

### Value SAS: A New Class of SSD and Why You Need It

#### What is value SAS?

Value SAS (vSAS) is a new class of SAS solid-state drives (SSDs) that is expected to replace enterprise SATA SSDs in most server applications. Compared to SATA, value SAS delivers performance, capacity, reliability, manageability and data security benefits, at a competitive price point, making them a good upgrade from SATA SSDs.

#### Why is a new type of SSD needed?

The SATA interface has peaked in performance and has no future speed improvements planned. For many applications, enterprise SATA SSDs may become a bottleneck to the server, preventing the CPU from reaching its operational or transactional potential. This may result in an underutilization of the server’s compute capabilities or a negative impact in the number of clients that can be serviced simultaneously.

As a result of their cost-effectiveness, SATA SSDs are well-established and deployed in many servers; however, their attach rate is expected to decline over time as application and workload demands surpass their performance capabilities (Figure 1). Though SATA SSDs are a ‘good’ solution for application workload demands that don’t require exceptionally high performance or capacities, value SAS is a better acceleration solution that supports a wider range of workloads.

#### Why are value SAS SSDs better than enterprise SATA SSDs?

Since value SAS is based on 12 Gb/s SAS, it immediately has a leg up on 6 Gb/s SATA-based SSDs as it relates to bandwidth and throughput. From published performance<sup>1</sup>, value SAS delivers up to 100% more read bandwidth than SATA, as well as up to 90% more write bandwidth, up to 100% more random read I/O Operations Per Second (IOPS), and up to 66% more write IOPS, as depicted in Chart 1.

Read / Write Operation	Capacity	Enterprise SATA SSDs	Value SAS SSDs	
		Performance	Performance	Advantages
Sequential Read	1,920 GB	up to 550 MB/s	up to 1,100 MB/s	up to +100%
Sequential Write	1,920 GB	up to 550 MB/s	up to 1,050 MB/s	up to +90%
Random Read	1,920 GB	up to 95,000 IOPS	up to 190,000 IOPS	up to +100%
Random Write	1,920 GB	up to 33,000 IOPS	up to 55,000 IOPS	up to +66%

Chart 1: Leading enterprise SATA SSD vs. value SAS SSD comparison based on published information

**Notes:**

Enterprise SATA SSDs: leading and currently available – published specifications include 1,920 gigabyte<sup>2</sup> (GB) capacity, 2.5-inch<sup>3</sup> format, 1.5 Drive Writes Per Day<sup>4</sup> (DWPD), single port.  
 Value SAS SSDs: KIOXIA RM7-R Series — published specifications include 1,920 GB capacity, 2.5-inch format, 1 DWPD, single port.  
 MB/s: megabytes per second.

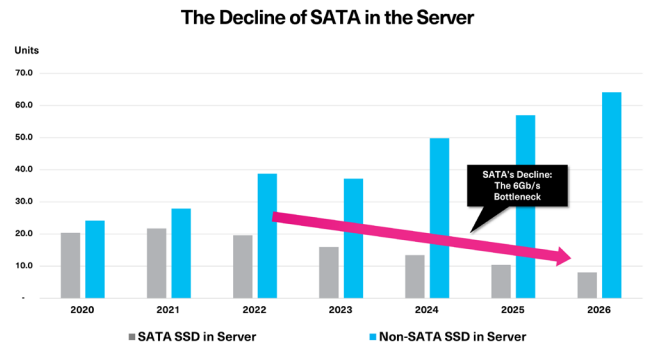


Figure 1: The decline of SATA SSDs in servers (source: Forward Insights Q1 2023 / Enterprise Server Units)

Value SAS SSDs provide multiple levels of data security with Sanitize Instant Erase<sup>5</sup> (SIE) and Self-Encrypting Drive<sup>6</sup> (SED) options. The SAS interface itself provides better infrastructure and SSD management capabilities than SATA and was designed from the ground up to address robust enterprise deployments, while SATA was designed as a lower-cost interface originally targeted for consumer-grade devices. Additionally, the SAS interface provides full-duplex data transmission, while SATA is only half-duplex. This enables the SAS interface to deliver much higher transfer rates between the host and storage device. A single, full-duplex, SAS 12 Gb/s port can support up to a 22.5 Gb/s data rate (bidirectional), while a single SATA 6 Gb/s port can only support 6 Gb/s (unidirectional).

The SAS interface also supports deeper command queuing per device (up to 65,535 queues versus 32 queues with SATA), which allows for more efficient command queuing and processing at the device level. As such, SAS is better suited for enterprise deployments with large topologies because it supports multi-level expanders, a longer cable length than SATA, as well as advanced error detection and correction mechanisms. These robust switching designs, electrical designs, and reliability designs allow for broader and more flexible topologies that support hundreds of SSDs without compromising data integrity – something that the SATA interface does not support. Lastly, the SAS interface is much more feature-rich than the SATA interface and supports more management, error recovery and error reporting features than the ATA SMART feature set utilized by SATA.

