Micron's All-Flash vSAN – The Future Home of Your VMs and Containers

SOLID Ready vSAN AF-4 Delivers 2.5X to 22X More 4K IOPS and
60% to 95% Lower Average Latency Than a Similarly Equipped Hybrid Design

Key Advantages of an All-Flash vSAN vs. a Hybrid

Superior 4K IOPS With Large Datasets

Our all-flash vSAN Ready Nodes with TCG-E encryption are optimized at the platform level for better 4K IOPS than hybrid designs across a variety of workloads.

Workload	AF-4 vs. Hybrid	AF-6 vs. Hybrid	AF-8 vs. Hybrid
100% Read	6.5X	6.4X	6.3X
70% Read	22.2X	23.4X	36.8X
50% Read	10.8X	12.6X	19.6X
30% Read	5.2X	4.8X	8.12X
0% Read	2.5X	1.9X	4.3X

All-flash 4K IOPS performance multiplier

Lower 4K Latency With Large Datasets

All-flash vSAN Ready Nodes respond more quickly thanks to using flash in both the cache and capacity tiers.

Workload	AF-4 vs. Hybrid	AF-6 vs. Hybrid	AF-8 vs. Hybrid
100% Read	86%	79%	61%
70% Read	95%	95%	96%
50% Read	91%	91%	93%
30% Read	81%	76%	83%
0% Read	60%	40%	68%

Percentage all-flash 4K average latency is lower

Overview

As more IT departments move to a virtualized infrastructure, their focus is shifting from, "Should I move to virtual?" to "How can I *efficiently* move to virtual?" and "How can I effectively manage un-forecasted demand?"

To answer these questions, IT teams can turn to Micron's SOLID Ready all-flash vSAN 6.2 solutions, available in AF-4, AF-6 and AF-8 configurations.

Our all-flash vSAN Ready Nodes with advanced DRAM and TCG-E-enabled (AES 256-bit encryption) SSDs offer state-of-the-art data center efficiency features like deduplication, compression and erasure coding, and hardware-assisted data-at-rest encryption.

vSAN Node Design

When choosing how to deploy vSAN 6.2, one of the first considerations is the basic node design. One option is to use all-flash storage with SSDs for both the capacity tier and the cache tier. Another option is a hybrid using SSDs for the cache tier only, leaving the capacity tier serviced by HDDs.

This technical brief compares measured 4K IOPS performance and average latency of a Micron all-flash VMware vSAN (four all-flash nodes) to a similarly configured hybrid vSAN solution (four hybrid nodes).

Figure 1: Micron All-Flash Ready

Micron All-Flash vSAN: Superior 4K IOPS and Average Latency

Small, random IOs are common in virtualized deployments so exceptional IOPS performance and low latency across various workloads is essential. We measured small transfer (4K) random IOPS and average latency for both the Micron all-flash and the hybrid vSAN using VMware's HCIBench test tool.

VMWare's HCIBench Test

HCIBench is a publicly available test tool that leverages the ability to deploy large virtual machine configurations with very specific working sets and workload types. Because of its deterministic approach, HCIBench enables consistent, repeatable performance measurement to enable direct comparisons among different platforms and technologies like all-flash and hybrid vSAN configurations.

To ensure we tested the capabilities of each configuration as a whole (both cache and capacity tiers), we used a working set equivalent to 75% of the total vSAN capacity. This "outside of cache" test extends the test data well beyond the vSAN 6.2 cache tier to ensure the results reflect the performance of the complete vSAN architecture.

All-Flash vSAN: Superior 4K Random IOPS

Figure 2 shows the 4K IOPS performance of the all-flash AF-4, AF-6, AF-8 and hybrid configurations. The working set is large — 75% of the vSAN capacity.

4K IOPS are on the vertical axis, and the five tested workloads (100% read at the left, 0% read at the right) are on the horizontal axis. The hybrid configuration is in orange, the all-flash AF-4 in light green, AF-6 in dark green and AF-8 in blue (from left to right).

In each workload, the all-flash configuration demonstrated superior 4K IOPS performance. Since the working set extends into the capacity tier, Figure 2 shows how the HDDs in the hybrid capacity tier simply cannot offer the small, random access IOPS of the M510DC SSDs in the all-flash configuration capacity tier.

