



The VergelO UCI Architecture



EXECUTIVE SUMMARY

IT planners are struggling to identify the next architecture for their infrastructures. On-premises data centers are hampered by VMware's overly complex and expensive stack, which is being compounded by Broadcom's acquisition of the company. Microsoft's Hyper-V has consistently underwhelmed IT professionals and the company isn't providing clear leadership on the future of its hypervisor. Open-source solutions have been unable to fill the gap because they lack enterprise scalability and capabilities.

The Public Cloud, once thought of as the solution to resolve all IT problems, is now showing to be as complex and more expensive than its on-premises alternatives. The purchase cost of computing, storage capacity, and performance are declining rapidly. For most organizations, it makes much more financial sense to "own" the data center instead of "renting" it as long as they can simplify its operations.

Public Cloud vendors build their infrastructures in the same way as organizations build their on-premises infrastructures. Most use open-source hypervisors and custom-built storage solutions. In addition, each provider now offers four to six different types of storage (tiers) with little to no data management automation. While Public Cloud vendors try to hide the complexity of their architectures, as customers scale their workloads, it begins to seep through.

On-premises data centers were all "supposed" to leverage hyperconverged infrastructure (HCI), which was said to simplify operations and dramatically lower costs. HCI failed on all counts. It has proven to be as complex as legacy three-tier architectures and potentially even more expensive.

The problem is that HCI didn't converge anything. Instead, it "squeezed" the three data center tiers (compute, networking, and storage) into a box by software defining each tier. Each of these software-defined tiers is independent of the others and is often from three different vendors. Using three separate software applications means a lot of overlapping code and metadata, creating even more inefficiency. As a result, HCI, if used in the data center, is typically relegated to a single niche use case, like virtual desktop infrastructure (VDI).

The impact of HCI's inefficiencies is that most on-premises data centers continue to use legacy three-tier architectures with a dedicated storage array running proprietary software, a restrictive, single vendor, compute tier running a hypervisor like VMware, and a dedicated network tier using a single vendor's proprietary switches.

VergeIO's vision is to Simplify IT. To fulfill that vision requires an evolution in IT infrastructure that builds on the concept of HCI, addresses its shortcomings, and expands its capabilities well beyond the original intent. VergeIO's solution is an ultraconverged infrastructure (UCI) solution called VergeOS.

The VergeIO development team started with three core elements:

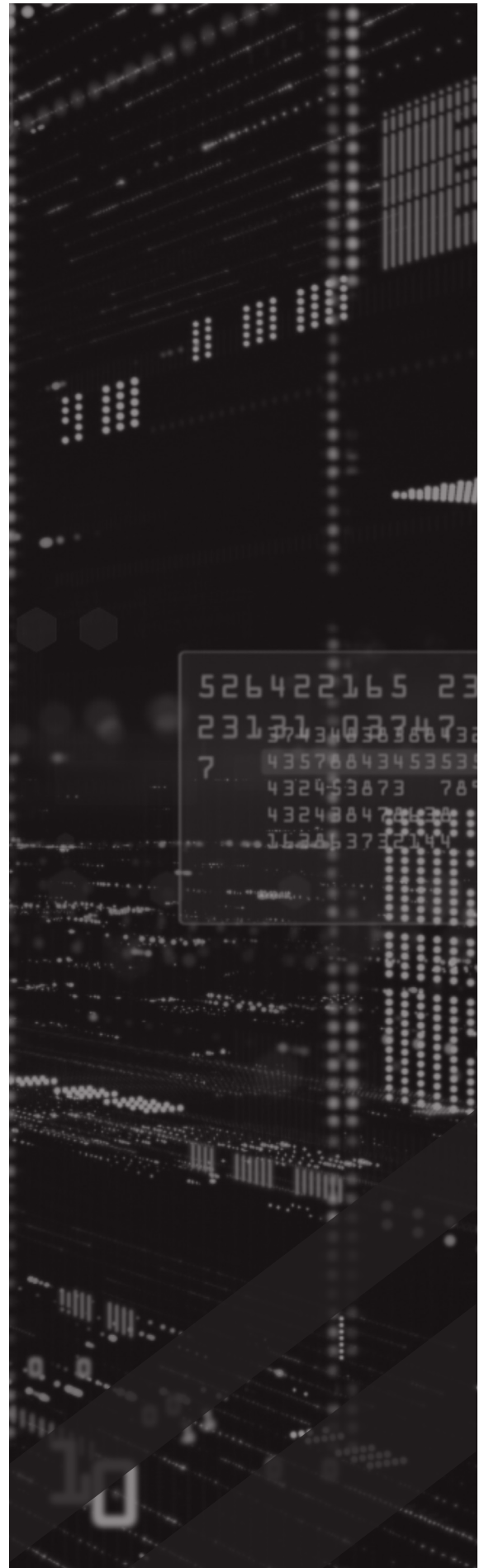
- VergeFabric for networking
- VergeHV for server virtualization
- VergeFS for storage

