

How SSDs Benefit Using KIOXIA BiCS FLASH™ Generation 8 Technology

Every day an astronomical amount of data is systematically generated by AI, video streaming, social media, IoT devices, business transactions and scientific research, and there's an overwhelming amount of individual human-generated content like videos, photos and texts as well. Storing this ever-growing mass of data requires state-of-the-art SSDs, as they provide significantly faster input/output operations per second (IOPS) and bandwidth performance and lower latency that enables quicker boot times and file transfers when compared to hard disk drives (HDDs). SSDs are also more energy efficient, operate more quietly, support newer Enterprise and Datacenter Standard Form Factor (EDSFF) form factors (E1.S, E1.L, E2, E3.S, E3.L) and can have much higher capacities. As HDDs use spinning disks and mechanical components, SSDs deliver increased durability as there are no moving parts.

The underlying and interconnected NAND flash memory chips within an SSD stores data written to them and enables retrieval of data read from them. With technological advances in CPU, GPU, memory and networking, data can move very quickly in a server or system requiring data storage to maintain technological pace. This technical brief presents the way NAND flash memory impacts SSD performance as well as other SSD capabilities and introduces the advanced KIOXIA BiCS FLASH generation 8 NAND flash memory technology. This breakthrough architecture provides major boosts in performance, storage density and power efficiency while enabling much higher SSD capacities compared to the previous NAND flash generation.

Industry Challenge

Many companies and organizations invest heavily in powerful CPUs, GPUs, DRAM and high-speed networks. If SSD storage lags in performance, these system resources can sit idle and become underutilized, limiting system performance that can lead to poor ROI. AI, analytics, scientific simulations and large-scale databases are applications that require rapid access to massive datasets. If SSD storage performance is not fast enough, application performance will also suffer.

Recapping SSD Components and Performance

Before addressing how flash memory improves SSD performance and other drive capabilities, recapping an SSD's architecture is helpful. An SSD is a complete storage device that includes NAND flash memory chips that physically store data in cells, a controller (System on Chip or SoC) that manages data storage and retrieval, DRAM cache for temporary data storage and mapping tables, a power loss protection¹ subsystem and other supporting electronics. However, it's the NAND flash memory that's the core component of an SSD and has a significant effect on SSD performance and functionality.

SSD performance is directly impacted by the controller, DRAM and the PCIe® interface:

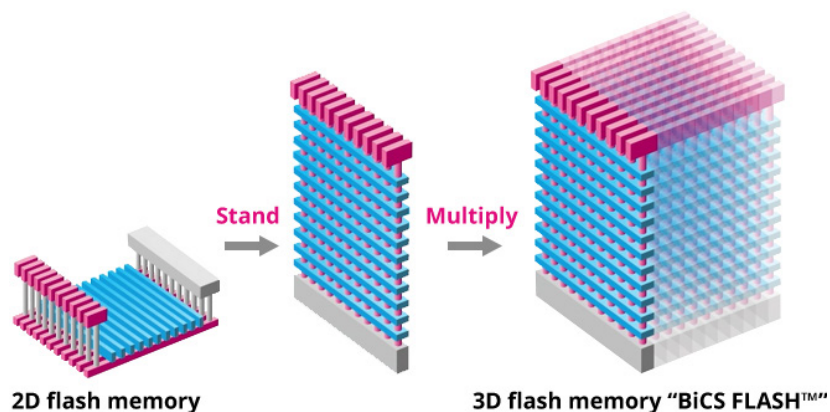
System Resource	Role	Performance Impact on an SSD
Controller	Manages all data flow and operations.	An advanced controller can handle more parallel operations, increasing read/write speeds. It provides more channels for simultaneous access to multiple NAND flash memory chips, and coupled with a faster interface, increases throughput.
DRAM	A cache that stores mapping tables and frequently accessed data.	Enables quick access to metadata, reducing latency for read/write operations. It also helps reduce write amplification, improving both speed and endurance.
PCIe interface	The connection between the SSD and the motherboard.	Higher PCIe generations like PCIe 5.0/6.0 enable faster data transfer rates.

