

SUPERMICRO SERVERS REFERENCE ARCHITECTURE FOR QUANTUM ACTIVESCALE

The Next Generation Object Storage Solution



TABLE OF CONTENTS

Executive Summary	1
Object Storage Solution Architecture Overview	2
ActiveScale Configuration & Performance.....	3
ActiveScale Software Overview.....	5
Supermicro Server Overview	6
Summary.....	8

SUPERMICRO

Supermicro (Nasdaq: SMCI), the leading innovator in high-performance, high-efficiency server and storage technology is a premier provider of advanced server Building Block Solutions® for Enterprise Data Center, Cloud Computing, Artificial Intelligence, and Edge Computing Systems worldwide. Supermicro is committed to protecting the environment through its “We Keep IT Green®” initiative and provides customers with the most energy-efficient, environmentally-friendly solutions available on the market.

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

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 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,

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

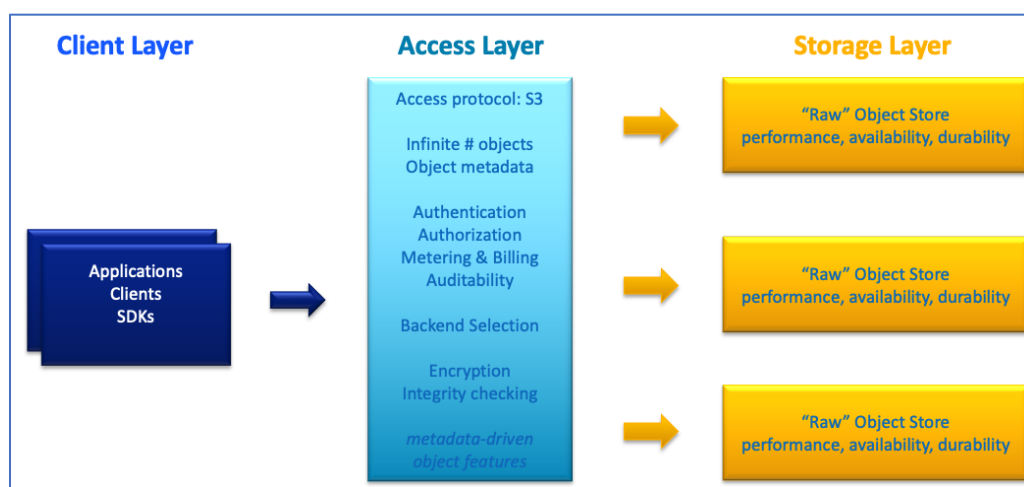


Figure 1 – ActiveScale Object Storage Architecture

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 x3.5" 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.

Type	Description	Qty
System	X11 Dual Node 90-bay Storage Server, use SSG-6049SP-7802A-QC001 to order	1
CPU	2 nd Generation Intel Xeon Scalable Processors Xeon Silver 4216 Processor, 16C/32T 2.1G 22M 9.6GT 100W 3647 L1	4
Memory	32GB DDR4-2933 2Rx4 LP ECC Registered DIMM	16
Boot Drive	Samsung PM983 3.84TB NVMe PCIe Gen3 x4 M.2 SSD	4
Storage Drive	WD or HGST 3.5"18TB SAS 12Gb/s 7200RPM HDD	90
NIC	Mellanox ConnectX-4, Standard Low-Profile Dual-port 25G SFP28	4
SAS HBA	Supermicro SAS HBA 3616 for 90 Bay system	2
SAS HBA	Supermicro SAS HBA 9405-16e 16-port Tri Mode	2
Management SW	Supermicro System Management Software Suite Node License	2

Table 1 - System Config Specifics

Type	Description	Qty
System	4U 90-bay Top Load JBOD w/ dual expander, using SSG-947HE1C-7803A-QC001 to order	1
Storage Drive	WD or HGST 3.5"18TB SAS 12Gb/s 7200RPM HDD	90