Instead of making these three separate products, they are unified into a cohesive, single code base called VergeOS. By running as a single, efficient software package, VergeOS can deliver unprecedented per-server efficiency, eliminating complexity and dramatically reducing upfront and long-term data center costs.

COMMON SENSE LICENSING

As part of VergeIO's vision to simplify IT, the company delivers a disruptive, common-sense licensing strategy. The software is licensed per physical server, not by processor, core, storage capacity, RAM, or IOPS. This style of licensing rewards customers who invest in hardware innovations like increasing core per CPU density and capacity per SSD. Customers can add servers with hundreds of cores and near petabytes of capacity without increasing software licensing. It enables organizations to shrink data center footprint while reducing power and cooling costs.

VergeIO stands against the move to per-core licensing and with customers looking to increase efficiency and reduce costs.





The VergeOS Architecture

THE THREE PILLARS OF UCI

For UCI to deliver the full promise of HCI requires:

- A unified, cohesive code base
- Three-dimensional scalability
- Virtualization beyond the individual server

UNIFIED CODE BASE

VergeOS integrates the hypervisor, storage, and network software into a single unified code base using less than 400,000 lines of code. Comparatively, VMware's ESXi, vSAN, and NSX stack has over 25,000,000 lines of code.

The first benefit of this unification is efficiency. VergeOS can deliver much closer to bare metal performance than other solutions on the market. Most VergeOS customers can increase per server virtual machine (VM) density and performance for performance-sensitive applications. Storage I/O performance is also impressive, with over 1 million IOPS per node performance when using NVMe flash storage. As a result, most customers can delay, shrink, or even cancel upcoming server hardware orders.

The unified code base also reduces complexity. VergeIO customers find that one or two IT administrators can manage environments with dozens of physical servers hosting thousands of virtual machines. Given the rampant IT skills shortage, VergeOS allows IT leaders to focus on other mission-critical workloads instead of using available personnel for infrastructure.

