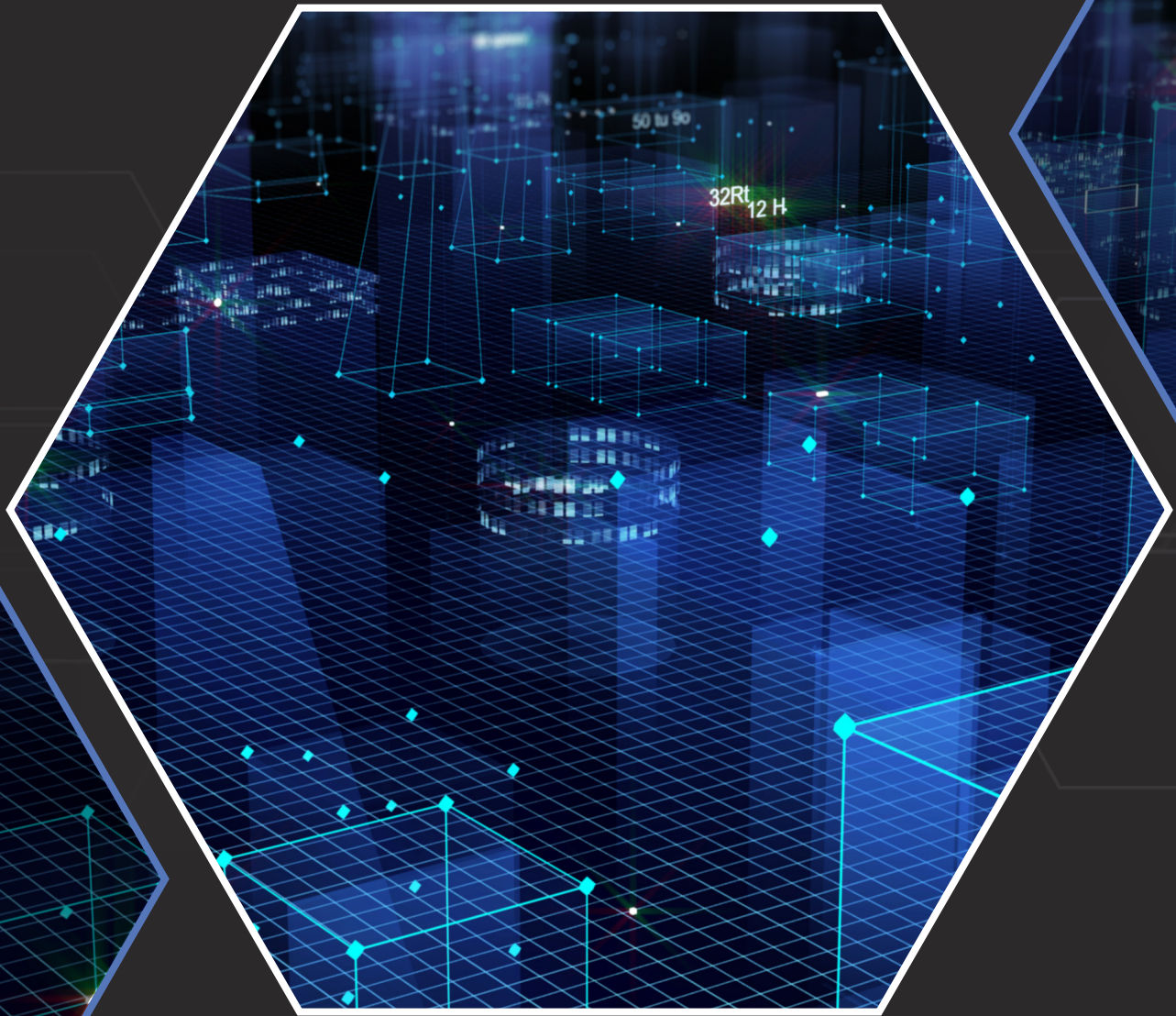# Solving The High-Performance HCI Problem

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Hyperconverged Infrastructure (HCI) has redefined how organizations deploy and manage IT resources by consolidating virtualization, storage, and networking into a prepackaged solution. Despite its popularity, achieving high performance in HCI environments remains a significant challenge, with bottlenecks arising from hypervisor overhead, resource contention, and inefficient architectures. As a result, most HCI infrastructures are only used for low-demand applications. Customers often deploy dedicated storage and compute infrastructure for mainstream and performance-demanding applications.