SSD performance is a result of how well the controller manages data parallelism, how much and how fast DRAM can cache operations, the bandwidth provided by the PCIe interface, and the speed of the NAND flash memory interface. Any bottleneck in these areas will directly reduce SSD speed and efficiency.

AI workloads (ingest-transform-training-inference), big data analytics and virtualization demand high throughput and low latency from SSD storage. Fast SSD performance is essential, especially with high-speed interfaces like PCIe® 5.0/6.0 and efficient NVMe™ SSD protocols that are designed to keep pace with the speed of today's CPUs, GPUs, DRAM and networking technologies.

KIOXIA BiCS FLASH™ Generation 8 Overview

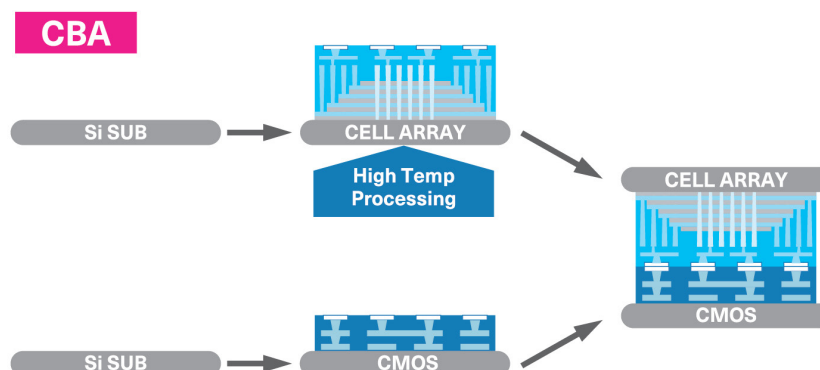
Traditional NAND flash memory (planar NAND) stores data in cells arranged in a two-dimensional grid on a silicon wafer. As demand for higher capacity and lower cost grew, cell sizes shrank, but that created reliability, performance and yield issues due to physical limitations. To overcome these scaling challenges, KIOXIA Corporation invented 3D flash memory technology. Instead of spreading cells across a flat surface, 3D flash memory stacks memory cells vertically in multiple layers, dramatically increasing density without shrinking individual cells.



Source: KIOXIA Corporation

In July 2024, KIOXIA Corporation [began sample shipments](#) of KIOXIA BiCS FLASH generation 8 technology that delivered industry firsts with its CMOS directly Bonded to Array (CBA) [technology](#)² and [32-die stack](#)³ as follows:

- Vertical and lateral scaling of the memory die is achieved through proprietary processes and innovative architectures including CBA technology. With CBA technology, each CMOS wafer and cell array wafer are manufactured separately in its optimized condition and then bonded together to enhance bit density and deliver an industry-leading NAND I/O speed of 3.6 gigabits per second (Gb/s). Fabricating the CMOS wafer and cell array wafer separately enables optimization of each while eliminating the trade-off between cell reliability and I/O speed.



Source: KIOXIA Corporation

- The creation of 2 terabit⁴ (Tb) QLC NAND die represents the industry's highest capacity memory device⁵. A 32-die stack, each with 2 Tb capacity, is achieved with KIOXIA BiCS FLASH™ generation 8 technology resulting in an impressive 8 terabytes⁶ (TB) capacity within a single NAND package. This breakthrough was driven by an advanced back-end assembly process that included wafer thinning, material design and wire bonding technologies, and which also leveraged CBA technology and its ability to achieve a superior balance of performance, power efficiency and density at an optimal manufacturing cost.

KIOXIA BiCS FLASH generation 8 technology is designed to be a direct replacement for previous generations. SSDs built with this breakthrough flash technology adhere to industry standards like PCIe® 5.0 and NVMe™ 2.0 and use common form factors such as U.2 (2.5-inch), E1.S, E3.S and E3.L. This compatibility allows for the rapid integration of the new flash memory into existing SSD controller platforms and mechanical designs, significantly reducing development time and engineering costs. Its improvements over the previous generation include:

Feature	KIOXIA BiCS FLASH Generation 8	Improvement vs. Previous Generation
NAND I/O Speed	up to 3.6 Gb/s	200%
Bit Density	>23 Gb/mm ²	123%
Write Performance ⁷	>200 MB/s	439%
Read Latency (at 1 Tb)	up to 42 µs	30%
Max. Package Capacity	8 TB (32-die stack)	100%

How Does KIOXIA BiCS FLASH Generation 8 Impact Next-Generation SSDs?