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

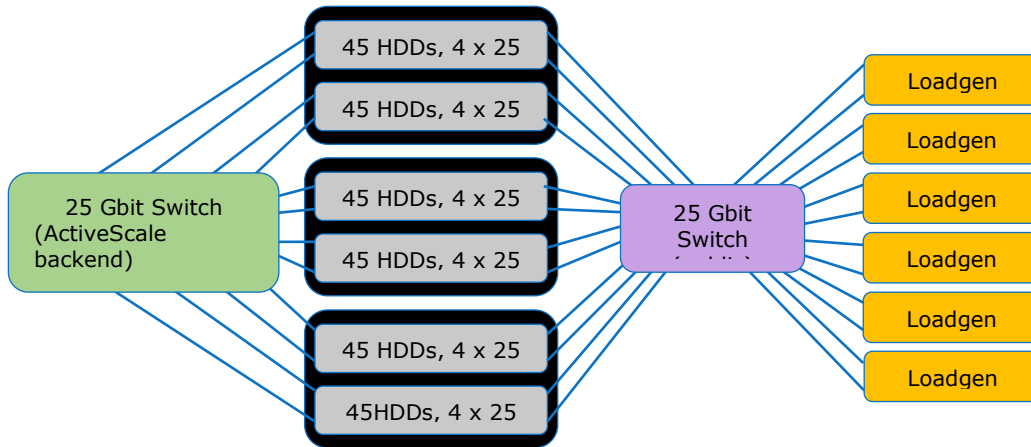