## Are value SAS SSDs more effective than enterprise SATA SSDs?

Enterprise SATA SSDs utilize an instruction set originally developed for inexpensive, low-end hard drives (AHCI). When SATA SSDs are deployed within a server, the I/O commands must traverse through a software stack (Figure 2) that cannot leverage the full performance potential of flash memory. Servers with powerful, multicore processors and an abundance of DRAM, may be left waiting for data transactions to complete, resulting in an underutilization of compute resources.

In addition, SATA SSDs use the server's SAS infrastructure and hardware RAID capabilities, requiring protocol translation which adds even more latency. By contrast, value SAS uses 'native' SAS from end-to-end, eliminating the need for protocol translation, that results in improved performance. It is no secret that SAS is a more reliable and performance-oriented protocol, making it much more effective in delivering server and application performance.

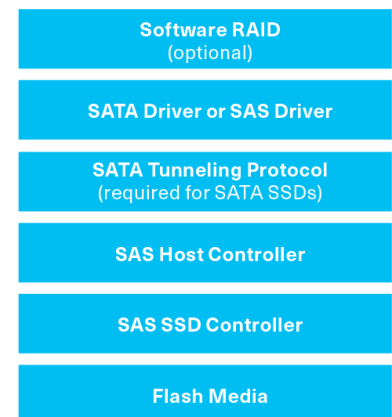


Figure 2: Software stack for SAS and SATA SSDs (in a SAS-enabled server)

## Why are SATA SSDs easy to replace with value SAS SSDs?

The SAS interface is designed to support the SATA protocol enabling enterprise SATA SSDs to connect to SAS backplanes, host bus adapters (HBAs) or RAID controllers in servers. Since the majority of today's servers ship with a SAS HBA or RAID card, both SAS and SATA SSDs/HDDs can be used in the same drive bay. This is why SATA SSDs can be easily swapped out with SAS SSDs with no changes to the server hardware.

## How is value SAS different from enterprise SAS?

The standard for high-performance, high-reliability and manageable SSDs is 24G enterprise SAS. It provides two SAS ports that can be used for redundancy/fault tolerance, or for additional performance. Value SAS is a scaled back, single-ported version of enterprise SAS, providing slightly reduced performance in exchange for being price-competitive to enterprise SATA. Since value SAS is built on enterprise SAS, there is no compromise relating to reliability.

## Why not use NVMe™ SSDs versus value SAS SSDs as a SATA SSD replacement?

Though NVMe SSDs offer even better drive performance than value SAS, the server infrastructure and hardware RAID options currently available are limited. Many of today's data centers, both large and small, are still utilizing SAS-based hardware RAID to provide a mature, robust level of fault tolerance and performance. Customers who buy enterprise SATA SSDs today, and use them with SAS hardware RAID, can easily choose value SAS SSDs and gain meaningful performance increases as well as the benefits of a more mature and robust technology. Migrating directly to NVMe SSDs requires purchasing new (and usually more expensive) NVMe-enabled servers.

## Where can one find KIOXIA value SAS SSDs?

In 2018, KIOXIA Corporation announced its RM Series of 12 Gb/s value SAS SSDs utilizing BiCS FLASH™ 3D flash memory. Since then, KIOXIA RM Series SSDs have been available from select OEM customers.

For details, visit the 'Life After SATA' website at <https://business.kioxia.com/en-us/ssd/life-after-sata.html>.



<sup>1</sup> The 6 Gb/s enterprise SATA SSD performance numbers are based on published performance specifications of a leading competitive SATA SSD as of the date of publish, while the 12 Gb/s value SAS SSD performance numbers are based on KIOXIA Corporation's RM7 Series.

<sup>2</sup> Definition of capacity: KIOXIA Corporation defines 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 1GB = 2<sup>30</sup> bytes = 1,073,741,824 bytes, 1TB = 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> 2.5-inch indicates the SSD form factor and not its physical size.

<sup>4</sup> Drive Write(s) Per Day (DWPD): One full drive write per day means the drive can be written and re-written to full capacity once a day for five years, the stated product warranty period. Actual results may vary due to system configuration, usage and other factors. Read and write speed may vary depending on the host device, read and write conditions, and file size.

<sup>5</sup> Sanitize Instant Erase is compatible with the Sanitize device feature set which is the standard prescribed by T10 (SAS) and T13 (SATA) committees of the American National Standards Association (ANSI), which makes it possible to invalidate the data recorded on magnetic disks at a blink.

<sup>6</sup> Optional security feature compliant drives are not available in all countries due to export and local regulations.

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