

# **CLOUDIAN® HYPERSTORE® CERTIFIED WITH AMD EPYC™ PROCESSORS** **OBJECT STORAGE SOLUTION**

Powered by 4th Gen AMD EPYC™ processors and Micron 6500 SSDs.

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## **AT A GLANCE**

Next-generation Cloudian® HyperStore object storage achieves 3GB/s Write and 4GB/s Read throughput per node on a 1P system powered by a 4th Gen AMD EPYC™ processor and Micron® 6500 ION NVMe® SSDs, with excellent multi-node scalability.

## **PERFORMANCE HIGHLIGHTS**

Deploying Cloudian HyperStore object storage software (versions 8.0 or later) on a 6-node 1P cluster powered by 48-core AMD EPYC 9454 processors with 30.72 TB Micron 6500 ION NVMe SSDs delivers an exceptional ~3 GB/s per node (~17.7 GB/s on a 6-node cluster) write<sup>1</sup> and ~4 GB/s per node (~24.86 GB/s on a 6-node cluster) read<sup>2</sup> bandwidth throughput with only ~50% CPU utilization on a 100 GbE network. 4th Gen AMD EPYC processors and Micron 6500 SSDs are certified for use with Cloudian HyperStore 8.0.

PER- NODE BANDWIDTH THROUGHPUT PERFORMANCE



## **KEY TAKEAWAYS**

Cloudian HyperStore delivers seamless integration and operation with 4th Gen AMD EPYC processors in a single-socket configuration and Micron 6500 ION NVMe SSDs. Each node in a 6-node cluster achieved a superb ~3 GB/s (or ~17.7 GB/s cluster) Write operation performance<sup>1</sup> and ~4 GB/s (or ~24.86 GB/s cluster) Read operation performance.<sup>2</sup> 4th Gen AMD EPYC processors are available in 1P and 2P configurations and feature:

- Up to 1152 MB of L3 cache.\*
- Up to 4 links of Gen 3 Infinity Fabric™ at up to 32 Gbps.
- Up to 12 memory channels that support up to 6 TB of DDR5-4800 memory, respectively.\*
- Support for up to 128 (1P) or 160 (2P) PCIe® Gen 5 lanes at up to 32 Gbps.
- AVX-512 instruction support for enhanced HPC and ML performance.
- AMD Infinity Guard technology to defend your data.<sup>3</sup>

\*depending on your AMD EPYC processor model

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## 4TH GEN AMD EPYC PROCESSORS

4th Gen AMD EPYC processors continue the AMD history of x86 architecture innovations and [world-record](#) performance found in 3rd Gen AMD EPYC processors. Each 4th Gen AMD EPYC processor includes up to 128 cores running at high frequencies, high memory bandwidth and capacity, and up to 1152 MB of L3 cache to unleash exceptional performance, depending on the processor model.

4th Gen AMD EPYC processors are built on next-generation 5nm technology. They support up to 12 channels of high-performance DDR5 DIMMs with one or two DIMMS per channel (depending on OEM configuration), AVX512, and either 128 lanes (single-socket) or up to 160 lanes (dual-socket) of fast PCIe® Gen 5 I/O. These features meet the demands of today's compute- and memory-intensive AI, ML, HPC, and in-memory workloads. They also natively support the increasing use of accelerators, GPUs, FPGAs, and high-capacity LAN cards. 4th Gen AMD EPYC processors raise the bar for datacenter performance on premises or in the cloud running bare metal, VM, or containerized workloads.

This latest generation of AMD EPYC Series Processors empower faster time-to-value by delivering performance and scalability, while also helping keep your data secure. AMD Infinity Guard helps your organization take control of security and decrease risks to your most important assets – your data.<sup>3</sup>

## CLOUDIAN HYPERSTORE

[Cloudian HyperStore](#)\* brings the flexibility and elasticity of the cloud to your data center. The HyperStore exabyte-scale, software-defined-storage platform satisfies critical requirements such as data locality, residency, and security while seamlessly storing, moving, and defending any unstructured data across locations. Some of the key benefits of Cloudian HyperStore include<sup>4</sup>:

- **Cloud-like scalability:** Start small and grow without disruption.
- **Highly secure:** Most security-certified on-prem object storage with features like secure shell, RBAC/IAM, integrated firewall, audit logs, and encryption to protect data at rest and in motion.
- **Data immutability for ransomware protection:** Object Lock feature protects data from encryption by ransomware.
- **Data Resiliency:** Leadership on-prem data resiliency with pre-configured storage policy to protect the data using Replication<sup>6</sup> or Erasure Coding<sup>7</sup>.
- **Analytics:** Metadata-based search and analytics capabilities help you get the most from your data.
- **Data protection:** Exceptional data durability for long-term data protection.
- **Hybrid-cloud ready:** Supports AWS, Azure, and GCP.
- **Cost-effective:** Optimizes TCO compared to legacy disk-based storage systems<sup>4</sup>.

## MICRON 6500 ION NVMe SSDS

[Micron 6500 ION SSDs](#)\* are the world's first 200+ layer NAND data center SSD. They are engineered to evolve data center economics with 30.72 TB of storage and high performance paired with low power consumption. These drives provide scalable storage at an optimal TCO that helps cash-strapped IT departments keep up with end user data growth, ever-increasing performance expectations, and mounting environmental concerns. The Micron 6500 ION addresses all these problems head-on with excellent performance that offers energy efficiency and outstanding value. Some of the key benefits of Micron 6500 ION SSDs include<sup>5</sup>:

- **Capacity:** 30.72 TB in both U.3 and E1.L form factors for high design flexibility.
- **Performance:** Up to 6800 MB/s | 5000 MB/s (128KB read | write), 1M /200K IOPS (random 4K read | write)
- **Efficiency:** Uses up to 20 W, thereby optimizing cooling and power costs.
- **Security:** SPDm 1.2 (attestation) for identity authentication and firmware integrity verification, digitally signed firmware, FIPS 140-3 L2 certifiable, and TAA compliant SKUs.

# CLOUDIAN HYPERSTORE ARCHITECTURE

Figure 1 displays the Clodian HyperStore architecture.

