EXECUTIVE SUMMARY

Unstructured data is our customers’ most valuable asset, which must be preserved and protected forever. However, relentless data growth and retention trends drive demands for more efficient, resilient, and secure Exabyte-scale storage solutions. These demands continue to pressure IT budgets and administrators. Simultaneously, organizations are looking to unlock the value in their data, which makes the task even more challenging. The correct storage architecture can allow organizations to leverage more of their data without requiring budgets to scale at the same pace and make facilitating data forever realistic. Jointly with our market leading, strategic partners, Supermicro® can help organizations to easily transition from their legacy storage to Object Storage platforms.

Supermicro, in collaboration with Quantum ActiveScale, enables our customers to deploy any targeted size of Data Lake with great flexibility and scalability. Supermicro’s fully integrated, pre-tested, tuned, and racked solution, built...
explicitly for ActiveScale patented Object Storage technologies, can be operational in less than 30 minutes. Other primary use cases include Artificial Intelligence/Machine Learning and High Performance Computing (HPC), where WekaIO* provides the high performance, low latency, and consistent response time of local NVMe storage. ActiveScale stores massive amounts of data with geographically distributed systems in the back end. Another use case is to provide on-premise Data Lake as cache space to a public cloud, delivering up to 10X performance while cutting down the overall cost to the public cloud by over 90% (30% overall).

Supermicro can offer our customers the best-in-class and fully qualified storage solution featuring Quantum ActiveScale. Our starter offering consists of 3 4U90 systems with 5PB of raw capacity, which achieved over 17GB/Sec and 22K Obj/Sec overall performance. ActiveScale provides seamless scalability to a multi Exabyte scale with high performance in a very cost effective way.

While ActiveScale is HDD S3 Object based, it can be fully integrated with WekaIO running on NVMe front-end for file access to provide leadership performance.

**Object Storage Solution Architecture Overview**

![Figure 1 – ActiveScale Object Storage Architecture](image)

**Cluster Reference Configuration Explain**

*Quantum ActiveScale Object Storage Architecture* provides a system that can maximize storage availability and scale the system with minimal to no impact on the customer experience and performance by implementing a 2-layer architecture combined with advanced next-gen shared nothing storage techniques.

*The Access Layer* is responsible for providing a single global namespace across the entire environment. Client applications talk to the Object Storage system through the Access Layer using the S3 protocol. The Access Layer executes client facing functions like authentication, authorization, encryption. It also houses a scalable object metadata database, protected by having multiple copies across the access servers.

*The Storage Layer* is where all object data is stored in a very reliable fashion. While there is only one instance of the access layer in a single system, there might be multiple instances of the storage layer called Columns. A single object is stored in a single column. Dynamic Data Placement allows the system to directly store the objects on available disk and storage nodes,
ensuring reliability and availability. No rebalance is required when scaling up the Column. Dynamic Data Repair will provide all drives upon detection of a failed drive, and the missing data can be repaired to any available drive in the system.

Configuration

Together, Supermicro and Quantum ActiveScale provide the high-performance object storage solution with the 4U90 Top Loading Dual Node Storage Server. 4U90 Storage Server provides 90 x 3.5” drive bays supporting 18 TB drives, totaling 1.620 PB per 4U Rack space. Using standard 42U x 1200mm rack and reserving 6U for Top of rack switches, we can easily fit 9 X 4U90 chassis, totaling 14.6 PB per a Data Lake Rack.

An example of a validated solution using three (3) SSG-6049SP-DE1CR90 storage servers where each dual node server has the following configuration. Reference: https://www.supermicro.com/en/products/system/4U/6049/SSG-6049SP-DE1CR90.cfm

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>SSG-6049SP-DE1CR90 X11 Dual Node 90-bay Storage Server</td>
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<tr>
<td>CPU</td>
<td>2nd Generation Intel Xeon Scalable Processors</td>
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</tr>
<tr>
<td></td>
<td>Xeon Silver 4216 Processor, 16C/32T 2.1G 22M 9.6GT 100W 3647 L1</td>
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<td>Memory</td>
<td>32GB DDR4-2933 2Rx4 LP ECC Registered DIMM</td>
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<tr>
<td>Boot Drive</td>
<td>Samsung PM983 3.84TB NVMe PCIe Gen3 x4 M.2 SSD</td>
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<tr>
<td>Storage Drive</td>
<td>WD or HGST 3.5&quot;18TB SAS 12Gb/s 7200RPM HDD</td>
<td>90</td>
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<tr>
<td>NIC</td>
<td>Mellanox ConnectX-4, Standard Low-Profile Dual-port 25G SFP28</td>
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<td>SAS HBA</td>
<td>Supermicro SAS HBA 3616 for 90 Bay system</td>
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<tr>
<td>SAS HBA</td>
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<tr>
<td>Management SW</td>
<td>Supermicro System Management Software Suite Node License</td>
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</tbody>
</table>