THREE-DIMENSIONAL SCALE

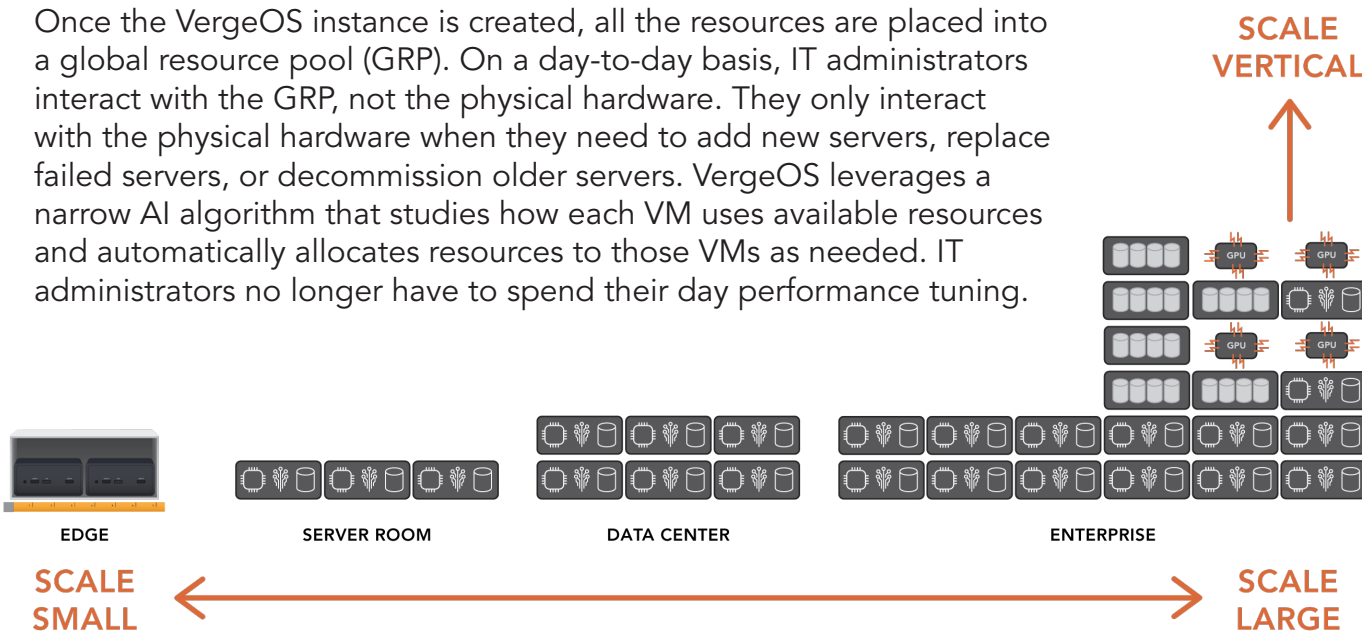
Change is the only constant in the data center, so an infrastructure that promises convergence should adapt quickly. VergeOS provides three-dimensional scaling. It can scale small to as few as two nodes (most HCI solutions require a minimum of three nodes). Two-node systems are ideal for Edge locations, remote offices, or small data centers.

VergeOS can also scale large, over 200 nodes, although thanks to its efficiency, most customers won't need to scale beyond 50 nodes. Large scale is a requirement for enterprise data centers, cloud service providers (CSP), managed service providers (MSP), and software as a service (SaaS) providers. VergeOS' inclusion of networking allows it to fix the inter-node or east-west traffic issues that plague most HCI solutions. Its optimized protocol enables it to break through the 32-node barrier the typical HCI solution faces.

Finally, VergeOS can scale flexibly. It can mix nodes of different types within a single instance. Customers can add nodes whose processors are from different manufacturers (Intel, AMD, Nvidia) or different configurations (compute-centric, capacity-centric, IOPS-centric).

