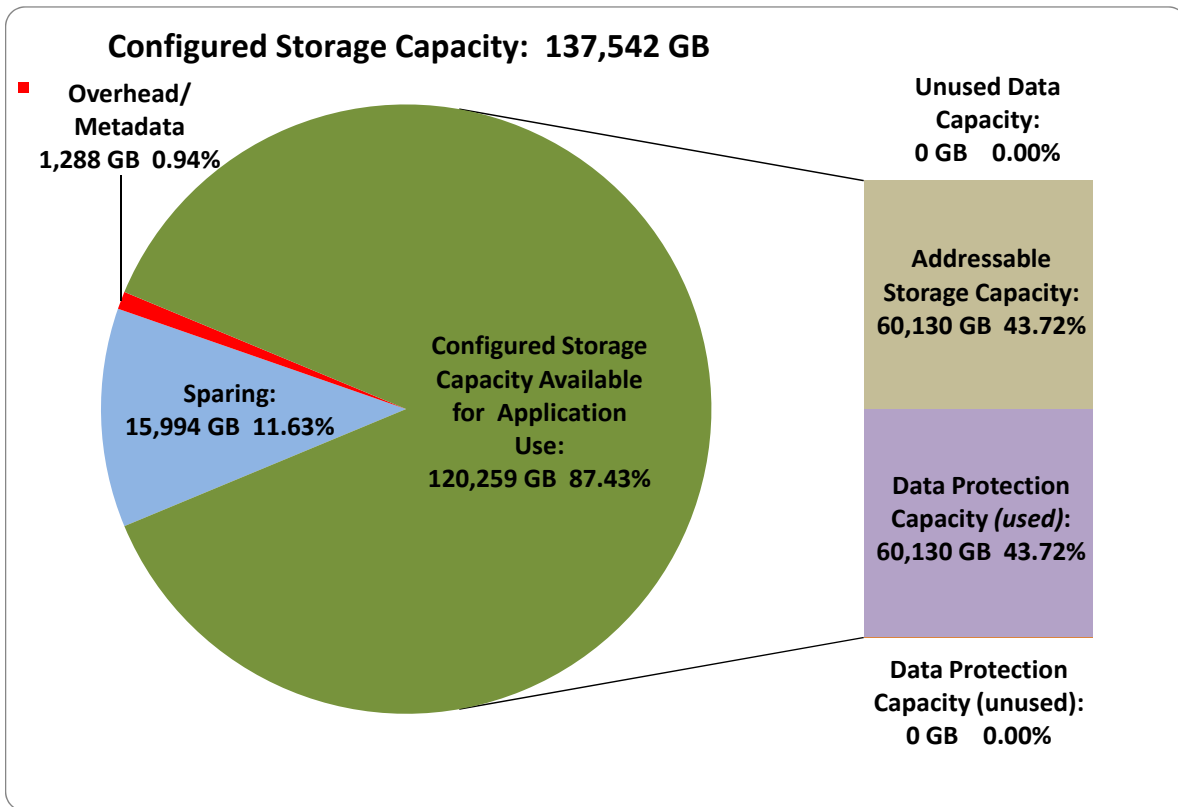
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

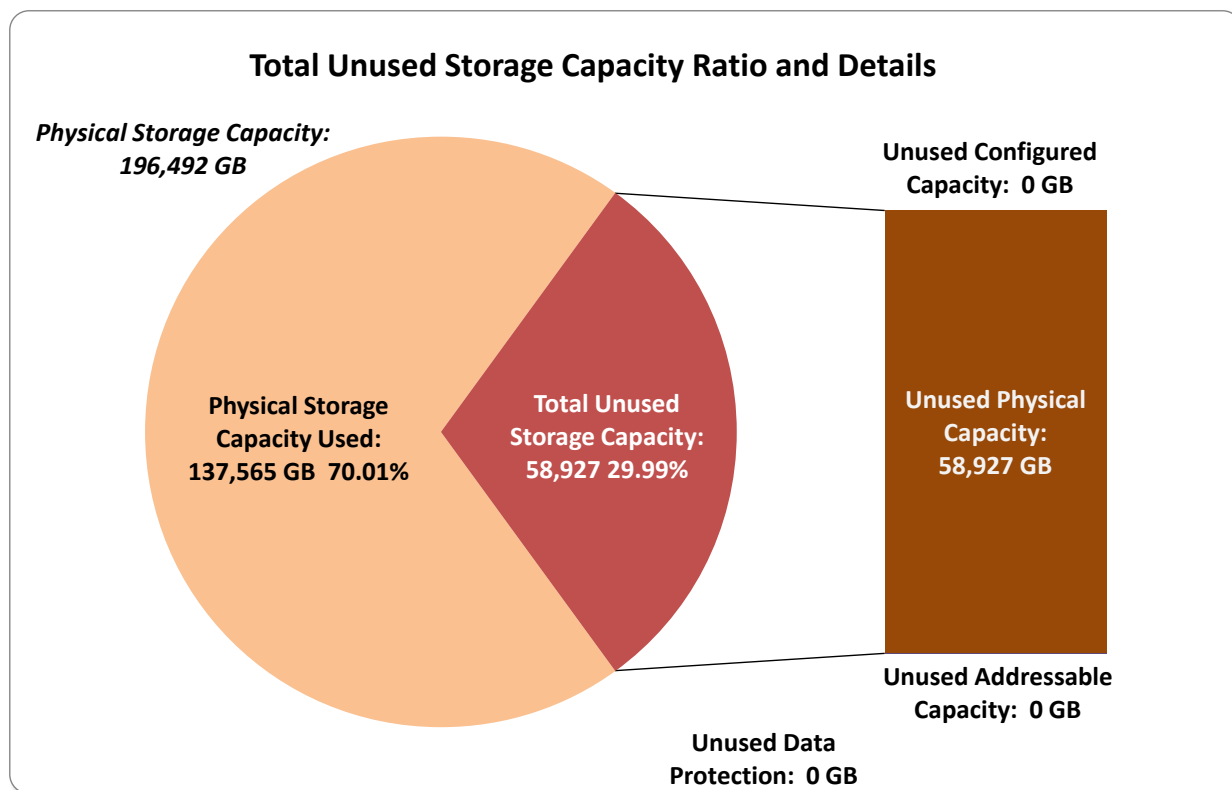
### Storage Capacities, Relationships, and Utilization

