Process more read-heavy I/O with HPE ProLiant DL385 Gen10 Plus servers configured with KIOXIA value SAS and NVMe mainstream SSDs

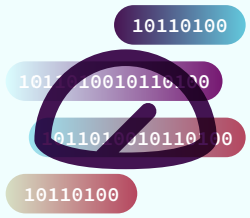
VMware vSAN clusters of three HPE servers with RM Series value SAS and CD6 Series NVMe mainstream SSDs supported greater throughput in multiple large-block input/output (I/O) profiles than clustered servers configured with SATA SSDs and offered better performance per dollar

Three HPE ProLiant® DL385 Gen10 Plus servers in a VMware vSAN™ cluster running three read-heavy sequential workloads with large block sizes

The ability to read large files quickly is an advantage in multiple applications, such as those that stream video. SSDs are a speedy storage option for servers that run those applications, but two types of SSDs, SAS and NVMe™, can offer faster access to large files than a third type, SATA. In addition, SATA SSDs use a technology that has no future roadmap for performance improvements,[1] and won't help you prepare for growth.

To see whether SAS and NVMe SSDs from KIOXIA can offer faster data access and help you prepare for increased read I/O and potentially improve application performance, we ran a Vdbench synthetic workload in three I/O profiles on an HPE ProLiant DL385 Gen10 Plus server-based vSAN cluster in three capacity storage configurations: with enterprise SATA SSDs, with KIOXIA RM Series value SAS SSDs, and with KIOXIA CD6 Series NVMe mainstream SSDs offered through HP Enterprise. For more information on the drives we used in the capacity tier of each configuration, see the section How we tested. The SAS- and NVMe-based configurations handled more megabytes (MB) of data per second than the SATA configurations.

More throughput at larger block sizes could allow your users to view video faster, reduce the possibility of lag while streaming video, or work with large files more quickly. In addition to faster data access, the SAS and NVMe configurations offered a better value than the SATA configuration by completing more input/output operations per second (IOPS) per dollar spent on the solution's hardware.



Retrieve large amounts of data more quickly

Up to 3.7X the bandwidth*

More bang for your buck

With a 2.6% additional cost, get up to 3.6X the IOPS per dollar in our scenario*

*Configuration with NVMe mainstream SSDs vs. one with enterprise SATA SSDs

The benefits of SAS and NVMe storage over SATA technology for servers

Speed

Both SAS and NVMe technologies generally access and store data much faster than SATA, which is limited to only a 6Gb/s connection.[2] For a VMware vSAN configuration using these SSDs for the capacity tier, improved transfer speeds could mean faster reads for stored data across your cluster.

Protocol differences

Whereas SATA drives can only either send or receive data at any given time, the full-duplex functionality of SAS technology enables drives to send and receive data simultaneously and at full speed.[3]

PCIe Gen4 NVMe drives have much greater parallelism than SATA drives, meaning the CD6 Series mainstream PCIe Gen4 NVMe SSDs can run more simultaneous operations via multiple processing threads. SATA drives can handle only one request at a time with up to 32 requests in their Native Command Queuing,[4] but PCIe Gen4 NVMe drives can typically handle up to 65,535 simultaneous requests.[5]

Roadmap for continued technological upgrades

In addition to helping your organization by working faster than SATA SSDs, SAS and NVMe technologies could have more to offer in the years to come. The SCSI Trade Association, a "globally recognized authority on Serial Attached SCSI (SAS) technology used in data storage interconnects,"[6] published a roadmap in 2021 that shows organizations should be able to acquire both 12Gb/s and 24G SAS technologies.[7] Similarly, the NVM Express organization announced the NVMe 2.0 family of specifications in June 2021.[8] That group also has over 50 ongoing projects in their technical working groups with over 130 companies working on them.[9] In contrast, there won't be any further advances for SATA SSDs to improve their transfer rates.[10]

KIOXIA CD6 Series NVMe mainstream SSD

About the HPE ProLiant DL385 Gen10 Plus server

The HPE ProLiant DL385 Gen10 Plus features AMD EPYC™ 7000 Series processors and can support up to 24 KIOXIA value SAS or 16 NVMe mainstream SSDs.[11]

Process more read-heavy I/O with HPE ProLiant DL385 Gen10 Plus servers configured with KIOXIA value SAS and NVMe mainstream SSDs

How we tested

We wanted to see how organizations using VMware vSAN could benefit by configuring the capacity drive tier of servers in a vSAN cluster with value SAS or NVMe mainstream SSDs from KIOXIA versus enterprise SATA SSDs from a competing vendor. vSAN will service all write I/O out of the cache tier, which was a single 800GB KIOXIA CM6 Series NVMe SSD per node for each of our three configurations, and will service read I/O out of the capacity tier. As such, the drive type used for capacity tiers can affect vSAN performance in some cases, such as the large block 100 percent sequential reads from our testing.