The KIOXIA BiCS FLASH generation 8 architecture is now standard in the latest generation of KIOXIA SSDs featuring the [KIOXIA LC9 Series](#), [KIOXIA CM9 Series](#) and [KIOXIA CD9P Series](#) – all geared to meet the demanding needs of AI and other data-intensive applications. This new flash architecture delivers performance⁷, capacity and power efficiency improvements to the same form factors as prior generation SSDs but with upgraded NAND flash memory to boost performance. The improvements are presented in the tables below:

KIOXIA CM9 Series vs. KIOXIA CM7 Series:

Metric	KIOXIA CM9 Series	KIOXIA CM7 Series	Improvement with KIOXIA BiCS FLASH Generation 8
Sequential Read	14.8 GB/s	14 GB/s	5%
Sequential Write	11 GB/s	7 GB/s	57%
Random Read	3,400,000 IOPS	2,700,000 IOPS	25%
Random Write	800,000 IOPS	600,000 IOPS	33%
Highest Capacity	61.44 TB	30.72 TB	100%

KIOXIA CD9P Series vs. KIOXIA CD8P Series:

Metric	KIOXIA CD9P Series	KIOXIA CD8P Series	Improvement with KIOXIA BiCS FLASH Generation 8
Sequential Read	14.8 GB/s	12 GB/s	23%
Sequential Write	7 GB/s	5.5 GB/s	27%
Random Read	2,600,000 IOPS	2,000,000 IOPS	30%
Random Write	750,000 IOPS	400,000 IOPS	87%
Highest Capacity	61.44 TB	30.72 TB	100%

The primary difference between the KIOXIA CM9 Series and KIOXIA CM7 Series, as well as between the KIOXIA CD9P Series and KIOXIA CD8P Series, is the NAND flash memory. From the charts above, by simply upgrading the NAND to KIOXIA BiCS FLASH generation 8 technology, faster performance, higher capacities due to smaller package size and up to 179% improved power efficiency⁸ can be achieved over the previous flash generation used for enterprise SSDs.

An impressive example of KIOXIA BiCS FLASH™ generation 8 capabilities is well represented in the recently announced KIOXIA LC9 Series which utilizes QLC 3D flash memory. These breakthrough NVMe™ SSDs support very high capacities up to 245.76 TB and feature the innovative 32-die stack. The result is higher storage density and improved power efficiency which can:

- Double the capacity in the same SSD footprint (vs. 122.88 TB)
- Yield over 9.8 petabytes⁶ (PB) (40 x 245.76 TB) in a 40-slot E3.L 2U rack-mount server
- Yield over 2.9 PB (24 x 122.88 TB) in a 24-slot 2.5-inch 2U rack-mount server
- Yield over 3.9 PB (32 x 122.88 TB) in a 32-slot E3.S 1U rack-mount server
- Provide 2x capacity per watt (vs. 122.88 TB)

The KIOXIA LC9 Series specifications are equally impressive and demonstrate an exceptional balance between performance⁷ and high capacity:

Metric	KIOXIA LC9 Series
Sequential Read	12 GB/s
Sequential Write	3.5 GB/s
Random Read	1,000,000 IOPS
Random Write	45,000 IOPS
Highest Capacity	245.76 TB

KIOXIA SSDs for AI

As AI growth and development directly impact storage infrastructures, it is critical that SSDs stand ready to meet the end-to-end demands of rapidly evolving AI workloads. [Enterprise and data center SSDs](#) with KIOXIA BiCS FLASH generation 8 technology are well equipped to meet these data-intensive storage demands:

- The KIOXIA LC9 Series⁹ is well positioned for the data ingestion stage of the AI workflow where high-sequential bandwidth is required to ingest vast amounts of raw data. The raw data may consist of unstructured or semi structured data that require reformatting and preprocessing, potentially growing the data set further and where very high capacities are needed.
- The KIOXIA CD9P Series¹⁰ is a good match for the training stage of the AI workflow where low latency and high bandwidth are required for read-dominated training and write-dominated checkpointing. They are also ideal for the inference stage of the AI workflow that applies learned knowledge to new, unseen data for making predictions and decisions. This stage requires high bandwidth of read-dominated data and low latency.
- The KIOXIA CM9 Series¹⁰ is targeted for inference and Retrieval Augmented Generation (RAG) implementations where RAG-based vector databases, and related indexes, can grow significantly larger than the size of the data. For these use cases, mixed workloads are prevalent requiring high IOPS, high bandwidth and low latency.



Summary

NAND flash memory is a core component of an SSD and has a significant effect on overall SSD performance and functionality. KIOXIA BiCS FLASH™ generation 8 is a revolution in 3D flash memory, enabling storage architects/engineers to meet extreme AI-driven capacity and performance demands by leveraging a new CBA technology to create high density and power-efficient flash memory products.

Given rapidly evolving customer requirements related to data storage, IT administrators expect next-generation SSDs to include familiar components and form factors to facilitate a more streamlined and cost-efficient upgrade process. KIOXIA SSDs built with BiCS FLASH generation 8 technology supports industry standards and common form factors.

As the inventor of 3D NAND flash memory and a leader in SSDs, KIOXIA is committed to continuous innovation that revolutionizes the industry such as KIOXIA BiCS FLASH generation 8 CBA technology and a 32-die stack that achieves 8 TB capacity in a single memory package. As KIOXIA BiCS FLASH generation 8 technology use begins in current KIOXIA high-capacity SSDs, KIOXIA BiCS FLASH generation 9 and 10 technologies are already in development. The KIOXIA BiCS FLASH migration strategy ensures a seamless, minimally disruptive, cost-effective upgrade path to newer generations providing customers with long-term product support, performance improvements and cost savings by leveraging the same manufacturing processes.

More information is available [here](#).

FOOTNOTES:

¹ Power Loss Protection (PLP): In case of an unexpected shutdown, PLP allows data recorded in buffer memory to be written to flash memory, utilizing back up power from solid capacitors

² Source: KIOXIA Corporation, as of July 3, 2024.

³ Source: KIOXIA America, Inc. as of August 5, 2025.

⁴ Definition of product density: Based on the density of memory chip(s) within the Product, not the amount of memory capacity available for data storage by the end user. Consumer-usable capacity will be less due to overhead data areas, formatting, bad blocks, and other constraints, and may also vary based on the host device and application. For details, please refer to applicable product specifications. The definition of 1KB = 2^{10} bytes = 1,024 bytes. The definition of 1Gb = 2^{30} bytes = 1,073,741,824 bytes. The definition of 1GB = 2^{30} bytes = 1,073,741,824 bytes. 1Tb = 2^{40} bytes = 1,099,511,627,776 bytes.

⁵ As of August 6, 2025, based on KIOXIA Corporation survey.

⁶ Definition of capacity: KIOXIA Corporation defines a megabyte (MB) as 1,000,000 bytes, a gigabyte (GB) as 1,000,000,000 bytes, a terabyte (TB) as 1,000,000,000,000 bytes and a petabyte (PB) as 1,000,000,000,000,000 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, 1TB = 2^{40} bytes = 1,099,511,627,776 bytes and 1PB = 2^{50} bytes = 1,125,899,906,842,624 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.

⁷ Read and write speed may vary depending on various factors such as host devices, software (drivers, OS, etc.) and read/write conditions.

⁸ Based on internal testing conducted by KIOXIA Corporation.

⁹ The KIOXIA LC9 Series specifications provided by KIOXIA Corporation are accurate as of this publication date, but subject to change. The product images shown are representations of the design models and not accurate product depictions.

¹⁰ The KIOXIA CD9P Series and KIOXIA CM9 Series specifications provided by KIOXIA Corporation and subject to change. The product images shown are representations of the design models and not accurate product depictions.

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