

## Questions You Need to Ask About 24G SAS and PM6 Series SSDs

### What is 24G SAS?

24G SAS (SAS-4) is the next SAS interface being promoted by the [SCSI Trade Association](#). It effectively doubles the bandwidth from the 12 gigabits per second (Gb/s) line rate and has been improved with new capabilities such as 128b/150b encoding, 20-bit Forward Error Correction (FEC), optimal operation in high-speed and noisy environments, improved write stream management, and backwards compatibility with SAS-3, SAS-2 and 6 Gb/s SATA devices.

**“24G SAS incorporates a new 128b/150b encoding method that improves link efficiency and enables 24G SAS to achieve the same level of data fidelity as 12 Gb/s even though it is transferring data at twice the rate”**

### What does 24G SAS bring to enterprise SSDs?

Performance is the overwhelming benefit that 24G SAS delivers to enterprise SSDs. Each 24G SAS lane supports a line rate of 22.5 Gb/s, effectively doubling the bandwidth from 12 Gb/s. When compared to 6Gb/s SATA, 24G SAS delivers about four times the bandwidth and is about eight times the bandwidth when running in full-duplex mode. As data traffic increases, particularly data-intensive and computational workloads, 24G SAS performance can meet these requirements.

To meet the requirements of the 22.5 Gb/s line rate, 24G SAS incorporates a new 128b/150b encoding method that improves link efficiency and enables 24G SAS to achieve the same level of data fidelity as 12 Gb/s even though it is transferring data at twice the rate. The new encoding process also includes 20-bit FEC that enables errors to be corrected on-the-fly, without requiring a retransmission, so that optimal throughput can be maintained under less than ideal operating conditions. Additionally, a new adaptive PHY training algorithm (APTA) enables 24G SAS to operate in extremely dynamic environments with noisy signal lines, severe temperature ranges or volatile operating voltage changes.

In 24G SAS, additional storage intelligence enables applications to manage write streams for better control over background housekeeping tasks and to help reduce garbage collection interruptions and write amplification that can improve performance and help extend SSD life.

### Is SAS still viable in today's data centers?

SAS is geared toward applications that place a premium on performance, high availability and data protection. Along with NVMe Express™, it is one of the main storage interfaces between computing and storage subsystems in data centers worldwide.

The SAS infrastructure provides tremendous value as it enables SATA drives (SSDs and/or HDDs) to connect to SAS backplanes, host bus adapters (HBAs) or RAID controllers in servers and storage systems. Since most of today's servers are equipped with a SAS infrastructure, SAS and SATA drives can be used in the same drive bay. As future storage requirements change, SATA drives can be easily replaced with KIOXIA SAS SSDs without any changes to the SAS-enabled server or infrastructure while protecting the customer's initial SATA infrastructure investment.

The interface is also well-positioned for large data center topologies where thousands of drives are required in support of a range of applications as SAS can support up to 65,535 devices through expanders. And, to protect the customer's SAS investment, 24G SAS is backwards-compatible with earlier SAS generations (12 Gb/s and 6 Gb/s) as well as 6 Gb/s SATA.

## What are the key use cases for 24G SAS?

**Read-intensive use cases:** Large data center topologies and media streaming/video on demand (VoD), data warehousing and content delivery network (CDN) applications.

**Mixed-use cases:** High-performance computing (HPC), database and software-defined storage (SDS) applications.

**Write-intensive use cases:** Virtualized environments, online transaction processing (OLTP) and e-commerce applications, compute-side artificial intelligence (AI)/machine learning (ML), data analytics and caching.

## Does KIOXIA offer 24G SAS SSDs?

KIOXIA has introduced SSDs based on the 24G SAS interface with their recent PM6 Series. These 24G SAS SSDs leverage industry-leading 96-layer BiCS FLASH™ 3D flash memory technology while delivering the largest 2.5-inch<sup>1</sup> SAS SSD capacity at 30.72 TB<sup>2</sup>. The series features a full line-up of supported capacities, endurance, security options, and with single- or dual-port capabilities, to meet the most demanding application and workload requirements of tier 1 server and storage OEMs. The PM6 Series is KIOXIA's 6th SAS SSD generation that builds on the company's successes as a leading SAS SSD vendor.

The PM6 Series includes:

<b>PM6-R Series:</b>	Read-intensive SSDs with models ranging from 960 GB to 30,720 GB capacities (1 DWPD <sup>3</sup> )
<b>PM6-V Series:</b>	Mixed-use SSDs with models ranging from 800 GB to 12,800 GB capacities (3 DWPD)
<b>PM6-M Series:</b>	Write-intensive SSDs with models ranging from 400 GB to 3,200 GB capacities (10 DWPD)

## How does PM6 Series performance compare to leading 12 Gb/s SAS SSDs?

KIOXIA compared<sup>4</sup> its PM6 Series SSDs (22.5 Gb/s line rate) to leading and currently shipping 12 Gb/s SAS SSDs with the focus on read-intensive models as they are the most popular and represent the widest range of supported capacities. Only the read-intensive performance advantages are presented, however, the performance improvements are comparable to the mixed-use and write-intensive results.