We used a storage benchmarking tool called Vdbench, which measures block storage performance under different I/O workloads. We ran the workload on three storage configurations of a three-node HPE ProLiant DL385 Gen10 Plus server-based cluster that used VMware ESXi™ 7.0 Update 2 as the hypervisor. Our Vdbench workload ran on 24 virtual machines (VMs) with ten 10GB virtual machine disks (VMDKs). Each of the three storage configurations used different 3.84TB drives for the vSAN capacity tier, which were as follows:

- Two enterprise SATA SSDs
- Two KIOXIA RM5 Series value SAS SSDs
- Two KIOXIA CD6 Series NVMe mainstream SSDs

About the Vdbench workload

We tested each configuration with three I/O profiles that we configured with the Vdbench benchmark tool. Vdbench generates I/O workloads that IT staff can use to validate storage performance by configuring many parameters. The benchmark tool produces IOPS, throughput, and latency.

To learn more about Vdbench, visit https://www.oracle.com/downloads/server-storage/vdbench-downloads.html.

Increase read performance with KIOXIA value SAS and NVMe mainstream drives

According to our testing, KIOXIA value SAS or NVMe mainstream SSDs can offer better performance than SATA SSDs for your data center workloads that read large blocks of data. This could benefit applications that stream video, allow users to edit video, or those that require the export of large amounts of data.

The KIOXIA SSDs enabled the ProLiant DL385 Gen10 Plus server to support better throughput (in MB of data per second) in three I/O profiles. The I/O profile that showed the biggest difference between the KIOXIA SSDs and the SATA SSDs was 100 percent sequential reads at a block size of 128k (see Figure 1). In that profile, the KIOXIA SSDs handled up to three times the throughput of (or two times more than) the SAS configuration.

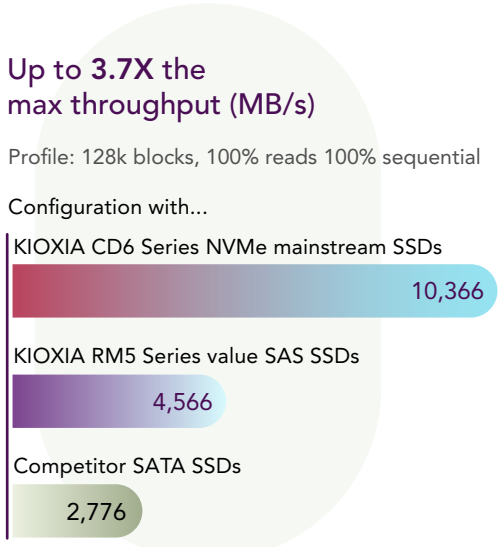
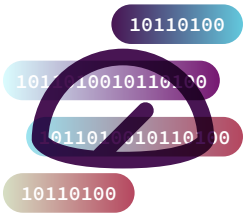


Figure 1: Max throughput in MB per second of a vSAN cluster of three HPE ProLiant DL385 Gen10 Plus servers running Vdbench with a 100 percent sequential read I/O profile using 128k blocks. Higher is better. Source: Principled Technologies.

At that 128k block size, the server configuration with SATA SSDs supported just 2,776 MB per second on average across the workload window, whereas the server configuration with value SAS SSDs achieved an average of 4,566 MB per second—a 64 percent increase in throughput over the SATA configuration. The ProLiant DL385 Gen10 Plus server configuration with NVMe mainstream SSDs supported the most throughput in our testing with that I/O profile—10,366 MB per second, more than three times the throughput of the SATA SSD configuration.

More throughput in the I/O profiles we show in Figures 1 through 3 could enable applications that run large-block workloads to help users perform read-intensive tasks more quickly. For example, greater throughput in video streaming could allow users to deliver more and higher-quality videos to viewers and reduce the possibility of lag while streaming.