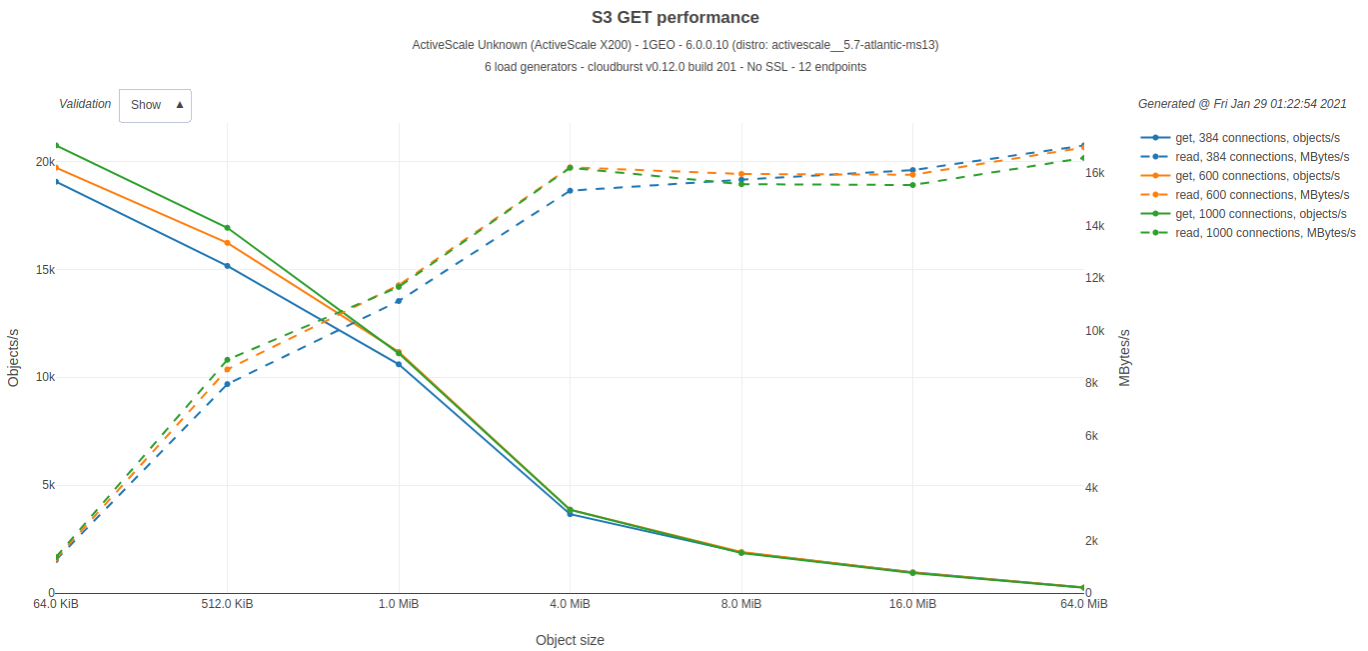
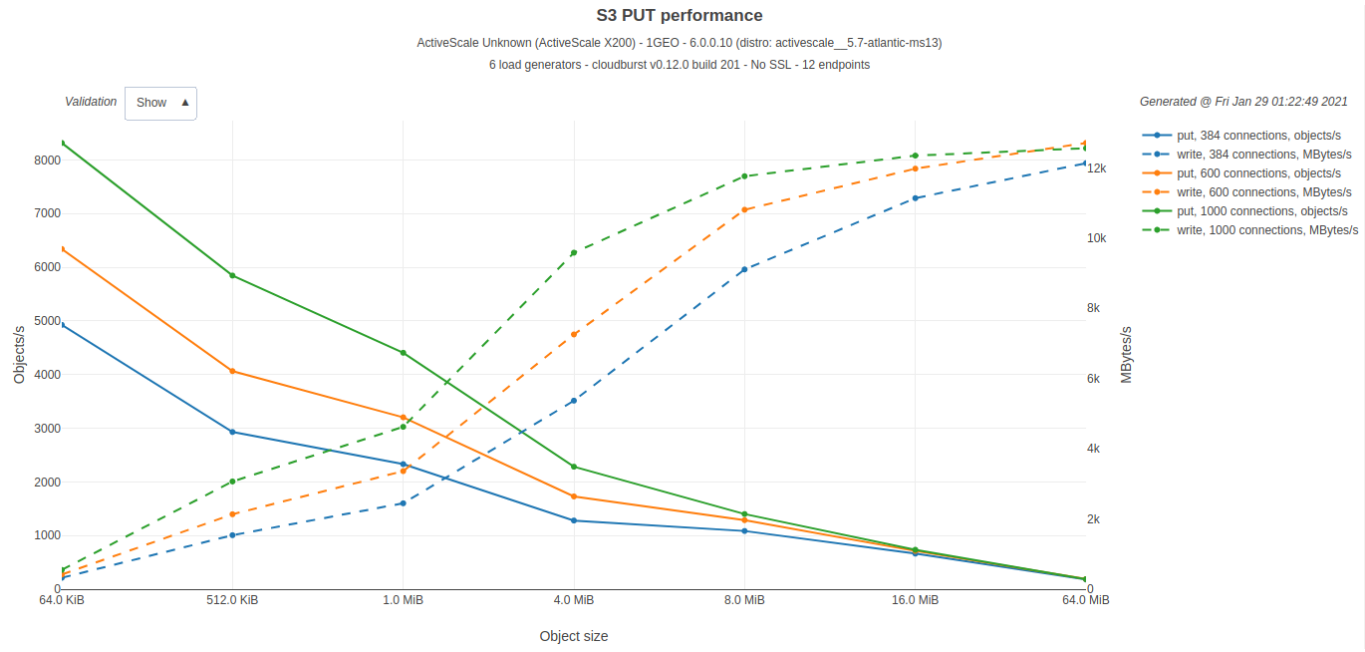