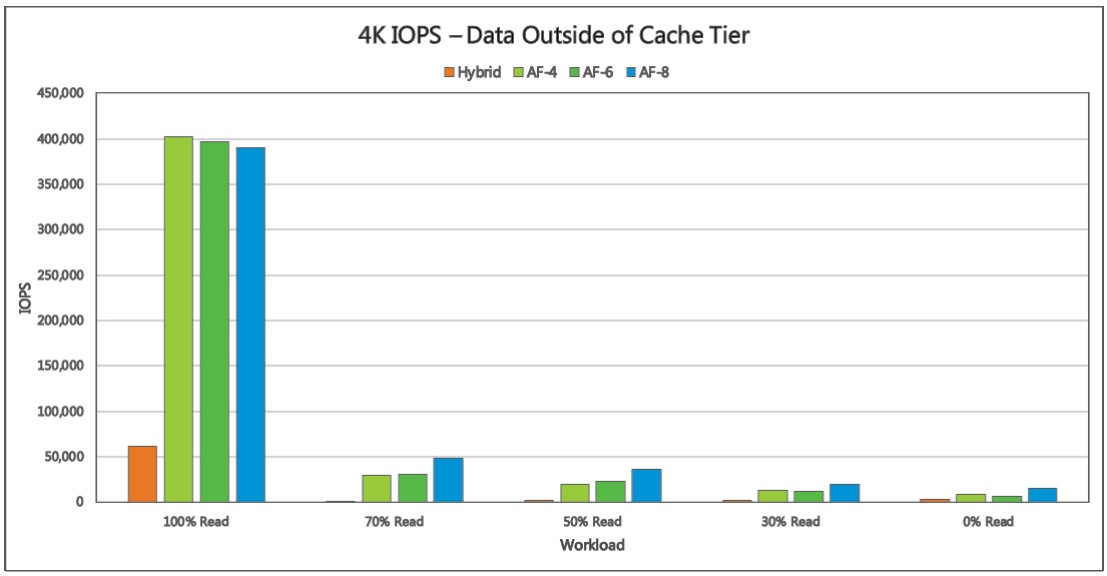

Figure 2: HCIBench 4K IOPS (data outside of cache) by Workload and Node Configuration (taller is better)

Table 1 summarizes the results of the 4K IOPS comparison. To use Table 1, locate the workload on the left, then locate the comparison along the top.

Their intersection is the 4K IOPS difference calculated as all-flash configuration IOPS divided by hybrid IOPS for the chosen workload.

For example — with a 0% read (100% write) workload the AF-4 measured 2.5X the 4K IOPS performance of the hybrid.

Workload	AF-4 vs. Hybrid	AF-6 vs. Hybrid	AF-8 vs. Hybrid
100% Read	6.5X	6.4X	6.3X
70% Read	22.2X	23.4X	36.8X
50% Read	10.8X	12.6X	19.6X
30% Read	5.2X	4.8X	8.12X
0% Read	2.5X	1.9X	4.3X

Table 1: Results for 4K IOPS Data Outside of Cache Tier

All-Flash vSAN: Latency Enables Workload Performance

For some deployments, how rapidly the vSAN responds (its average latency) may be more important than how many responses the vSAN supports (its IOPS performance).

Figure 3 shows the measured average 4K latency for the hybrid, AF-4, AF-6 and AF-8 configurations using the same working set and workloads that were used to measure 4K IOPS.

Average latency is on the vertical axis (in ms) and tested workloads (100% read at the left, 0% read at the right) are on the horizontal axis. The hybrid configuration is in orange, the all-flash AF-4 in light green, AF-6 in dark green and AF-8 in blue (from left to right).

In Figure 3, the all-flash configurations show much lower 4K average latency than the hybrid configuration. This is true of every tested workload. The HDDs in the hybrid capacity tier simply cannot respond as quickly as the M510DC SSDs in the all-flash configuration capacity tier.