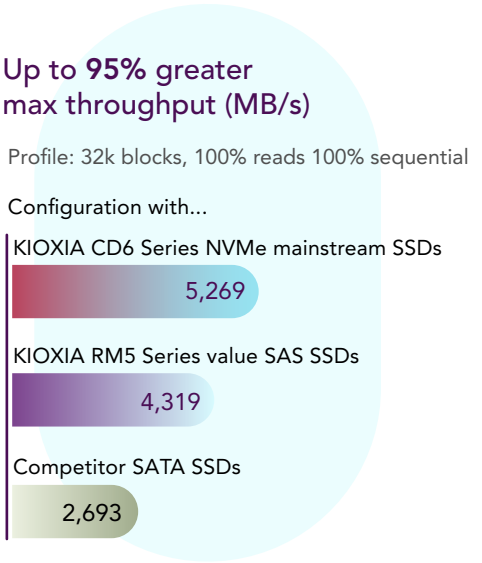


Figure 2: Max throughput in MB per second of a vSAN cluster of three HPE ProLiant DL385 Gen10 Plus servers running Vdbench with a 100 percent sequential read I/O profile using 32k blocks. Higher is better. Source: Principled Technologies.

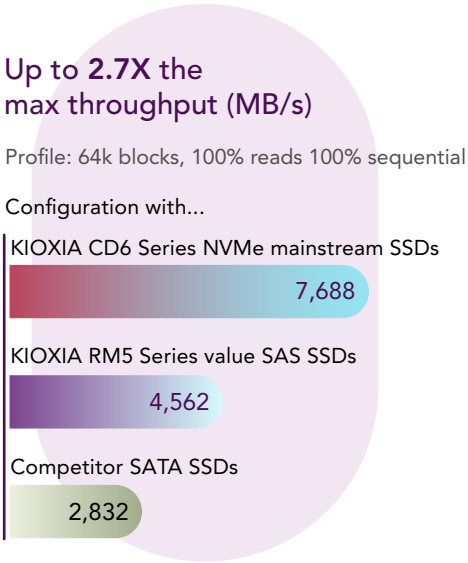


Figure 3: Max throughput in MB per second of a vSAN cluster of three HPE ProLiant DL385 Gen10 Plus servers running Vdbench with a 100 percent sequential read I/O profile using 64k blocks. Higher is better. Source: Principled Technologies.

Better performance from KIOXIA value SAS and NVMe mainstream SSDs could lead to a better investment

If you're running workloads that rely on large-block sequential reads, you could make a sounder investment for the future of your organization by choosing KIOXIA value SAS or NVMe mainstream SSDs based on their performance. As we noted, the configurations with value SAS and NVMe SSDs offered greater throughput than the SATA configuration of the server. They also delivered more IOPS than the SATA SSD configuration, which indicates that the KIOXIA drives can support a higher volume of read activity.

Using IOPS data from our testing, we quantified the value of our three configurations. We found that the SAS and NVMe SSD configurations delivered more IOPS per dollar than the SATA SSD solution at a small additional cost. The SAS configuration delivered up to 63 percent more IOPS per dollar for an additional US$810; the NVMe configuration delivered up to 3.6 times the IOPS per dollar at a 2.6 percent additional cost (US$5,040).

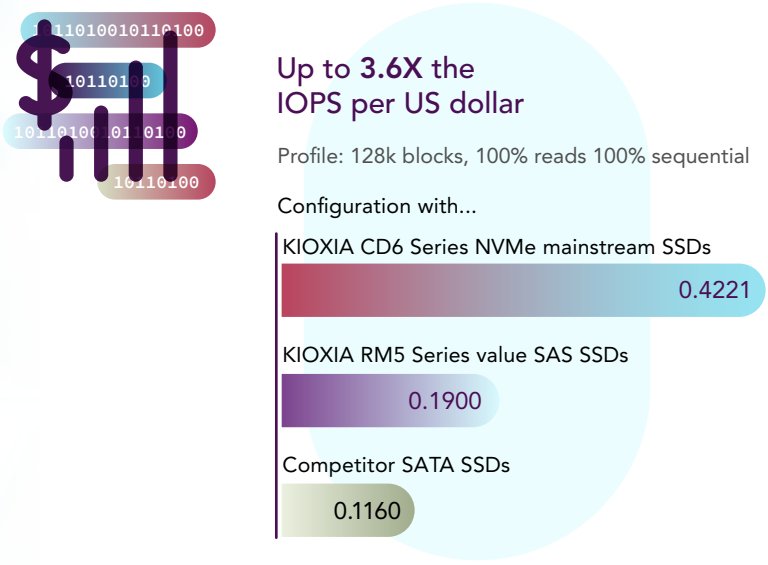


Figure 4: IOPS per dollar for vSAN clusters of three HPE ProLiant DL385 Gen10 Plus servers with SSDs running Vdbench with a 100 percent sequential read I/O profile using 32k blocks. Lower is better. Source: Principled Technologies.

