

# SAS or NVMe?

## Decisions, Decisions

**S**torage architects need to respond to today's business challenges by ensuring the storage solutions they choose provide the security, stability, scalability and management features necessary to support their ecosystem. As they look toward adopting new storage technologies, there are essential considerations they should weigh and review before moving to a new technology. New storage protocols are continually entering the market, and this paper explores how SAS technology remains the foundation for storage networks and will continue to deliver on that promise tomorrow and beyond.

### The trend toward SSDs

Solid-state disk (SSD) storage, enabled by NAND flash technology, has dramatically risen in adoption for primary storage, especially since they have the potential to provide much higher performance (IOPS and MB/s). As NAND flash becomes a commodity, prices continue to drop to the point that smaller capacity SSDs are competing with HDDs for market share. Both the SAS and NVMe protocols support SSDs. So, this begs the question: how should IT architects evaluate and integrate these technologies into their data center architecture?

### NVMe

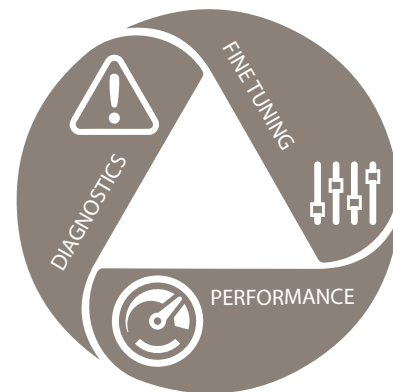
NVMe is designed specifically for the unique characteristics of solid-state technology. However, limitations in hardware and application infrastructure make it difficult to take full advantage of the performance benefits. This is especially important because NVMe SSDs are often more than 10x more expensive per GB than traditional HDDs. In addition, management tools such as the NVMe-MI specification are still in development and are not yet widely deployed.

Although NVMe All-Flash Arrays are beginning to hit the market, they remain prohibitively expensive. It will take several more years before robust, cost-effective, more readily available solutions exist that are sufficient to support enterprise storage systems. While the low-overhead NVMe technology shows future promise for wider-scale implementation, IT architects need technologies that are proven and that they can depend on today.

### SAS

The SAS interface is a general-purpose communication protocol for all types of storage media – hard drives (HDD), SSD, tape and more. Extremely fast, a single SAS port can achieve top performance of 2.4GB/s and millions of I/O operations per second (IOPS). More importantly, the SAS roadmap continues to evolve to support the even higher performance expectations of tomorrow's data center. For instance, upcoming 24Gb/s SAS with 'fairness' capabilities will allow users to build out high-performance 24Gb/s storage networks without significant changes to infrastructure using standard 12Gb/s storage on the back end. The roadmap doesn't stop there; 48Gb/s SAS is expected as soon as 2025.

SAS architectures deliver cost-effective performance with a better cost per GB than NVMe, especially with higher capacity and density SSDs and HDDs. And, today SAS has a much larger installed base in global data centers and cloud service providers than NVMe.



*"SAS has been able to remain the dominant data storage interconnect protocol in the data center and its outlook remains strong. SAS is enterprise proven and has earned their place in the market by providing key features, such as reliability and scalability."*

*-Jeff Janukowicz,  
Research Vice President at IDC.*

## SAS vs. NVMe

	Performance (IOPS, GB/s)	Performance (Read Latency)	Scalability	Power (per drive)	Flexibility	Manageability	Reliability	System Cost	Roadmap
SAS			✓	✓	✓	✓	✓	✓	✓
NVMe	✓	✓							✓

Source: SCSI Trade Association

According to IDC, SAS comprises more than 70% of enterprise storage drives and is expected to reach over 85% of enterprise storage capacity through 2022. This means that at present, SAS has a larger SCSI developer base with a supported roadmap to continue to develop low-cost high-performance solutions with a technology that has been around for over 30 years.

Most data centers today depend on SCSI-based technology, which is the underlying command set behind SAS. To move to a completely different I/O protocol such as NVMe requires a major forklift upgrade, including changes in management interfaces and tools, as well as to the architecture, controllers, NVMe-supported servers, and data protection to name a few. Despite the performance promises of NVMe, widespread adoption is not a trivial economic or operational task.

Another consideration is capacity requirements. SSD storage is only able to support a small percentage of the overall capacity needs of the typical data center. While SSDs are great, HDDs have a 2-10x capacity advantage, which translates into significant cost savings. SAS is, by far, the interface of choice for HDDs and mixed storage environments.

In addition, SAS expanders allow an economical and straightforward way to scale. This provides a cost-effective implementation for most workloads compared to NVMe, which uses switch-based scaling (often requiring retimers) that adds costs and complexity to achieve higher performance.

Software and OS vendors are still developing the applications and features that truly take advantage of NVMe performance benefits, unlike SCSI-based SAS. Until these vendors have full support for NVMe, realizing the benefits are limited.

### Summing it up

The adoption and distribution of SSDs in the data center has continued to increase. Because of this, the number of vendors has expanded, especially those developing new architectures that optimize how data is stored and retrieved specifically for solid-state storage technologies. This has generated a new class of storage companies that only support solid-state technology.

In the enterprise market the area that has seen new growth in the use of consumer-grade SSDs has been CSPs, MSPs and the media and entertainment markets, but the growth for data center-level SSDs has slower adoption in these markets due to cost. This is an indicator that SAS-based SSDs and HDDs will be consumed at a higher rate than NVMe for their cost, capacity and lower power characteristics. Most IT decision-makers don't understand the TCO associated with using SAS SSDs vs. NVMe SSDs. This has been a limiting factor, especially with associated finance departments (who are looking for the lowest prices) in determining how money is spent on hardware. There is still much education that needs to occur in this area.

While NVMe may win in raw performance, SAS wins everywhere else – scalability, power efficiency, manageability, reliability, and support. SAS will continue to be the foundation for data center computing for years to come.