Figure 2 - Solution Network Topology

Performance Results – S3 GET



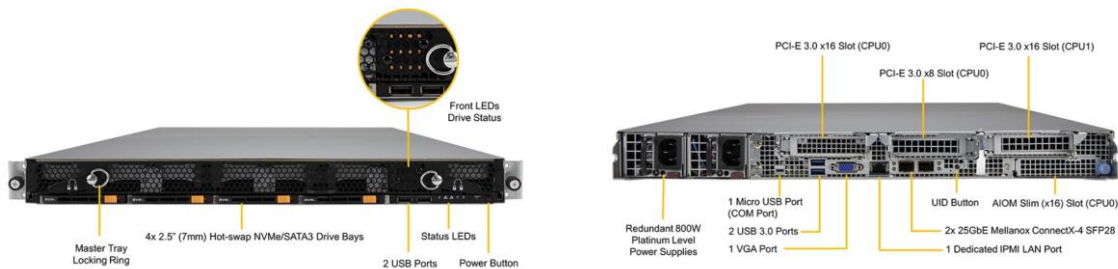
Performance Results – S3 PUT



The performance testing on three (3) Supermicro Dual-Node 4U90 storage servers, SSG-6049SP-7802A-QC001 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.

For Smaller configurations, one can start with 3 1Ux12 (or SSG-6119P-7804A-QC001)

This benchmark uses 6 1Ux12:



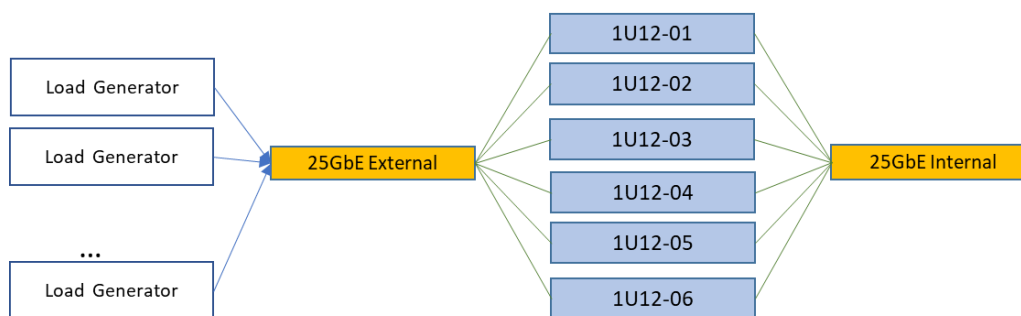
Specifications

Type	Description	Qty
System	X11 Dual Node 12-bay Storage Server, use SSG-6119P-7804A-QC001 to order	1
CPU	2 nd Generation Intel Xeon Scalable Processors CLX 4208 2P,8C/16T 2.1G 11M 9.6GT 85W 3647 R1	2
Memory	16GB DDR4-2933 1RX4 LP ECC RDIMM, HF, RoHS	4
Boot Drive	Kioxia XG6 256GB NVMe M.2 22x80mm <1DWPDP, HF, RoHS	2
Metadata Drive	Samsung PM983 960GB NVMe PCIe3x4 V4 TLC 2.5" 7mm (1.3 DWPDP)	2
Storage Drive	WD or HGST 3.5"18TB SAS 12Gb/s 7200RPM HDD	12
NIC	AIOM Dual-Port 25GbE SFP28 based on Mellanox CX-4 Lx EN	1
Management SW	Supermicro System Management Software Suite Node License	1

