KIOXIA

Performance Brief

XD6 Series OCP-aligned E1.S SSDs Deliver Consistent and Reliable QoS Performance

PCIe® 4.0 Data Center NVMe® SSDs Enable Data Centers to Provide Competitive SLAs on Application Performance

KIOXIA was one of the first SSD suppliers to introduce Enterprise and Datacenter Standard Form Factor (EDSFF) E1.S SSDs with its XD6 Series PCIe 4.0 data center NVMe SSDs. This product family addresses the specific requirements of hyperscale applications including the performance, power and thermal requirements of the Open Compute Platform (OCP) NVMe Cloud SSD specification. The small E1.S form factor is more than an evolutionary replacement for the M.2 format as it delivers greater density, performance, power, reliability and thermal management over M.2, and with hot plug support, provides increased physical serviceability as well.

Designed for consistent performance, latency and reliability in 24x7 cloud data centers, the XD6 Series delivers 4x greater improvement in random write performance, 3.5x greater improvement in random read performance, 2.5x greater improvement in sequential write performance and 2x greater improvement in sequential read performance when compared to the previous XD5 Series generation (M.2 format). The XD6 Series utilizes a purpose-built controller with the latest PCIe 4.0 interface enabling sequential read bandwidth to saturate the PCIe 4.0 bus, transferring data at speeds up to 6,500 megabytes per second[1] (MB/s) (Figure 1).

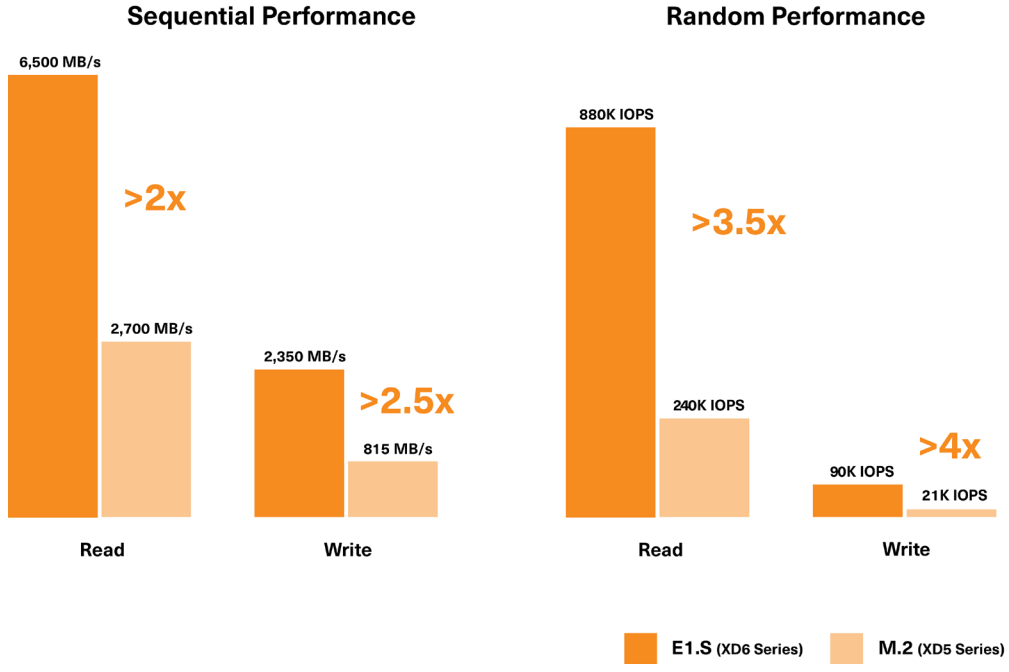

Figure 1: XD6 Series (E1.S SSD) vs XD5 Series (M.2 SSD) performance comparisons

The four-corner performance testing (Figure 1) is very important for predicting sequential and random read/write performance, but a more critical metric amongst data center administrators is Quality of Service (QoS). QoS is a predictability measure of low latency during high input/output operations per second (IOPS) while servicing I/O workloads. The XD6 Series design focus is on consistent, low read latencies across a whole spectrum of mixed workloads (ranging from 100% writes to 100% reads). The results of the read latency[1] across a range of read/write mixed workloads include:

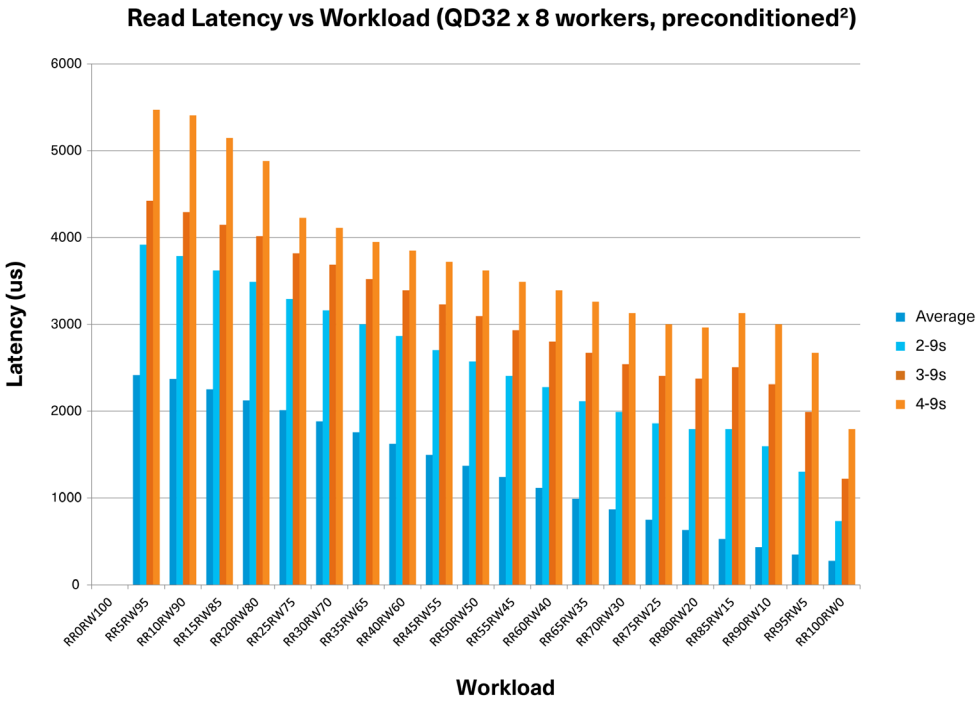

Figure 2: XD6 Series read latency on mixed workloads

The read latency on mixed workload type results (Figure 2) showcase that XD6 Series SSDs maintain a very tight latency distribution of service ranging across a spectrum of mixed workloads. With consistent and predictable read latencies, XD6 Series SSDs are well suited for various applications where high QoS is the key metric. These applications include cloud computing, social media, streaming media, content delivery networks (CDN), machine learning (ML), media post-production, and others.

QoS in a mixed workload is one of the most important metrics for an SSD in the data center since long-tail latencies will impact data responsiveness and potentially impact customer Service Level Agreements (SLAs). Reliable and consistent QoS enables data centers to provide competitive SLAs on application performance. With this objective, additional tests were conducted by KIOXIA that compared the QoS mixed workload read latencies of an XD6 Series E1.S SSD versus two leading data center SSDs (referred to as Vendor A and Vendor B). All SSDs were tested with 3.84 terabyte[3] (TB) capacities.

The results[1] in Figure 3 show QoS measurements from two 9s all the way to the Maximum Response Time (MRT), which is measured at eight 9s using an industry common 70%R/30%W mixed workload.

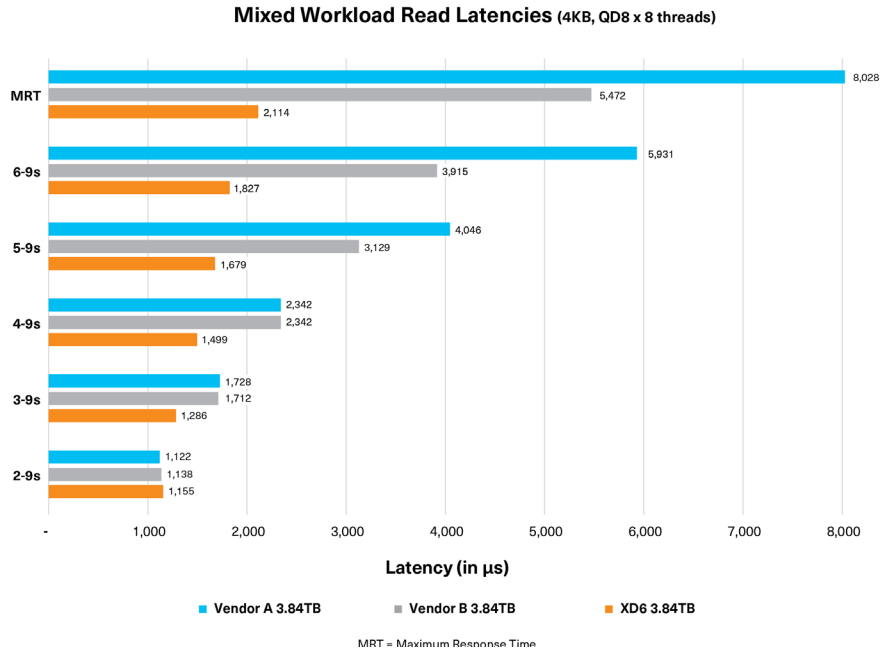

Figure 3: Mixed workload read latency QoS comparing the XD6 Series to two U.2 SSDs from leading vendors

The results in Figure 3 also indicate that XD6 Series SSDs demonstrate very consistent QoS latency across mixed workloads enabling hyperscalers to provide competitive SLAs on application performance. For highly latency-sensitive applications where data is gathered from different nodes, combined and presented, the output is as slow as its slowest node. In such cases, consistent low latency and high QoS is of paramount importance. From the results (lower is better), Vendor A suffered from more than a ~7x increase in latency[4] and Vendor B had more than a ~4.75x increase in latency[4] when compared to the XD6 Series SSD going from two 9s to the MRT.