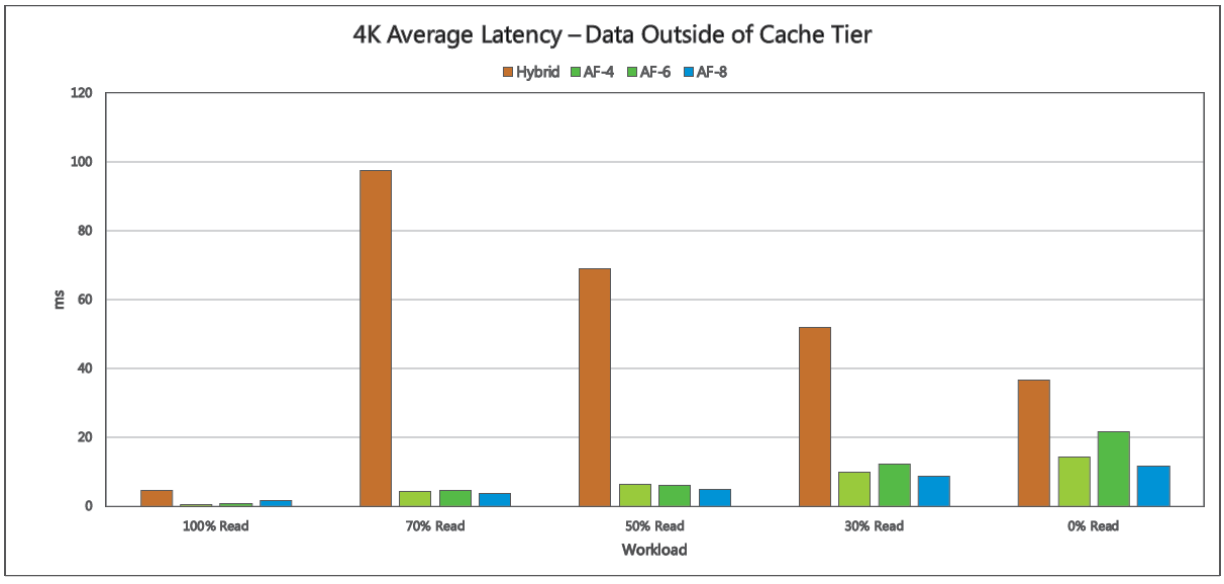

Figure 3: HCIBench 4K Average Latency (data outside of cache) by Workload and Node Configuration (lower is better)

Table 2 summarizes the results of the 4K average latency comparison. To use table 2, locate the workload on the left, then locate the comparison along the top.

Their intersection is the percentage of time the all-flash configuration 4K average latency is lower compared to the hybrid for the selected workload.

Workload	AF-4 vs. Hybrid	AF-6 vs. Hybrid	AF-8 vs. Hybrid
100% Read	86%	79%	6.3X
70% Read	95%	95%	96%
50% Read	91%	91%	93%
30% Read	81%	76%	83%
0% Read	60%	40%	68%

Table 2: Results for 4K Average Latency Data Outside of Cache Tier

We calculated the percentage improvement by dividing the all-flash 4K average latency by the hybrid 4K average latency, then expressing that as a percentage improvement over hybrid for the chosen workload.

For example — with a 0% read workload the AF-4 measured 60% lower average latency than the hybrid.

Conclusion

VMware's vSAN 6.2 is a highly consolidated virtualization platform that brings significant advantages to IT planning, design and deployment teams. When planning to deploy vSAN 6.2, one of the first choices is the basic node design: hybrid (with flash in the cache tier and hard drives in the capacity tier) or all-flash (flash in both tiers).

This technical brief compares the 4K IOPS performance and average latency of our all-flash AF-4, AF-6 and AF-8 Ready Nodes to that of a similarly configured hybrid design.

The results are compelling. In multiple workloads, our all-flash configuration showed much better 4K IOPS performance and much lower average 4K latency with our AF-4 showing from 2.5X to 22X more IOPS with 60% to 95% lower average latency with large working sets. Our AF-6 and AF-8 configurations showed similar advantages in both 4K IOPS and 4K average latency.

Micron's all-flash vSAN Ready Nodes with advanced DRAM and TCG-E-enabled SSDs are the natural choice for high-performance, low-latency, SOLID Ready virtualization.

Want to Learn More?

Micron's all-flash vSAN Solution Brief is available online. This brief shows key features and configuration details for AF-4, AF-6 and AF-8 platforms.

The AF-4, AF-6 and AF-8 configurations can be found in the VMware Compatibility Guide and on Supermicro's vSAN Solutions page.

Visit our SOLID Ready solutions page to see how Micron is innovating with leading software partners to bring you tightly integrated compute, networking and optimized solid state storage for highly scalable platforms.

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