System Specification

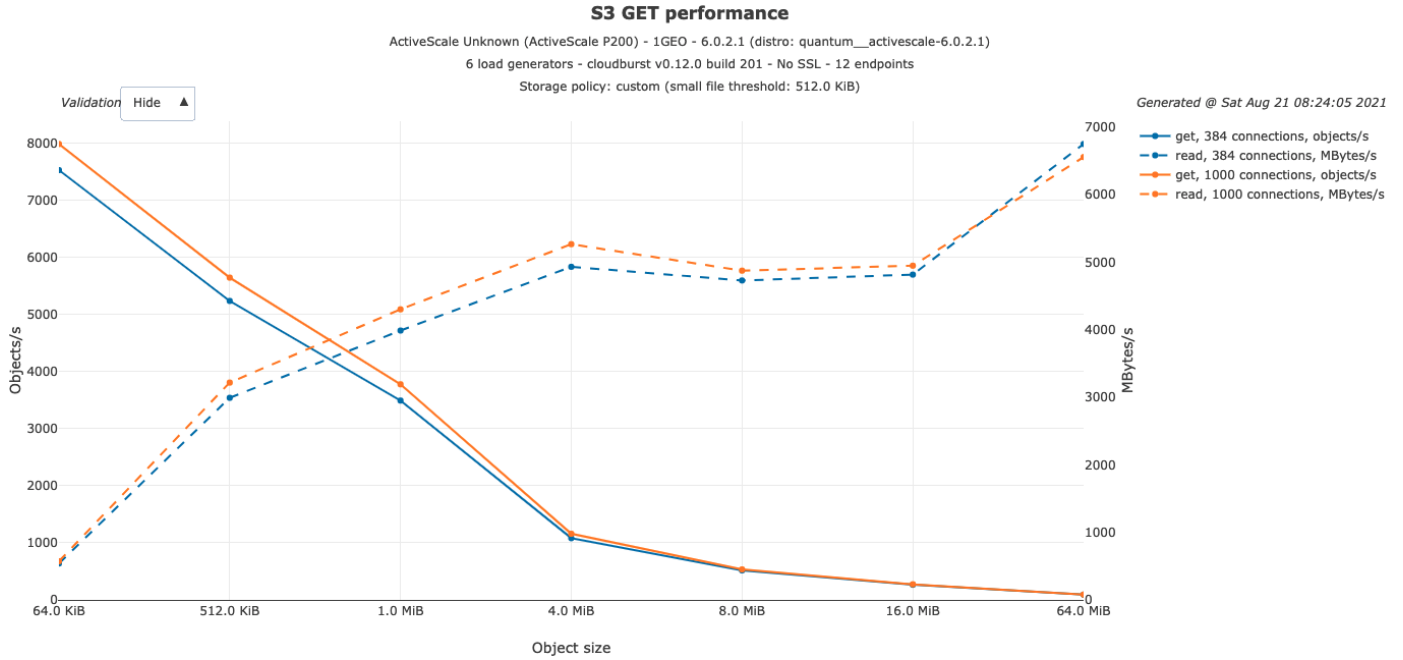
Configurations

- EC policy: 13/4 (=9+4 Reed-Solomon)
- 12 HDDs per system
- Service Network: 12 x 25Gbps, Backend Network: 12 x 25Gbps
- S3 PUT performance: 5.2 GB/s
- S3 GET performance: 6.5 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