Table 1 - System Config Specifics

A 90-bay Top Loading JBOD expansion is optional if it a customer requires more data capacity without additional servers. Reference: https://www.supermicro.com/en/products/chassis/4U/947/SC947HE2C-R2K05JBOD

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Qty</th>
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<tr>
<td>System</td>
<td>CSE-947HE1C-DRJBOD-QC001 4U 90-bay Top Load JBOD w/ dual expander</td>
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<tr>
<td>Storage Drive</td>
<td>WD or HGST 3.5&quot;18TB SAS 12Gb/s 7200RPM HDD</td>
<td>90</td>
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</tbody>
</table>

ActiveScale Performance, Proven and Validated by the Joint Lab

ActiveScale Performance Setup and Measurements

- EC policy: 13/3 (=10+3 Reed-Solomon)
- 90 HDDs per 4U Chassis (45 HDDs per Node)
- Backend Network: 12 x 25Gbps
- Theoretical max S3 PUT performance: 27 GB/s
- Theoretical max S3 GET performance: 37.5 GB/s
- Different object sizes: 64 kiB, 512 kiB, 1 MiB, 4 MiB, 8 MiB, 16 MiB
- Different number of parallel TCP connections: 384 connections, 10000 connections

Figure 2 - Solution Network Topology

Performance Results – S3 GET
The performance testing on three (3) Supermicro Dual-Node 4U90 storage servers, SSG-6049SP-DE1CR90 with 18TB Drives, showed impressive results with both PUT and GET operations pushing the system to theoretical drive performance limits. The system achieved 17.4 GB/s READs, and 13.0 GB/s WRITES. Random read requests were above 20K Objects/Sec. Much higher performance can be achieved by using more nodes as performance scales linearly.

ActiveScale Software Overview

Quantum Corporation, founded in 1980, focuses on creating innovative technology and solutions to help our customers get the most value from their data. Quantum is proud to offer the ActiveScale Object Storage system in its portfolio. ActiveScale Object Storage is an early pioneer in the Object Storage market, emphasizing fully consistent, very low touch, and easy-to-scale object storage solutions. ActiveScale is now wholly owned by Quantum, ActiveScale software is running in a multitude of customer environments from less than a PB to multiples 100s of PBs under management.

<table>
<thead>
<tr>
<th>Software</th>
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<tbody>
<tr>
<td>Operating system software</td>
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<tr>
<td>Management interfaces</td>
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<td>System analytics</td>
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<tr>
<td>Security</td>
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<td>Data protection</td>
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<tr>
<td>Data durability</td>
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<tr>
<td>SW/FW upgrades</td>
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</tbody>
</table>
Supermicro Server Overview

4U 90-Bay Dual Node Storage Server

**Processor Support**
- Dual 2nd Gen Intel® Xeon® Scalable (Cascade Lake-Refresh) processors, up to 205W TDP

**Memory Capacity**
- 16x DDR4 slots, Up to 4TB ECC 3DS LRDIMM, DDR4-2933
- Supports Intel® Optane™ Persistent Memory

**Expansion**
- 2x PCIe 3.0 x16 and 1x PCIe 3.0 x8

**Networking & I/O**
- 2x 10GbE Base-T LAN ports
- 1x RJ45 Dedicated IPMI LAN port
- 2x USB 3.0 ports, 1x VGA ports and 1x Serial port

**Drive Bays**
- 90x Hot-swap 2.5" or 3.5" drive bays (SAS3/SATA3)
- 2x rear Hot-swap 2.5" SATA drive bays
- 2 onboard PCIe x2 M.2 slots and 2 internal slim SATA SSD slots
- 4 rear NVMe U.2 bays for cache support (optional)