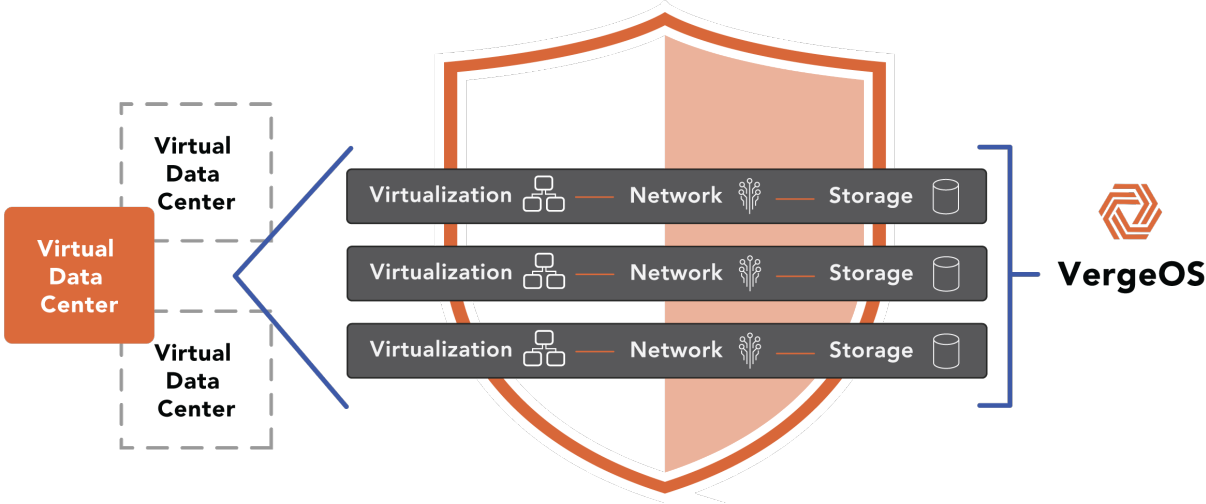
VergeOS’ three-dimensional scale provides the ultimate in future-proofing. It is not uncommon for VergelO customers to, within the same instance, have servers that are more than six years old alongside servers that are a few months old. Thanks to VergeOS’ high availability and self-healing capabilities, customers can leverage older servers until they fail without risking data loss or application downtime.

Once the VergeOS instance is created, all the resources are placed into a global resource pool (GRP). On a day-to-day basis, IT administrators interact with the GRP, not the physical hardware. They only interact with the physical hardware when they need to add new servers, replace failed servers, or decommission older servers. VergeOS leverages a narrow AI algorithm that studies how each VM uses available resources and automatically allocates resources to those VMs as needed. IT administrators no longer have to spend their day performance tuning.



VIRTUAL DATA CENTERS

VergeOS goes beyond virtualizing physical servers by virtualizing the entire data center with its Virtual Data Center (VDC) technology. In the same way that a VM encapsulates a physical server, a VDC encapsulates the entire data center: all the VMs, all the network and storage settings. As a result, IT administrators can move a VDC with the same ease that they do a VM migration.



The VDC construct makes disaster recovery seamless and enables moving data centers between physical locations for follow-the-sun or maintenance needs. Because VergeOS includes all the networking software, and a VDC encapsulates it, when it arrives at another data center, it will work flawlessly, even if there is different networking hardware in each location.

VDCs make complete workload consolidation achievable by enabling the allocation of specific assets to specific VDCs. IT administrators can allocate a specific type of processor (Intel, AMD, Nvidia), a specific number of cores, and a specific type of storage.

VDCs also create the first layer in VergeOS' multi-layer ransomware resiliency capabilities. While a VDC has to be opened up to users, and those users are typically the way ransomware gets into the environment, it is nearly impossible for the trigger file to propagate to other VDCs. Even if connectivity between VDCs is required, VergeOS' networking capabilities enable fine-grained control over how the VDC accesses other VDCs.

VergeOS Capabilities Highlights

VIRTUALIZATION

VergeOS is a robust hypervisor with complete enterprise capabilities. Unifying the hypervisor code with the storage and networking code means that VergeOS delivers near-bare-metal performance. There is no noticeable impact of virtualization. Many VergeOS customers report that bare metal workloads perform better after being virtualized by VergeOS.

In addition to the Narrow-AI algorithm, which provides automated performance optimization and self-healing, VergeOS is also resilient to external exploits plaguing VMware and other hypervisors. When installing VergeOS, it creates a read-only core that acts as firmware. It can't be changed or altered. As IT administrators create VDCs, the read-only core is injected into the RAM of that VDC via crypto-verification. If the VergeOS instance of that VDC is, for whatever reason, compromised, a simple reboot clears the RAM and resets the operating system. The hardening of the VergeOS represents the second layer of the VergelO multi-layered ransomware resiliency capabilities.