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	30.60%
Protected Application Utilization	61.20%
Unused Storage Ratio	29.99%

**Application Utilization:** Total ASU Capacity (60,129.542 GB) divided by Physical Storage Capacity (196,491.768 GB).

**Protected Application Utilization:** Total ASU Capacity (60,129.542 GB) plus total Data Protection Capacity (60,1129.542 GB) minus unused Data Protection Capacity (0.000 GB) divided by Physical Storage Capacity (196,491.768 GB).

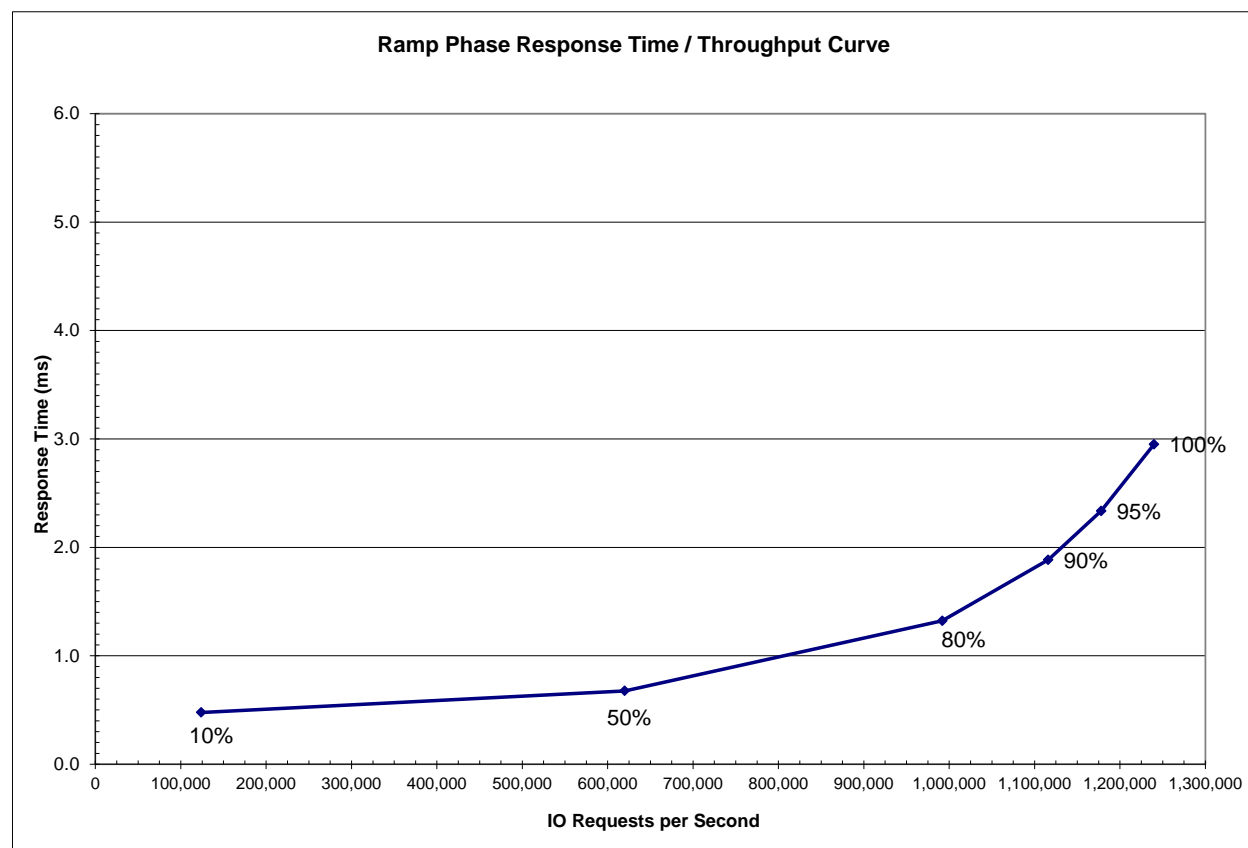
**Unused Storage Ratio:** Total Unused Capacity (58,926.951 GB) divided by Physical Storage Capacity (196,491.768 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 26-27 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
<b>I/O Request Throughput</b>	123,983.09	620,025.93	992,030.12	1,116,050.68	1,178,012.70	1,239,898.00
<b>Average Response Time (ms):</b>						
<b>All ASUs</b>	0.48	0.68	1.32	1.88	2.34	2.95
<b>ASU-1</b>	0.49	0.70	1.33	1.78	2.19	2.79
<b>ASU-2</b>	0.50	0.68	1.03	1.42	1.71	2.09
<b>ASU-3</b>	0.44	0.61	1.44	2.31	2.92	3.67
<b>Reads</b>	0.57	0.80	1.35	1.76	2.11	2.64
<b>Writes</b>	0.42	0.60	1.31	1.97	2.48	3.15