VergeIO moves beyond traditional HCI to Ultraconverged Infrastructure (UCI), introducing an innovative approach that eliminates inefficiencies and integrates virtualization, storage, and networking into a unified platform. VergeOS 4.13, the flagship UCI solution, delivers advanced performance capabilities while maintaining affordability, scalability, and simplicity. Real-world testing results demonstrate the transformative potential of UCI, making VergeOS a leading choice for all modern IT environments—from low-demand workloads to high-performance situations.

Challenges Facing High-Performance Infrastructure

While HCI offers simplicity and scalability, the performance demands of modern workloads often expose its limitations. The core challenges include:

Hypervisor Overhead
In most infrastructure solutions, storage operates as a virtual machine (VM), making it a second-class citizen of the hypervisor. This design increases latency and reduces overall efficiency, especially in resource-intensive workloads such as custom applications and databases.

Dual Tasking and Resource Contention
The hypervisor must allocate resources to both applications and storage services, creating significant contention. For example, while one workload requires compute power to handle network requests, another may need the same resources to read or write data to storage media. This dual-tasking creates bottlenecks that limit scalability and reduce responsiveness.

Scalability and Efficiency
Traditional approaches struggle to scale efficiently without introducing excessive overhead. Most HCI architectures fail to get latency under 5 milliseconds when under load and often utilize less than 30% of the available bandwidth. The lack of an optimized architecture means higher latency and lower throughput as workloads grow. For organizations with mission-critical applications, these limitations can lead to delays, downtime, and increased operational complexity.

Fixing Performance with VergeIO's UCI Approach

VergeIO addresses these challenges with an innovative rethinking of infrastructure architecture. VergeOS integrates storage, virtualization, and networking into a unified UCI platform, eliminating inefficiencies and delivering exceptional performance.

Efficient Hypervisor Architecture

Unlike traditional solutions, VergeOS integrates storage directly into the hypervisor as a service, rather than as a separate VM. This design eliminates unnecessary overhead and ensures faster access to storage resources. By reducing latency and streamlining operations, VergeOS ensures high performance even under demanding workloads.

Resource Optimization

The VergeOS UCI architecture optimizes resource allocation, balancing the needs of compute, networking, and storage workloads. By fine-tuning the software to minimize resource contention, VergeOS ensures that applications and infrastructure services can operate without interference.

Support for Mixed Node Types

Many VergeIO customers start with HCI-style nodes, which balance storage and compute resources. As their environments grow, VergeOS seamlessly supports heterogeneous environments. Organizations can deploy dedicated compute nodes for application demands and storage nodes for IO-intensive workloads, creating a flexible and scalable UCI infrastructure.

Value of High-Performance UCI with VergeOS

High Performance for Demanding Workloads

With VergeOS, organizations can achieve impressive performance benchmarks. Tests have demonstrated 1 million read IOPS and 500,000 write IOPS using standard configurations. These tests were conducted using 64K block sizes, which provide a more realistic representation of modern virtualized environments. Sub-millisecond response times, full network throughput, and software-embedded ECC (Error-Correcting Code) ensure that performance remains consistent and reliable. These capabilities make VergeOS ideal for data-intensive applications and mission-critical workloads.

Affordable Performance for Mainstream Workloads

VergeOS excels not only in delivering high-end performance but also in providing enterprise-grade capabilities on entry-level hardware. By leveraging its efficient UCI architecture, VergeOS can deliver impressive results using cost-effective server configurations, such as:

- Consumer-grade AMD Ryzen CPUs for high compute power at a fraction of the cost of enterprise-grade processors.