For the total solution cost, we obtained a quote for a base model of the HPE ProLiant DL385 Gen10 Plus server matching our configuration minus the SSDs. Next, we obtained list pricing from HPE for the competitor SATA, value SAS, and NVMe mainstream drives.[12] For each configuration, we totaled the cost of the server and the specific SSDs. Note that our cost evaluation includes only the cost of hardware.

Conclusion

Faster KIOXIA value SAS and NVMe mainstream SSDs for HPE ProLiant DL385 Gen10 Plus servers in VMware vSAN clusters can help your organization meet today's large-block read I/O demands as well as prepare for the demands of tomorrow. SAS and NVMe configurations of the HPE server supported greater throughput in our large-block sequential reads testing than a SATA configuration. In addition, the performance of the KIOXIA SAS and NVMe configurations delivered more average IOPS per dollar spent on the solution's hardware than the performance of the SATA configuration did. For your large-block workload needs, consider investing in KIOXIA value SAS and NVMe mainstream SSDs to get better performance and potentially support more users.

---

1 "SATA-IO Frequently Asked Questions," accessed June 9, 2021, https://sata-io.org/sata-io-frequently-asked-questions.

2 "The Serial ATA International Organization (SATA-IO), which describes itself as "an independent, non-profit organization developed by and for leading industry companies" ("About SATA-IO," accessed June 9, 2021, https://sata-io.org/about-sata-io), last announced a doubling of maximum transfer speeds on SATA (from 3Gb/s to 6Gb/s) in August 2008. "New SATA Spec Will Double Data Transfer Speeds to 6 Gb/s," accessed June 9, 2021, https://sata-io.org/system/files/member-downloads/SATA_6Gb_Phy_PR_Finalv2.pdf.

3 TechMikeNY, "SAS vs. SATA. A Primer and Backplane Compatibility for Enterprise Servers," accessed June 9, 2021, https://techmikeny.com/blogs/techtalk/sas-vs-sata-a-primer-and-backplane-compatibility-for-enterprise-servers.

4 "NCQ Feature Set Clarification," accessed June 23, 2021, https://sata-io.org/sites/default/files/ECN080v3_SATA32_NCQFeatureSetClarification.pdf.

5 "What is NVMe®?," accessed June 23, 2021, https://nvmexpress.org/.

6 "SCSI Trade Association Announces 2021 Board of Directors as Storage Industry Transitions to 24G SAS Technology," accessed June 9, 2021, https://www.scsita.org/library/scsi-trade-association-announces-2021-board-of-directors-as-storage-industry-transitions-to-24g-sas-technology/.

7 "Serial Attached SCSI Technology Roadmap," accessed September 16, 2021, https://www.scsita.org/library/serial_attached_scsi_technology_roadmap/.

8 "Everything You Need to Know About the NVMe 2.0 Specifications and New Technical Proposals," accessed June 23, 2021, https://nvmexpress.org/everything-you-need-to-know-about-the-nvme-2-0-specifications-and-new-technical-proposals/.

9 "The Evolution and Future of NVMe™," accessed June 9, 2021, https://nvmexpress.org/wp-content/uploads/NVMe-Roadmap-Webinar-2017.Final_.v2.pdf.

10 "SATA-IO Frequently Asked Questions," accessed June 9, 2021.

11 "HPE ProLiant DL385 Gen10 Plus server," accessed June 9, 2021, https://buy.hpe.com/us/en/servers/proliant-dl-servers/proliant-dl300-servers/proliant-dl385-server/hpe-proliant-dl385-gen10-plus-server/p/1012189113.

12 KIOXIA is phasing out RM5 Series SAS SSDs in anticipation of RM6 Series SAS SSDs, so the RM5 Series SSDs are no longer available with the ProLiant DL385 Gen10 Plus server. "RM6 Series 12Gb/s Value SAS SSD," accessed June 15, 2021, https://business.kioxia.com/en-us/ssd/oem/hpe/rm6-value-sas.html.

Read the science behind this report at http://facts.pt/dqiy2jj ▶

Principled Technologies®

Facts matter.®

Principled Technologies is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.
For additional information, review the science behind this report.

This project was commissioned by KIOXIA.