KIOXIA

Top 5 Reasons

Top 5 Reasons to Deploy KIOXIA CM7 Series PCIe® 5.0 SSDs

The latest generation KIOXIA CM7 Series enterprise SSDs are compliant with the NVMe™ 2.0 protocol and the PCI Express® (PCIe) 5.0 specification. With the advent of the PCIe 5.0 specification revision, data can move through the interface up to twice as fast when compared with the previous PCIe 4.0 generation. This enables devices, such as SSDs, graphics processing units (GPUs) and network interface controllers (NICs), to deliver input/output (I/O) even faster than before. The speed upgrade is beneficial to data-intensive and computational applications such as cloud computing, databases, data analytics, artificial intelligence (AI), machine learning (ML), container orchestration and media streaming, to name a few.

Key server and SSD vendors are developing solutions to comply with the PCIe 5.0 standard (and associated NVMe 2.0 protocol) for immediate availability. There are a number of reasons to deploy KIOXIA CM7 Series PCIe 5.0 SSDs in your data center, but here are the top five:

1. *Twice the Performance*
2. *Device Density*
3. *Power Benefits*
4. *Support for Multiple SSD Form Factors (2.5-inch[1] and E3.S)*
5. *Single Port and Dual Port*

#1 Twice the Performance

The PCIe 5.0 interface standard developed by PCI-SIG® is an upgrade that enables twice the data transfer speed and bandwidth versus the PCIe 4.0 specification (Table 1). It increases data transfer speeds from 16 gigatransfers per second (GT/s) to 32 GT/s. In other words, the PCIe 5.0 interface can move data at approximately 4 gigabytes per second (GB/s) per lane versus the almost 2 GB/s per lane supported by PCIe 4.0, doubling performance while delivering a theoretical 4-lane (x4) bandwidth of approximately 16 GB/s. As a result, PCIe 5.0 NVMe SSDs are able to deliver bandwidths from 13,000 to 14,000 megabytes per second (MB/s). When compared to top-end enterprise SATA SSD bandwidths from 500 to 600 MB/s, PCIe 5.0 bandwidth performance is eye popping.

PCIe Revision	Highest Supportable* Transfer Rate (in GT/s)	4-lane Link Bandwidth (in GB/s)	Year Ratified
PCIe 1.0	2.5	1.25	2003
PCIe 2.0	5.0	2.5	2007
PCIe 3.0	8.0	4.0	2010
PCIe 4.0	16.0	8.0	2017
PCIe 5.0	32.0	16.0	2019
PCIe 6.0	64.0	32.0	2021

Table 1: PCIe specification generations (source: PCI-SIG)

* PCIe SSDs that comply with individual PCIe revisions are not required to support the highest transfer rate specified by the revision.

#2 Device Density

The PCIe 5.0 specification is an update to the PCIe 4.0 standard. The doubling of performance enables devices to communicate faster with system CPUs and transfer large chunks of data with lower latency. It also means that devices may be able to achieve the same throughput with fewer PCIe lanes, making more lanes available. For example, a PCIe 4.0 SSD that used to require four lanes to run at full speed may now be able to run at the same speed with two PCIe 5.0 lanes, with two additional lanes available for other workloads. This is an important benefit because CPUs provide a limited number of lanes for distribution among devices so they can communicate with each of them.

By utilizing half of the lanes, the PCIe 5.0 interface enables many more devices in a system versus the PCIe 4.0 interface. The PCIe 5.0 interface is expected to become a critical part of data centers as it possesses high-speed networking capabilities that can easily handle a 400 Gigabit Ethernet® (GbE) network connection.

#3 Power Benefits

The increased performance gains of the PCIe 5.0 interface also has a positive effect on energy efficiency within a system. Performance per watt is one example where a system measures the rate of computation for each watt of power it consumes. To demonstrate system performance per watt efficiency, KIOXIA CM7-V Series PCIe 5.0 SSDs utilizing 25-watt (25 W) power envelopes and KIOXIA CM6-V Series PCIe 4.0 SSDs utilizing 19 W power envelopes are compared[2] in 3.2 terabyte[3] (TB) capacities (Table 2).

		KIOXIA CM7-V Series *(25 W power)*		KIOXIA CM6-V Series *(19 W power)*		
Read / Write Operation		**PCIe 5.0 Performance**	**PCIe 5.0 Performance/Watt**	**PCIe 4.0 Performance**	**PCIe 4.0 Performance/Watt**	**PCIe 5.0 Advantage**
Sequential Read	*(128 KB; QD=32)*	14,000 MB/s	560 MB/s per watt	6,900 MB/s	363 MB/s per watt	+54%
Sequential Write	*(128 KB; QD=32)*	6,750 MB/s	270 MB/s per watt	4,200 MB/s	221 MB/s per watt	+22%
Random Read	*(4 KB; QD=256)*	2,700,000 IOPS	108K IOPS per watt	1,400,000 IOPS	73K IOPS per watt	+47%
Random Write	*(4 KB; QD=32)*	600,000 IOPS	24K IOPS per watt	350,000 IOPS	18K IOPS per watt	+33%

Table 2: Performance comparisons between PCIe 5.0 and PCIe 4.0 using KIOXIA CM Series SSDs

In this example, the PCIe 5.0 interface delivers significant performance/power efficiency advantages over the previous PCIe 4.0 interface, and reflects the performance per watt increases, improving energy efficiency by 54% for sequential reads, 22% for sequential writes, 47% for random reads and 33% for random writes.