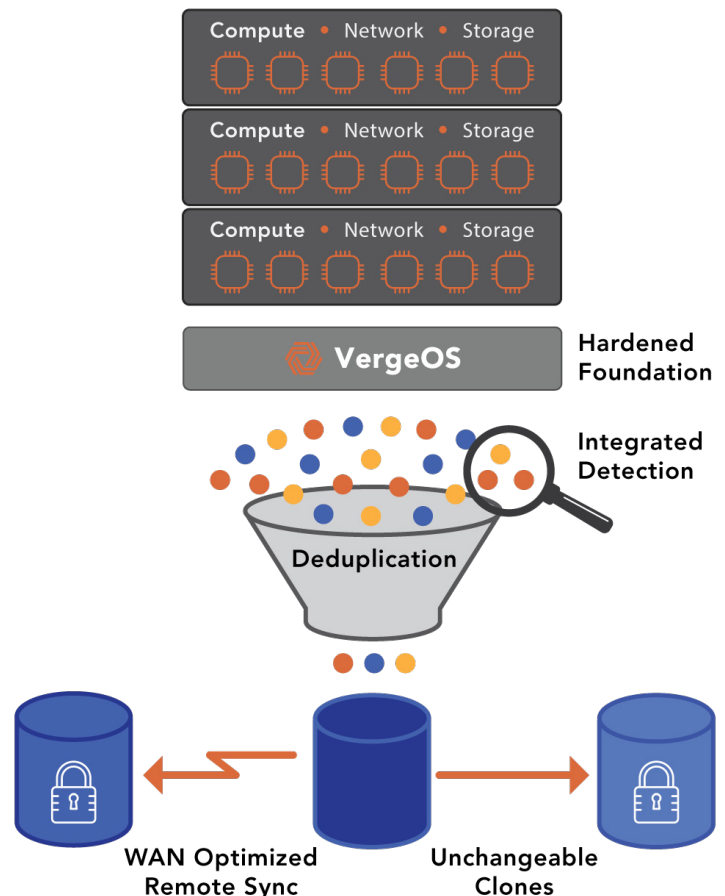
STORAGE

Cost Effective Server Based Storage

VergeOS eliminates the need for a dedicated storage array. It uses server-class storage media (NVMe/SATA flash or SAS/SATA HDDs) installed inside the nodes within the VergeOS instance. It then aggregates that capacity, making it available to VMs and providing complete drive redundancy. This approach provides better performance and resiliency than dedicated storage arrays at a price that is 5X less expensive.

Global Inline Deduplication

At the heart of VergeOS' storage capabilities is Global Inline Deduplication, which delivers a 90% improvement in capacity efficiency with no noticeable performance impact. Unlike its software-based competitors that either bolted the feature on years after their initial launch or dedicated storage arrays that hide performance by forcing customers to