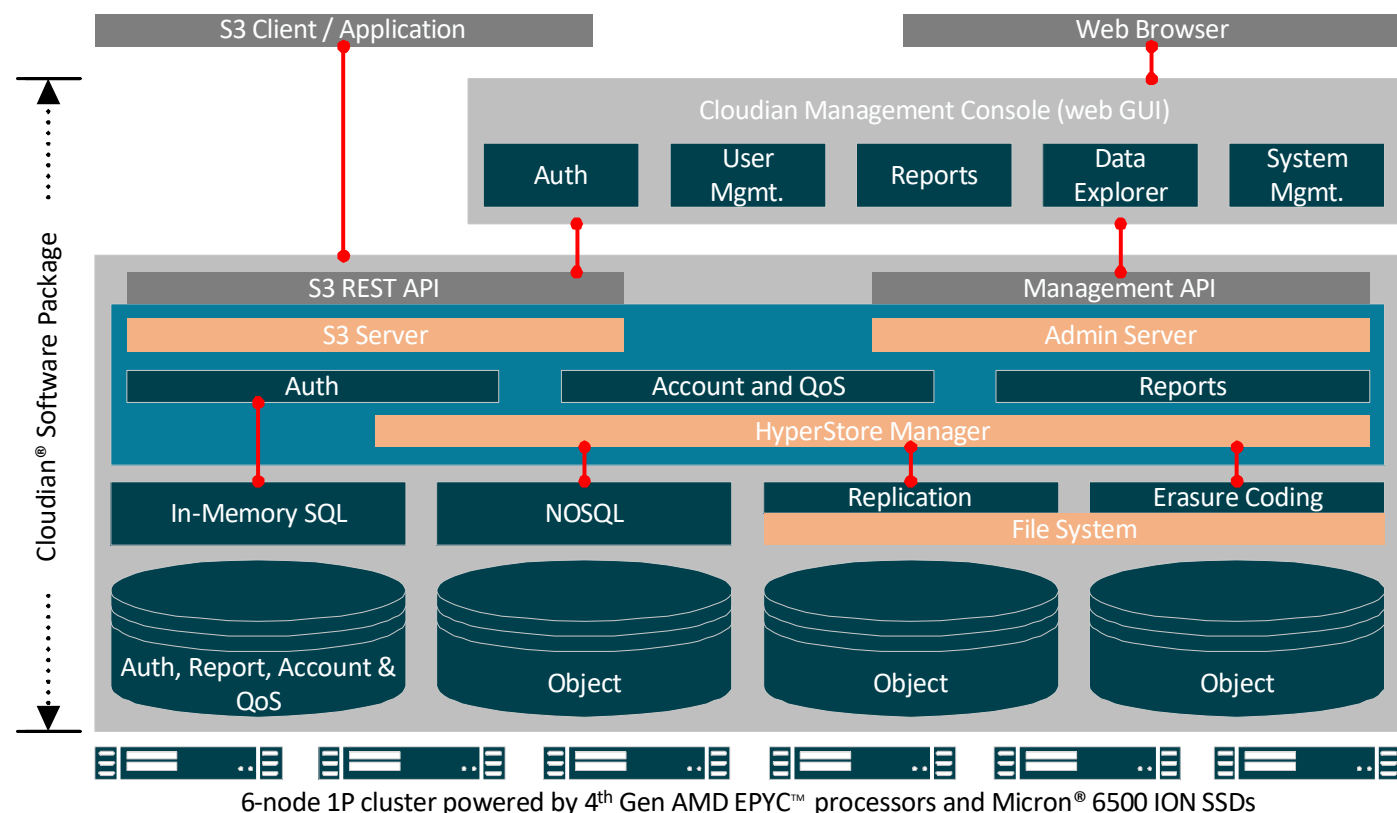


Figure 1: Clodian HyperStore architecture (courtesy of Clodian)

## TEST METHODOLOGY

AMD provided the hardware configured as shown in Table 1, below, and Micron contributed 6500 ION SSDs. Clodian installed, configured, tested, and benchmarked Clodian HyperStore using the Usage, Saturation, and Errors (USE) methodology. Clodian HyperStore ran in a 6-node clustered setup that was placed under load, and each usage was tracked via monitoring tools such as HyperIQ (HIQ). The system under test was driven to maximum values, saturation and diminishing returns. Testing required a 100% success rate for all S3 Synthetic workloads to pass; any errors would invalidate the test. Performance bandwidth throughput is measured in gigabytes/second (GB/s), which quantifies the amount of data that a storage system can process in one second. Per-node performance was calculated by dividing the 6-node cluster performance by 6.

Testing examined all aspects of software and hardware integration points and used both happy path (known input and expected output) and negative testing (unexpected inputs). Certification was only achieved after successfully completing all tests. Servers powered by 4<sup>th</sup> Gen AMD EPYC processors and Micron 6500 ION SSDs are certified by Clodian and ready for deployment as a Clodian HyperStore 8.0 Software Defined Storage solution. This solution did not use the AVX-512 instruction set or AMD Infinity Guard.

## SYSTEM CONFIGURATION

AMD SYSTEM CONFIGURATION	
Servers	6x 2P Lenovo ThinkSystem SR665 V3 rackmount servers (Each server was powered by a single AMD EPYC processor.)
Server Operating Mode	Maximum performance
CPUs	1 x AMD EPYC 9454P
Frequency: Base   Boost <sup>8</sup>	2.75 GHz   3.80 GHz (up to)
Cores	48 cores/socket (96 threads)
L3 Cache	256 MB per CPU
Memory	384 GB (12x) Dual-Rank DDR5 4800 32 GB DIMMs 1 DPC
NICs	Mellanox ConnectX-7, Mellanox ConnectX-5 Mix [100GbE]
Storage: Metadata   Data	2 x Micron 7450 PRO (3.84 TB total/node)   4 x Micron 6500 ION (~120 TB total data/node)
BIOS Version	KAE106V
BIOS Settings	SVM (virtualization)=OFF; NPS=4; Determinism Slider=Performance, L3asNUMA=Disabled, SMT=ON
OS	Rocky Linux <sup>®</sup> 8.7, Kernel v4.18
OS Settings	tuned-adm=throughput_performance, grub=amd_passive
HyperStore SW Version	v8.0
HyperStore Settings	s3.threads.max=500, hyperstore.threads.max=1500