**Storage Controller**
- Broadcom SAS 3816 AOM (IT mode)
- Broadcom SAS 3816, 3106 AOC (HW RAID mode)

**System Cooling**
- 6x Heavy duty counter-rotate redundant PWM cooling fans

**Power Supply**
- 2x 2600W High-efficiency (Titanium level, 80%) redundant supply

**System Management**
- Built-in Server management tool (IPMI 2.0, KVM/media over LAN) with dedicated LAN port

**Dimensions**
- 17.68" (W) x 6.9" (H) x 42.9" (D)

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4U 90-Bay JBOD Expansion

**Storage Architecture**
- Single or Dual Path Storage Enclosure

**SAS EXPANDER (JBOD Sled)**
- 6x SAS3.0 I/O ports (Mini SAS HD/SFF-8644) per node

**Drive Bays**
- 60/90x Hot-swap 2.5" or 3.5" drive bays (SAS3/SATA3)

**Storage Controller**
- Broadcom SAS 9405/9300/9380

**System Cooling**
- 6x Heavy duty counter-rotate redundant PWM cooling fans

**Power Supply**
- 2x 2000W High-efficiency (Titanium level, 80%) redundant supply

**System Management**
- IPMI 2.0 (dedicated LAN)
- SCSI Enclosure Service SES-4 support
- Redfish OOB management protocol support

**Dimensions**
- 60 bay : 17.68" (W) x 6.9" (H) x 34.1" (D)
- 90 bay : 17.68" (W) x 6.9" (H) x 42.9" (D)
Value Proposition

- **Density**: Highest density storage and computing power
- **Performance**
  - Dual node configuration provides double processors and dram performance
  - Multiple expanders architecture maximizes drive performance.
- **Flexibility**
  - Capacity and TCO software defined scale-out object storage
  - Flexible configurations to match different workloads
- **Quality**
  - The architecture SW+HW is fully redundant (NSPOF)
  - Component compatibility verification
  - Enterprise serviceability with hot-swappable drives, fans, and power supplies
  - Server nodes can be replaced hot without disruption of other nodes in the chassis
- **Building Block** modular design with the highest drive capacity

Supermicro Top Load Storage Design Enhancement

- Design for Easy Field Serviceability
- Passive Mid-plane, Backplane
- No CMA required
- Tool-less access
- Drawer type design
- Twin server nodes can be replaced hot without disruption to other nodes (share nothing)

Minimum configuration for ActiveScale Object Storage

ActiveScale can also be configured with Supermicro 1U12 systems which provide an entry-level configuration for customers who want to start small.

The entry configuration: 3 X 1U12 Server: Total of 648 TB (18 TB HDD)
SuperStorage SSG-6119P-ACR12N4L (1U12)
- Optimized component integration for increased cost-effectiveness and reliability
- Better energy efficiency with optimal thermal design and CRPS power supply (single 12V power source)
- Great serviceability with the patented internal cable arm design
- Tiered storage architecture (2x M.2 -> 4x NVMe/SATA SSD -> 12x 3.5” HDD), optimized for Object Storage applications

TCO Savings

Implementing our new 4U90 storage servers vs. previous generations can reduce 650-1200 KW/hr. in power consumption (Totaling $2M-$4M saving over three years) and reduce rack counts by 250-500 (totaling $21M-$48M saving over three years). Below are comparisons of current platforms and saving estimates based on future implementation.
Services
Supermicro Global Services organization can support customers who require rack integration/configuration, installation, training, post-deployment hardware/software maintenance.

Summary

With no slowdown in sight for data growth, IT’s imperative remains the same – find more efficient and effective ways to store and protect the organization’s vast store of valuable data. The correct storage architecture must simplify complexity and help organizations take advantage of their data without requiring budgets to scale at the same pace as data growth. It should deliver disk-based access performance from anywhere in the world, protect the data from loss with high durability, scale without limits and be easy to manage. ActiveScale, a new class of storage built on patented object storage technology, addresses these needs. Its architecture supports exabyte solutions and beyond with high data durability and high data integrity that disperse erasure encoded chunks across drives, chassis, and geographies, protecting against data loss and data corruption. The distributed, scale-out design supports high-throughput performance even in a geo-dispersed deployment. ActiveScale provides better resiliency and seamless adoption of new capacity as customers grow their way into the future.

With just 3 Supermicro 4U90 Storage Servers, over 17GB/sec can already be achieved. With more nodes, one can quickly achieve 100’s GB/s. With industry leading $/GB, the storage density of 14.5 PB per rack, combined CapEx and OpEx savings, Supermicro and Quantum can deliver a complete rack integrated, tested, ready-to-deploy ActiveScale object storage solutions to customers immediately, Supermicro presents a best in class, low cost, up to 19 9’s availability, from 5PB on 3 4Ux90 to multi-exabytes with Quantum ActiveScale which enables our customers to deploy any targeted size of Data Lake with great confidence.

Additional Resources

Quantum ActiveScale [www.quantum.com/object-storage](http://www.quantum.com/object-storage)