## Priced Storage Configuration Pricing

Quantity	Item	Description	Unit Price	Price
1	K2F000000700**	Kaminario K2 Flash 7 K-Blocks with 86.49TB total usable capacity		730,000.00
1	Three years maintenance	4 hours mission critical		255,000.00
56	T54-M11FF-10	WesternWire FC cable LC-LC 3m	8.00	448.00
28	QME2572	QLogic QME2572 8Gbps Fibre Channel I/O Card	425.00	11,900.00
	<b>Total System Price:</b>			<b>997,348.00</b>

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 with 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.

### K2F000000700\*\* Line Item Components

The K2F line item in the above pricing includes the following components:

- **28 K-Nodes:** *SuperMicro SYS-1027R-72BRFTP1-EI007:*
  - Each K-Node includes eight 800 GB solid state storage devices (SSD), which provide the storage capacity for the primary and mirror SPC-1 ASUs.
  - Each K-node also runs an IO-director process responsible for exposing the data volumes to the Host Systems, connected via Fibre Channel.
- **2 K-Management Nodes, Storage System Management (SSM)**  
*SuperMicro SYS-1027R-72BRFTP1-EI007.*

The SSM modules provide storage installation, configuration and monitoring functionality. Each SSM module included eight 1 TB HDDs that serve as spare backup capacity for the system.

- **2 Dell Force10 S4810 10GB switches** - Interconnects all K-nodes for the purpose of sending Host System data between the K-nodes and for supporting management communication.
- **2 Cisco Catalyst 2960G 1 GB switches** - Interconnects all K-nodes to the K-management node for the purpose IPMI protocol control over the K-nodes.
- **1 Rack:** Used to house all of the above components.



## **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

### Kaminario K2 (K2F0000700)

- 2 – SuperMicro K-Management Nodes  
Storage System Management (SSM)**  
10 – 4 GiB DRAM modules per node  
8 – 1 TB disk drives per node

*56 ports used for FC connections*

**28 – dual-port 8Gb FC  
I/O cards  
(56 ports total)**



- 28 – SuperMicro K-Nodes**  
10 – 4 GiB DRAM Modules per node  
8 – 800 GB Flash SSDs per node
- 2 – Dell Force10 S4810 10GB switches**  
*interconnect between all K-Nodes and K-Management Nodes for Host System data and management communication*
- 2 – Cisco Catalyst 2960G 1 GB switches**  
*interconnect between all K-Nodes and K-Management nodes for IPMI control*



## Priced Storage Configuration Components

### Priced Storage Configuration

28 – dual port QLogic 8 Gb FC I/O Cards (*56 ports total, 56 ports used*)

#### **Kaminario K2 (K2F00000700)**

- 28 – SuperMicro K-Nodes
  - 8 – 800 GB SSDs per node
  - 10 – 4 GiB DRAM modules per node
- 2 – SuperMicro K-Management Nodes
  - Storage System Management (SSM)
  - 10 – 4 GiB DRAM modules per node
  - 8 – 1 TB disk drives per node
- 2 – Dell Force10 S4810 10GB switches  
*(interconnect between all K-Nodes and K-Management Nodes for Host System data and management communication)*
- 2 – Cisco Catalyst 2960G 1 GB switches  
*(interconnect between all K-Nodes and K-Management nodes for IPMI control)*
- 1 – 42U rack and 4 PDUs