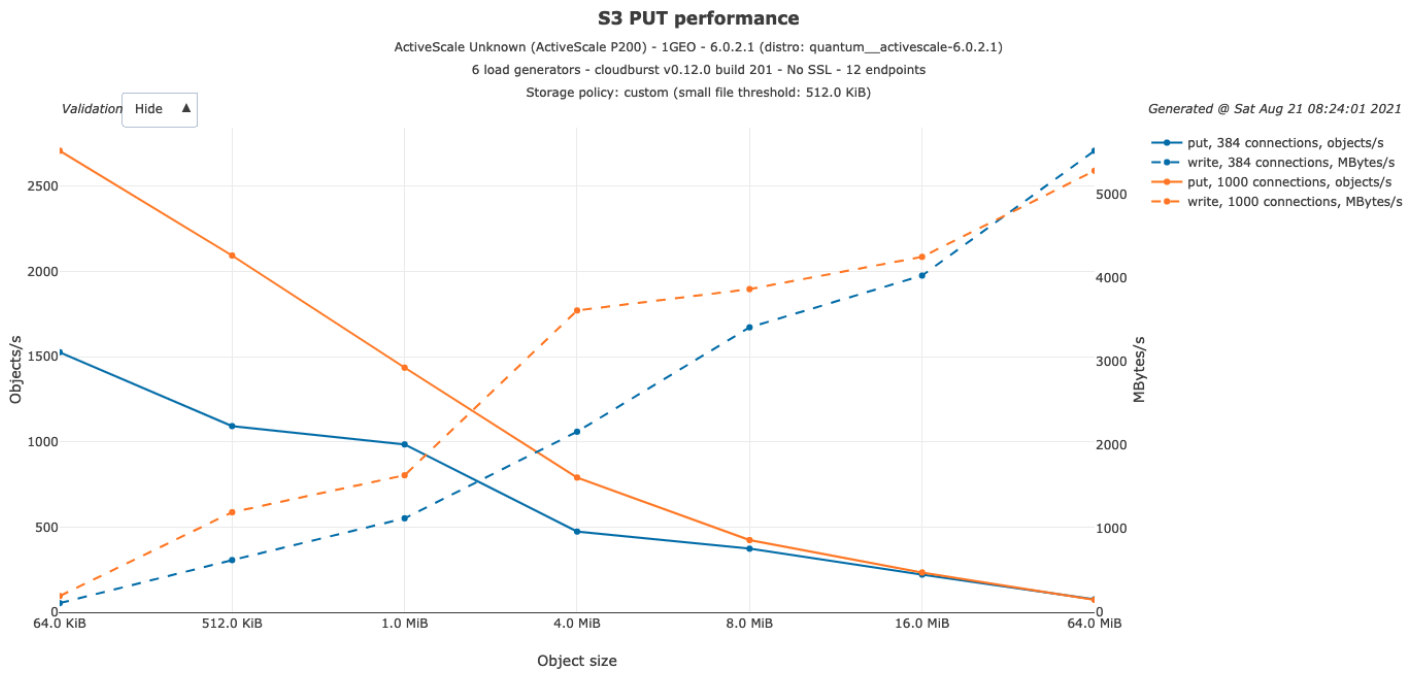


Network Topology for Benchmark

S3 GET Results



S3 PUT Results



ActiveScale Software Overview

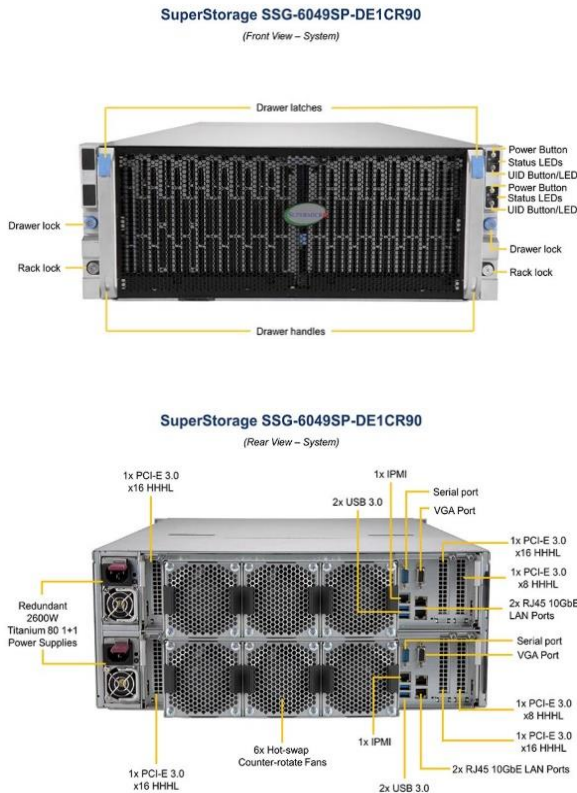
Quantum Corporation, founded in 1980, focuses on creating innovative technology and solutions to help our customers get the most value from their data. Quantum is proud to offer the ActiveScale Object Storage system in its portfolio. ActiveScale Object Storage is an early pioneer in the Object Storage 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.

Software

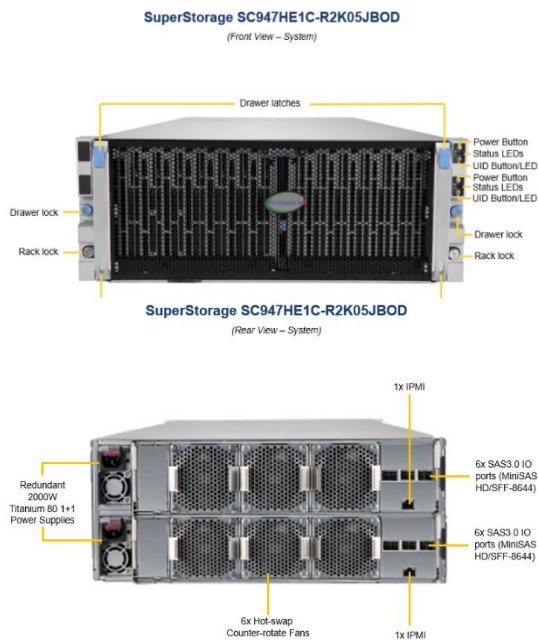
Operating system software	ActiveScale OS 6.0
Management interfaces	Real-time System Management Console, CLI, RESTful API
System analytics	ActiveScale CM, a cloud-based storage analytics service
Security	Data encryption in flight SSL/TLS using AES-256, Data encryption at rest using AES-256
Data protection	Advanced Erasure Coding, Dynamic Data Placement, Versioning, Object Locking
Data durability	Up to 19 nines, Dynamic Data Repair
SW/FW upgrades	Non-disruptive rolling upgrades