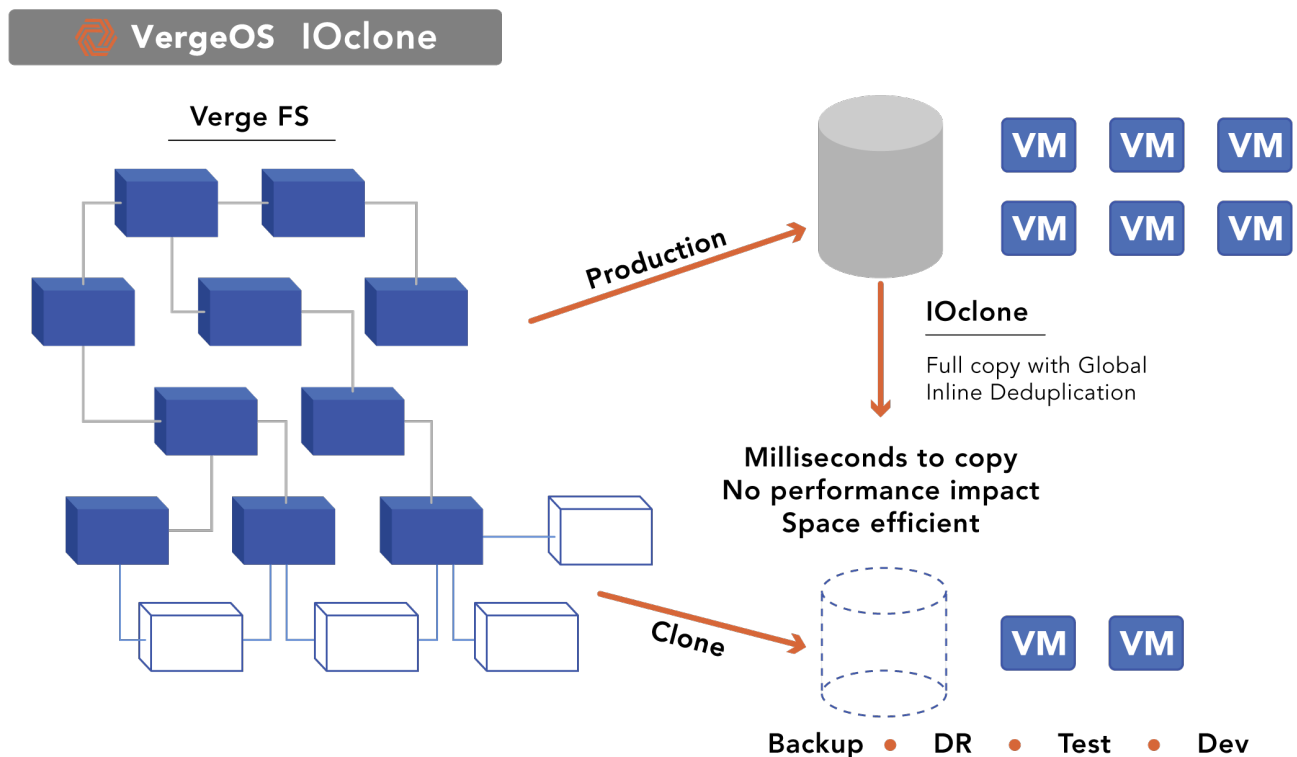
pay for high-end processing power, VergeOS' Global Inline Deduplication was built into the operating system's core from its inception. IT planners can leverage the technology without overcompensating with processing power or compromising data protection flexibility.

Its global nature means that VergeOS' deduplication is WAN-aware, making many-to-one replication efficient and ideal for Edge or Remote office or complete disaster recovery strategies. Customers can eliminate the need for expensive high-speed connections between facilities.

Snapshots That Act Like Clones

Global Inline Deduplication also enables VergeOS to provide unprecedented data protection capabilities through its snapshot technology. Legacy snapshots are a complex tree of interdependent copies strung together via metadata. To avoid performance-related issues, IT must limit the number of active snapshots and how long they are maintained. These limitations make legacy snapshots useless for any meaningful form of data protection.

If possible, deleting a snapshot in the middle of that tree can take days for the storage system to compensate and release capacity. If the primary volume is deleted, all snapshots are invalid. Performance is hamstrung because snapshot metadata must be managed separately from the rest of the storage environment.



VergeOS snapshots leverage our IOclone technology to provide space-efficient images that are independent of each other. Thanks to Global Inline Deduplication, a VergeOS snapshot does not consume any space after it is created until changes are made. VergeOS snapshot independence means that snapshots can be reclaimed in any order instantly to free up storage capacity. Even the original from which the clones were made can be removed, and the clones will continue functioning correctly.

IOclone eliminates the need for a particular metadata instance to track snapshot copies. As a result, administrators can execute snapshots frequently and retain them indefinitely without concern for performance impact. While VergeOS supports external backup applications, IOclone combined with VergeOS replication capabilities meets all the requirements of the traditional 3-2-1 rule for backup, three copies (or more) of data, on two separate types of media (flash or HDD), with at least one copy off-site.

Unprecedented Ransomware Resiliency

IOclone-powered snapshots also create the VergelO ransomware resiliency capabilities' third layer of immutable recovery points that are taken frequently enough to make a difference. Customers can execute snapshots as frequently as they want, typically every 10 to 15 minutes, with the confidence of knowing that ransomware can't alter them.