The performance comparisons include PM6-R Series 24G SAS SSDs versus the latest and currently shipping 12 Gb/s SAS SSDs (from a leading vendor), with supported capacities from 960 GB<sup>2</sup> to 30,720 GB (at 1 DWPD endurance):

### PM6-R Series Advantages vs Leading 12 Gb/s SAS SSDs

SPECIFICATION	960 GB	1,920 GB	3,840 GB	7,680 GB	15,360 GB	30,720 GB
Sequential Read	+97%	+97%	+97%	+97%	+97%	+97%
Sequential Write	+45%	+50%	+22%	+85%	+105%	+117%
Random Read	+56%	+38%	+32%	+48%	+48%	+48%
Random Write	+87%	+108%	+27%	+72%	+146%	+33%

Up to 97% faster sequential read performance

Up to 117% improved sequential write performance



Up to 56% better random read performance

Up to 146% greater random write performance

## What features does the PM6 Series offer to advance reliability, high availability and data protection?

The PM6 Series continues to support both dual-port and single-port capabilities. Dual-ports enable high availability so if one of the PM6 Series SSD ports fail, or the data path becomes compromised, the other port continues operating as if no failure had occurred. From a data security perspective, the PM6 Series SSD options that include Sanitize Instant Erase<sup>5</sup> (SIE) and Self-Encrypting Drive (SED) with TCG-Enterprise encryption<sup>6</sup> security options<sup>7</sup> and SED FIPS 140-2 (Level 2) support<sup>8</sup>.

**“KIOXIA's implemented its sixth-generation two-die failure management architecture within the PM6 Series enabling SSDs to sustain a simultaneous two flash memory die failure, recover from it and still read all of the data.”**

To further improve reliability, KIOXIA implemented its sixth-generation two-die failure management architecture within the PM6 Series enabling SSDs to sustain a simultaneous two flash memory die failure, recover from it and still read all of the data. In other SSDs, even a single die failure would render an SSD inoperative. Once data has been recovered, the SSD automatically moves it to a new flash memory die location, ensuring that the drive will continue operating. With the addition of 20-bit Forward Error Correction that enables errors to be corrected on-the-fly, provide a powerful combination for high reliability.

PM6 Series SSDs are specified with an industry-high mean-time to failure (MTTF) of 2.5 million hours and an uncorrectable bit-error rate (UBER) of 1e-17. PM6 Series SSDs are backed by KIOXIA's reputation for reliability and an industry-leading 5-year warranty<sup>9</sup>.

## When will KIOXIA PM6 Series 24G SAS SSDs become available in the market?

Market availability for KIOXIA's PM6 Series of 24G SAS SSDs is expected in servers and storage systems from leading OEMs in 2021.

### Notes:

<sup>1</sup> Based on publicly available specifications from enterprise SAS SSD products as of this publication – March 2021, Rev. 2.0.

<sup>2</sup> 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 1 Gbit = 2<sup>30</sup> bits = 1,073,741,824 bits, 1 GB = 2<sup>30</sup> bytes = 1,073,741,824 bytes and 1 TB = 2<sup>40</sup> 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.

<sup>3</sup> 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, for the specified lifetime. Actual results may vary due to system configuration, usage, and other factors.

<sup>4</sup> Based on publicly available performance specifications covering the PM6 Series and a leading 12 Gb/s SAS SSD.

<sup>5</sup> The Sanitize Instant Erase (SIE), Self-Encrypting Drive (SED), FIPS (Federal Information Processing Standards) optional models are available. SIE option supports Crypto Erase, which is a standardized feature defined by the technical committees (T10) of INCITS (InterNational Committee of Information Technology Standards).

<sup>6</sup> SED supports TCG-Enterprise SSCs. For more details, please make inquiries through "Contact us" in each region's website, <https://business.kioxia.com/>

<sup>7</sup> Optional security feature compliant drives are not available in all countries due to export and local regulations.

<sup>8</sup> KIOXIA FIPS drives utilize a security module designed to comply with FIPS 140-2 Level 2 and FIPS 140-3 Level 2, which define security requirements for cryptographic module by NIST (National Institute of Standards and Technology). For the latest validation status of each model, please contact us in each region's website, <https://business.kioxia.com/>

<sup>9</sup> KIOXIA SSDs based on the 24G SAS interface are expected to achieve high quality and reliability through multiple solutions and are backed by a 5-year warranty.

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