- Support for most consumer-grade NVMe SSDs achieve exceptional storage performance without requiring proprietary hardware. VergeOS has built-in functions that replace the need for enterprise SSDs with capacitors and ECC memory, making consumer-grade SSDs safer to use in an enterprise setting. The platform ensures perfect write distribution, eliminating hotspots and addressing wear-leveling concerns to extend the lifespan of storage media.

- 1.5 million IOPS and sub-millisecond latency using $1,500 servers, showcasing the ability to deliver mainstream workload performance on entry-level budgets.

These capabilities empower organizations to support mainstream workloads, such as departmental applications, virtual desktops, and general-purpose compute tasks, without the need for costly infrastructure upgrades. VergeOS proves that high performance can be both accessible and affordable, enabling organizations of all sizes to scale efficiently.

Simplified Operations

One of the key advantages of VergeOS is its simplicity. The platform manages virtualization, storage, and networking through a single interface, eliminating the need for complex storage configurations like LUNs. Features such as snapshots, virtual data centers, and integrated replication simplify data protection and disaster recovery, reducing administrative overhead while ensuring business continuity.

Testing and Real-World Results

Extreme Performance Testing with Solidigm
In collaboration with Solidigm, VergeIO tested VergeOS 4.13 in a controlled environment using Solidigm's Gen 5 NVMe drives. The tests demonstrated remarkable performance:

- A six-node cluster surpassed 1 million random read IOPS using 64K blocks, a configuration commonly used in virtualized environments. Response times were consistently sub-millisecond, measured using external VMs to simulate real-world noisy neighbor conditions.
- Random write performance reached 485,000 IOPS, exceeding 30 GB/s throughput while maintaining sub-millisecond latency.
- The raw performance of the Solidigm SSDs achieved 17 million IOPS with 4K blocks, highlighting the drive's capability to handle intensive workloads.

These results confirm VergeOS's ability to optimize storage performance, utilize maximum network bandwidth, and minimize overhead, even in demanding scenarios.

Affordability Testing in VergeIO Labs
VergeIO conducted affordability testing in its own labs, showcasing how VergeOS delivers enterprise-grade performance with cost-efficient hardware. Using eight consumer-grade servers priced at $1,500 each, the tests achieved the following:

- 1.5 million random read IOPS using 64K blocks at a total cost of $10,000, equating to less than $0.01 per IOPS. Response times remained sub-millisecond throughout the test.
- 195,000 random write IOPS with 12 GB/s throughput, utilizing the full 25Gbps network bandwidth while maintaining sub-millisecond latency.

These results highlight VergeOS's ability to combine performance, scalability, and affordability in a single UCI platform.

Why 64K Block Testing Matters

Testing with 64K blocks provides a more accurate representation of real-world workloads compared to traditional 4K block testing. In virtualized environments, applications such as databases and virtual machines rely on larger block sizes for optimal performance. By using 64K blocks, VergeIO ensures that its testing reflects the demands of actual enterprise workloads, providing meaningful results that organizations can rely on.

The Future of UCI: Advanced Capabilities with VergeOS

VergeOS 4.13 introduces advanced features that address the evolving needs of modern IT environments. Live storage migration allows organizations to dynamically move workloads across storage tiers, ensuring optimal performance while extending the lifespan of storage media. Additionally, VergeOS supports high-density storage solutions like Solidigm's 122TB QLC NVMe drives, enabling seamless integration without compromising performance.

Conclusion: Redefining Infrastructure with VergeOS

VergeOS 4.13 sets a new standard for ultra-converged infrastructure by addressing the core challenges of performance, scalability, and cost-efficiency. Its innovative architecture delivers enterprise-grade performance using cost-effective hardware, simplifying operations while enabling organizations to modernize their IT environments.

VergeOS is the future of virtualization. By combining advanced features with real-world affordability, VergeOS empowers businesses to achieve their goals without compromise.

About VergeIO

VergeIO is a leader in ultra-converged infrastructure (UCI) solutions, integrating virtualization, storage, and networking into a single, easy-to-manage platform. VergeIO's software empowers organizations to reduce costs, simplify IT operations, and achieve unmatched performance.