#4 Support for Multiple SSD Form Factors (2.5-inch and E3.S)

PCIe is an interface technology not tied to any SSD form factor - therefore, PCIe 5.0 SSDs could be available in any form factor as long as their electrical/connector specifications support the PCIe 5.0 characteristics. SSD form factors supported by the PCIe 5.0 interface include 2.5-inch, M.2 and new Enterprise and Datacenter Standard Form Factor (EDSFF) E3.S/E3.L and E1.S/E1.L variants. Today, all industry standard NVMe SSDs use the PCIe interface as a physical transport.

KIOXIA CM7 Series SSDs are available in 2.5-inch form factors. This SSD form factor has served the industry for three decades and fits in the conventional server chassis' that are broadly used today. At present, many existing infrastructure and server choices are available for 2.5-inch SSDs. When compared with electromagnetic hard disk drives, 2.5-inch SSDs deliver improved performance and more storage capacity, and with no moving parts, there is also less breakage. The 2.5-inch SSD format typically delivers lower power consumption and lower idle power when compared with HDDs.

KIOXIA CM7 Series SSDs are also available in the new EDSFF E3 Short Thin (E3.S) form factor targeted to NVMe SSDs with x4 PCIe link widths and positioned for mainstream NVMe server storage subsystems. They are optimized for flash memory storage and utilize a connector system designed to support extended next-generation high frequency interfaces (such as PCIe 5.0 and PCIe 6.0) that help to reduce signal integrity issues.

#5 Support for Single and Dual Port

A single port configuration enables one data path for high-speed data delivery. A dual port configuration enables redundancy and high availability in data intensive enterprise environments. It provides two separate data paths from the SSD to the host that helps to reduce single points of failure.

KIOXIA CM7 Series SSD Product Information

KIOXIA Corporation offers the CM7 Series enterprise SSDs supporting the PCIe 5.0 interface in 2.5-inch and E3.S form factors. The series includes:

KIOXIA CM7-R Series:

The KIOXIA CM7-R Series (Table 3) are read intensive PCIe 5.0 SSDs optimized to support a broad range of enterprise applications and workloads such as data warehousing, business intelligence, AI/ML, online transaction processing (OLTP), software defined storage (SDS) and virtualization.

KIOXIA CM7-V Series:

The KIOXIA CM7-V Series PCIe 5.0 SSDs (Table 3) for higher endurance mixed use workloads support a broad range of enterprise applications that could include HPC, OLTP, IoT/IIoT, edge computing and media streaming.

KIOXIA CM7 Series 2.5-inch SSD[4]

KIOXIA CM7 Series E3.S SSD[4]

	2.5-inch		EDSFF E3.S	
Metric	**KIOXIA CM7-R Series**	**KIOXIA CM7-V Series**	**KIOXIA CM7-R Series**	**KIOXIA CM7-V Series**
Interface / Protocol	PCIe 5.0 / NVMe 2.0	PCIe 5.0 / NVMe 2.0	PCIe 5.0 / NVMe 2.0	PCIe 5.0 / NVMe 2.0
Maximum Interface Speed	128 GT/s (PCIe 32 GT/s single x4, dual x2)	128 GT/s (PCIe 32 GT/s single x4, dual x2)	128 GT/s (PCIe 32 GT/s single x4, dual x2)	128 GT/s (PCIe 32 GT/s single x4, dual x2)
Capacities	1,920 / 3,840/ 7,680 / 15,360 / 30,720 GB	1,600 / 3,200 / 6,400 /12,800 GB	1,920 / 3,840 / 7,680 / 15,360 GB	1,600 / 3,200 / 6,400 / 12,800 GB
DWPD[5]	1	3	1	3
SR Performance[1]	up to 14,000 MB/s	up to 14,000 MB/s	up to 14,000 MB/s	up to 14,000 MB/s
SW Performance[1]	up to 7,000 MB/s	up to 7,000 MB/s	up to 6,750 MB/s	up to 6,750 MB/s
RR Performance[1]	up to 2,700,000 IOPS	up to 2,700,000 IOPS	up to 2,700,000 IOPS	up to 2,700,000 IOPS
RW Performance[1]	up to 310,000 IOPS	up to 600,000 IOPS	up to 310,000 IOPS	up to 600,000 IOPS

Table 3: Overview of KIOXIA CM7 Series SSDs

Notes:

[1] 2.5-inch indicates the form factor of the SSD and not its physical size.

[2] Performance metrics provided by KIOXIA Corporation. Actual results may vary due to system configuration usage and other factors.

[3] Definition of capacity - KIOXIA Corporation defines 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] The product image shown is a representation of the design model and not an accurate product depiction.

[5] DWPD: 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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