The fourth layer of VergelO's ransomware resiliency strategy is IOfortify, which provides rapid notification of a potential ransomware attack by monitoring the VergeOS Global Inline Deduplication trend line. After a few weeks of using VergeOS, most customers will tend to have a specific efficiency rating, typically 90%. This ratio should be relatively static except for adding new data, typically from additional imports of VMware VMs.

The other cause of a drop in deduplication efficiency is if a ransomware attack encrypts files. The deduplication algorithm treats these encrypted files as net new data, quickly reflected in the deduplication trend line. IOfortify monitors this trend line and typically, within 10 - 15 minutes, can notify IT administrators of a potential attack.

Rapid Recovery from Ransomware

If ransomware enters a VergeOS environment, the scope of the damage it can cause is limited to the VDC by which it enters. It can't harm the core instance since that version of the OS is firmware (read-only). A known good copy via an independent snapshot should only be 15 minutes old. And IT typically knows of the attack before the attack compromises that snapshot.

After verifying the IOfortify notification's accuracy, IT can use VergeOS telemetry information to pinpoint which VMs exhibited the behavior that caused the drop in efficiency. They can then mount the 15-minute old snapshot in a quarantined state, scan it for malware copies, and, if present, remove them before they activate. Then, IT can mount a snapshot as the primary volume. Again, because IOclone-powered snapshots are independent, no data movement is required, and IT can "tear down" the infected copy, ensuring complete malware eradication. IT can sleep well at night, knowing that "another shoe isn't going to drop."

VIRTUALIZATION

Verge OS provides Layer two and three networking capabilities, including complete network management and IP administration (DHCP, DNS, routing, firewall, etc.). The network is managed up to layer two by VergelO, with cross-node routing handled within the VergelO DMZ network.

As a result, VergeOS enables customers to use any off-the-shelf commodity switch. VergeOS networking reduces costs and enables the use and management of switches from various vendors as if there were one big switch.



VergeOS Basic Configuration

VergeOS is software. It is loaded on 64-bit Intel-compatible (Intel/AMD) servers. Each server needs one NVMe drive of at least 320GB for metadata. And at least one NVMe/SATA/SAS flash drive for guest VM storage. The drives within each server must be of the same physical capacity. HDDs can be used in place of flash with an acknowledged performance impact.

Each server needs 8GB RAM for VergelO operations plus designated memory for guest VMs. Additionally, the customer should allocate 1 GB of RAM per 1 TB of storage in each server. We refer to individual servers as nodes.

These nodes are grouped into a VergeOS instance—the instance groups similar servers into clusters. Clusters must have a minimum of two like servers.

For example, IT can build a VergeOS instance using three Intel- and three AMD-based servers. The Intel-based servers would be organized in one cluster and the AMD-based servers in another. Resources from the servers are available to any VMs within the VergeOS instance.

For more details, please refer to the VergeOS Technical [minimum requirements](#).

Conclusion

VergeOS is a versatile Ultraconverged Infrastructure (UCI) solution built on three key pillars: a unified code base, three-dimensional scalability, and advanced virtualization capabilities. These features make it efficient, adaptable, and resilient in modern IT environments.

The unified code base integrates hypervisor, storage, and network software, enhancing performance and simplifying management. Three-dimensional scalability allows for flexible scaling from small edge setups to large enterprise data centers. At the same time, advanced virtualization goes beyond servers to encapsulate entire data centers, simplifying disaster recovery and resource allocation.

VergeOS excels in virtualization, storage, and networking. It delivers near-bare-metal performance, offers space-efficient storage solutions with advanced data protection, and provides robust networking capabilities, reducing costs and enhancing manageability.

VergeOS is a powerful UCI solution that optimizes efficiency, adapts to varying needs, and ensures data protection in the face of evolving challenges, making it a valuable choice for modern IT infrastructures.