Table 1: AMD system configurations

## FOR ADDITIONAL INFORMATION

Please see the following additional resources for more information about 4th Gen AMD EPYC features, architecture, and available models:

- [4th Gen AMD EPYC™ Processors](#)
- [AMD EPYC™ Products](#)
- [AMD EPYC™ Tuning Guides](#)

## REFERENCES

1. Write performance obtained using the Cloudian GosBench Erasure Closure [EC4+2] configuration, Object size 10MB, S3 connections = 980.<sup>9</sup>
2. Read performance obtained using the Cloudian GosBench Replication Factor [RF3] configuration, Object size 10MB, S3 connections = 980.<sup>9</sup>
3. AMD Infinity Guard features vary by EPYC™ Processor generations. Infinity Guard security features must be enabled by server OEMs and/or Cloud Service Providers to operate. Check with your OEM or provider to confirm support of these features. Learn more about Infinity Guard at <https://www.amd.com/en/technologies/infinity-guard>. GD-183
4. This list of benefits was provided by Cloudian (see <https://cloudian.com/products/hyperstore/>) and has not been independently verified by AMD.
5. This list of benefits was provided by Micron (see <https://www.micron.com/products/ssd/product-lines/6500-ion>) and has not been independently verified by AMD.
6. Replication Factor (RF) is a configurable number of copies of each data object are maintained in the system, and each copy is stored on a different node. Copies can exist at various sites if desired. RF3 as an example maintains 3 copies of data on the system for resiliency.
7. Erasure Coding (EC) is an advanced resiliency mechanism where each object is encoded into a configurable number of data fragments plus a configurable number of redundant parity fragments. Each fragment is stored on a different node, and the object can be decoded from any number of fragments. Erasure coding provides high levels of resiliency with much better storage utilization efficiencies as compared to replication.
8. Maximum boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems. EPYC-18
9. Gosbench is a golang continuation of Cosbench, which was developed by Intel as a synthetic S3 workload generator. Gosbench is a server/client configuration that can scale out to match the scale out aspects of Object storage.

## AUTHORS

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## RELATED LINKS

- [Cloudian HyperStore\\*](#)
- [Micron 6500 ION SSDs\\*](#)
- [Lenovo ThinkSystem SR665 V3\\*](#)
- [AMD EPYC Processors](#)
- [AMD EPYC Technical Briefs](#)

*\*Links to third party sites are provided for convenience and unless explicitly stated, AMD is not responsible for the contents of such linked sites and no endorsement is implied.*

### 4TH GEN AMD EPYC CPUS

4th Gen AMD EPYC CPUs deliver excellent per-core performance by taking advantage of fast CPU frequencies, low latency memory, and a unified cache structure. Support for cutting edge technologies like PCIe Gen 5.0 I/O, DDR5 RAM, and the AVX-512 instruction set deliver the speed and reliability needed in today's datacenters. 4th Gen AMD EPYC processors are available in a variety of configurations optimized for diverse workloads.

### "ZEN 4" CORE & SECURITY FEATURES

Support for up to:

- 128 physical cores, 256 threads
- 1152 MB of L3 cache per CPU
- 96 MB of L3 cache per CCD
- 6 TB of DDR5-4800 memory
- Up to 128 1P, up to 160 2P PCIe® Gen 5 lanes

Infinity Guard security features<sup>3</sup>

- Secure Boot
- Encrypted memory with SME

### CLOUDIAN®

Cloudian's HyperStore exabyte-scale, software-defined-storage platform provides a cost-effective on-premises solution for enterprise customers. Deployed in your datacenter, HyperStore provides a proven storage option for capacity-intensive workloads that satisfies critical requirements such as data locality, residency, and security. HyperStore gives you the flexibility and elasticity of the cloud within your data center.

### HYPERSTORE BENEFITS

- Cloud-like flexibility & scalability.
  - Consolidated health records for easy access and management.
  - Access controls, audit logs, and encryption for data at rest and in motion.
  - Metadata-based search and analytics capabilities.
  - Exceptional data durability for long-term protection.
  - Hybrid-cloud ready with support for AWS, Azure, and GCP.
- Optimal TCO.

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