Supermicro Server Overview

SSG-6049SP-DE1CR90 Object Storage Server



Processor Support <ul style="list-style-type: none"> Dual 2nd Gen Intel® Xeon® Scalable (Cascade Lake-Refresh) processors, up to 205W TDP
Memory Capacity <ul style="list-style-type: none"> 16x DIMM slots, Up to 4TB ECC 3DS LRDIMM, DDR4-2933 Supports Intel® Optane™ Persistent Memory
Expansion <ul style="list-style-type: none"> 2x PCI-E 3.0 x16 and 1x PCI-E 3.0 x8
Networking & I/O <ul style="list-style-type: none"> 2x 10GBase-T LAN ports 1x RJ45 Dedicated IPMI LAN port 2x USB 3.0 ports, 1x VGA ports and 1x Serial port
Drive Bays <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Broadcom SAS 3616 AOM (IT mode) Broadcom SAS 3916, 3108 AOC (HW RAID mode)
System Cooling <ul style="list-style-type: none"> 6x Heavy duty counter-rotate redundant PWM cooling fans
Power Supply <ul style="list-style-type: none"> 2x 2600W High-efficiency (Titanium level, 80%) redundant supply
System Management <ul style="list-style-type: none"> Built-in Server management tool (IPMI 2.0, KVM/media over LAN) with dedicated LAN port
Dimensions <ul style="list-style-type: none"> 17.68" (W) x 6.9" (H) x 42.9" (D)



SC947HE2C-R2K05JBOD JBOD

Storage Architecture

- Single or Dual Path Storage Enclosure

SAS EXPANDER (JBOD Sled)

- 6x SAS3.0 IO 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

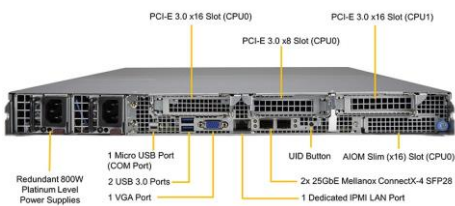
System Management

- 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)

6119P-ACR12N4L



Processor Support <ul style="list-style-type: none"> Dual Intel Xeon CLX/CLX-R Cascade Lake/Skylake LGA3647, up to 205 Watt TDP
Memory Capacity <ul style="list-style-type: none"> 16x DIMM Slots, Up to 3TB Registered ECC RDIMM/LRDIMM DDR4-2933 Supports Intel® Optane™ Persistent Memory
Expansion <ul style="list-style-type: none"> 2x PCI-E 3.0 x16, 1x PCI-E 3.0 x8, and 1x AIOM (PCI-E 3.0 x16, OCP3.0 NIC Compatible)
Networking & I/O <ul style="list-style-type: none"> 2x 25Gb SFP28 LAN Ports 1x RJ45 Dedicated IPMI LAN Port 2x USB2.0 Ports (Front), 2x USB3.0 Ports (Rear), 1x VGA Port
Drive Bays <ul style="list-style-type: none"> 12x Hot-swap 3.5" Drive Bays (SAS3/SATA3) 4x Hot-swap 2.5" Hybrid NVMe/SATA3 Bays (Front 7mm) 2x Onboard M.2 NVMe/SATA3 Slots (22x80mm)
Storage Controller <ul style="list-style-type: none"> Broadcom 3224 IT Mode Controller
System Cooling <ul style="list-style-type: none"> 6x 40mm Counter-rotate Redundant PWM Cooling Fans
Power Supply <ul style="list-style-type: none"> Dual 800W (Platinum Level, 96%) Redundant Power Supply
System Management <ul style="list-style-type: none"> Built-in Server Management Tool (IPMI2.0, KVM/Media-Over-LAN) w/Dedicated LAN Port
Dimensions <ul style="list-style-type: none"> 17.6" (W) x 1.7" (H) x 37" (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 SSG-6119P-7804A-QC001 systems which provide an entry-level configuration for customers who wants to start small.

The entry level configuration: 3 X SSG-6119P-7804A-QC001 Server: Total of 648 TB (18 TB HDD)

- 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

Assumption					Power	Power Costs
	Form Factor	Drive Size	Racks	CoLo Cost	Consumption (KW)	(\$M)
1) 1.2EB						
2) Co-Lo \$3K / month /rack						
3) \$0.13KW-Hr						
4) 3 Years						
Gen1 Storage HW	4U36	6TB	617	\$66,636,000	1758	\$6.0
Gen2 Storage HW	4U60	8TB	278	\$30,024,000	1320	\$4.5
Gen 3 (4U90)	4U90	18TB	83	\$8,964,000	586	\$2.0

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

Supermicro Storage Servers <https://www.supermicro.com/en/products/top-loading-storage>

Supermicro Storage Servers <https://www.supermicro.com/en/products/storage>