The XD6 Series SSD showed consistent and predictable low latency even at eight 9s of measured latency. As such, these data center SSDs are ideally suited for infrastructures that require low latency for mixed workload applications as well as data centers that are transitioning from SATA-based storage to NVMe/PCIe 4.0 storage and beyond.

Summary

The KIOXIA XD6 Series PCIe 4.0 data center NVMe SSDs take advantage of the latest developments in the storage ecosystem, enabling data centers to continue their explosive growth in the data rich world. The speed of the PCIe 4.0 interface enables the XD6 Series with the bandwidth required to scale performance. The OCP organization has standardized on the new E1.S form factor, ecosystem and open source EDSFF E1.S specification that improves upon legacy M.2 devices. The combination of the E1.S form factor with strong read QoS performance and rich feature set position the XD6 Series as one of the leading OCP-aligned E1.S SSDs for the modern data center.

The KIOXIA XD6 Series E1.S SSDs[5] include:

XD6 Series – 9.5mm[6]

XD6 Series – 15mm

XD6 Series – 25mm

XD6 Series NVMe/PCIe 4.0 Data Center SSD Specifications:

Form Factor	E1.S (9.5/15/25mm)	
Flash Memory Type	BiCS FLASH™ 3D flash memory	
Interface Specification	PCIe 4.0 x 4L, NVMe 1.4	
User Capacities *(in gigabytes[3])*	1,920 GB	3,840 GB
Performance		
Sequential Read: 128 kibibytes[7] (KiB), Queue Depth (QD) =32	6,500 MB/s	6,500 MB/s
Sequential Write: 128 KiB, QD =32	1,200 MB/s	2,350 MB/s
Random Read: 4 KiB, QD =256	660,000 IOPS	880,000 IOPS
Random Write: 4 KiB, QD =128	50,000 IOPS	90, 000 IOPS
Power		
Supply Voltage	12V	
Active Power Consumption	<14.0 watts	
Endurance *(per 5 years)*	1 Drive Write Per Day[8] (DWPD)	
MTTF Reliability	2.0 Million Power-On Hours (MPOH)	
Operating Temperature	0 to 70° C	
Security Option(s)	Self-Encrypting Drive: TCG-Opal 2.0	

Additional XD6 Series SSD information is available here.

Notes:

[1] Product testing was conducted in a lab environment by KIOXIA Corporation. Tested content are believed to be current and accurate as of the date that the document was published, but is subject to change without prior notice. Read/write sequential and random performance results may vary depending on the host device, read and write conditions, and file size. See Disclaimers section below.

[2] There was 10 minutes of preconditioning before the workload began.

[3] Definition of capacity - KIOXIA Corporation defines a kilobyte (KB) as 1,000 bytes, a megabyte (MB) as 1,000,000 bytes, a gigabyte (GB) as 1,000,000,000 bytes and a terabyte (TB) as 1,000,000,000,000 bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of 1Gbit = 2^{30} bits = 1,073,741,824 bits, 1GB = 2^{30} bytes = 1,073,741,824 bytes and 1TB = 2^{40} bytes = 1,099,511,627,776 bytes and therefore shows less storage capacity. Available storage capacity (including examples of various media files) will vary based on file size, formatting, settings, software and operating system, and/or pre-installed software applications, or media content. Actual formatted capacity may vary.

[4] Latency was determined by taking the 2-9s result and calculating the delta from the MRT. For example, the 2-9s result for Vendor A was 1,122µs. The MRT for Vendor A was 8,028µs. The delta between the 2-9s result and the MRT result was >7x. For Vendor B, the 2-9s result was 1,138µs and the MRT was 5,472µs resulting in >4.75µs delta. For the XD6 SSD, the 2-9s result was 1,155µs and the MRT was 2,114µs resulting in >1.75µs delta.

[5] Each XD6 Series E1.S SSD product image may represent a design model.

[6] The 'millimeter (mm)' size for each XD6 Series E1.S SSD indicates the form factor of the SSD and not its physical size.

[7] KiB: A kibibyte (KiB) means 2^{10}, or 1,024 bytes, a mebibyte (MiB) means 22^{0}, or 1,048,576 bytes, and a gibibyte (GiB) means 2^{30}, or 1,073,741,824 bytes.

[8] Drive Write(s) per Day: One full drive write per day means the drive can be written and re-written to full capacity once a day, every day, under the specified workload for the specified lifetime. Actual results may vary due to system configuration, usage, and other factors.

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