

AHEAD

4 Reasons NVME is Right for *Data-Driven Applications*

Designed for next-generation hardware platform configurations

NVMe optimizes many of today's highly data-driven workloads and applications, such as:

- Online transaction processing (OLTP)
- VDI and virtualization
- Public and private cloud storage
- Artificial intelligence (AI), machine learning (ML) and deep learning (DL)
- Video editing, entertainment and streaming services
- Training and caching

Four Reasons NVMe Is Right For Data-Driven Applications

SSDs have proven to be fast and power-efficient storage for server-based technology deployments, becoming a mainstay of business-critical storage for multiple applications, workloads and use cases. But when the first SSDs were offered, they used legacy protocols designed decades ago when hard disk drives (HDDs) ruled.

These protocols didn't take full advantage of NAND flash storage's inherently faster performance and lower latency from the significantly more parallel pathways for data flow between the host and flash media (i.e., parallelism).

That changed in 2011 when the NVMe protocol was built to exploit the fast PCI Express (PCIe) bus connecting SSDs to the host. Since then, NVMe has become the preferred way to connect SSDs to servers via multiple form factors (like U.3, M.2, and EDSFF).

Micron Technology's solid state drives (SSDs) with NVM Express™ (NVMe™) make good sense for server platform configurations. Offered in industry leading storage densities, Micron SSDs with NVMe provide strong security and performance at a compelling value for applications of all sizes. And, with Micron's approach, SSDs are optimized for key workloads and applications.

When your customers expect high performance from your real-time applications and more storage flexibility, NVMe SSD storage should be the first step. Here are four strong reasons to consider technology designed and built by Micron, a global storage leader in this tech-forward world.

01 Overcome The Limitations Of Legacy Storage

Your end customers expect near-instant application response times. When SSDs were first introduced into server configurations, they added speed and stability. The legacy protocols at the time (SAS and SATA) eased SSD adoption by enabling installation directly into existing servers (using the same storage device slots that had been used to connect mechanical HDDs).

While servers already had fast PCIe bus connections (typically used for network cards or RAID controllers), this connection wasn't widely used for SSDs until the NVMe protocol was invented. PCIe with NVMe was designed to mesh the high-speed, parallel nature of flash (i.e., many queues supporting thousands of commands each) into the high-speed, parallel PCIe bus.

Designed from the ground up for a PCIe interconnect (high performance, high parallelism and low latency), the NVMe protocol was a storage revelation. To enable the host to prioritize I/O requests, NVMe combines a streamlined command set with a flexible command queueing architecture that is superior to SATA or SAS (see Table 1 for a comparison taken from TechTarget).

Because NVMe reduces I/O overhead and enables optimized command processing, it also reduces latency and greatly improves performance.

Comparison of protocols for flash storage

Max. performance	NVMe	SATA	SAS
I/O queues (messaging)	65,535	1	2 (1 per port)
Outstanding commands	64,000 per queue	32 per queue	256 per queue (128 per port)
Time to reach un-cached data	Short	Long	Long
Latency	<10μ – 225μs	<1ms – 100ms	<100μ – 100ms

Table 1: High parallelism in NVMe supersedes previous protocols

Plus, NVMe SSD capacity continues to expand. The Micron® 7450 NVMe SSD, for example, reaches 15TB in capacity (unformatted). The sharing standard called NVMe Express over Fabric (NVMe-oF) provides a way to connect and aggregate remote NVMe devices over a high-bandwidth network and create centrally managed, shared pools with little cost to latency or speed. Unleash the pent-up IOPS and capacity of server-local NVMe!

02 Accelerate Your Workloads

NVMe delivers almost 13x the sequential reads of SATA. Many of the new drivers for the explosive data growth require high-capacity storage that's also fast. Data-intensive applications like artificial intelligence (AI), machine learning (ML) and 5G infrastructure are latency sensitive and make high-throughput storage a critical need. Again, NVMe delivers. The Micron 7450 SSD consistently reads up to 6.8GB/s of sequential data (see Figure 1) and offers up to 1 million IOPS for random data.

The growth trend of PCIe is expected to continue, with the transfer rate for four lanes of I/O generally doubling the bandwidth and transfer rate of the previous version of each new release in the PCIe bus (see Figure 2). To access the benefits of the speed increases, your server platform configurations can be optimized with Micron's easy to deploy purpose-built storage.

Sequential read (MB/s)

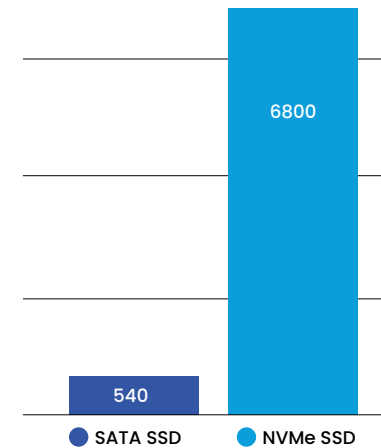


Figure 1: Sequential reads for a mainstream NVMe SSD vs. a mainstream SATA SSD¹

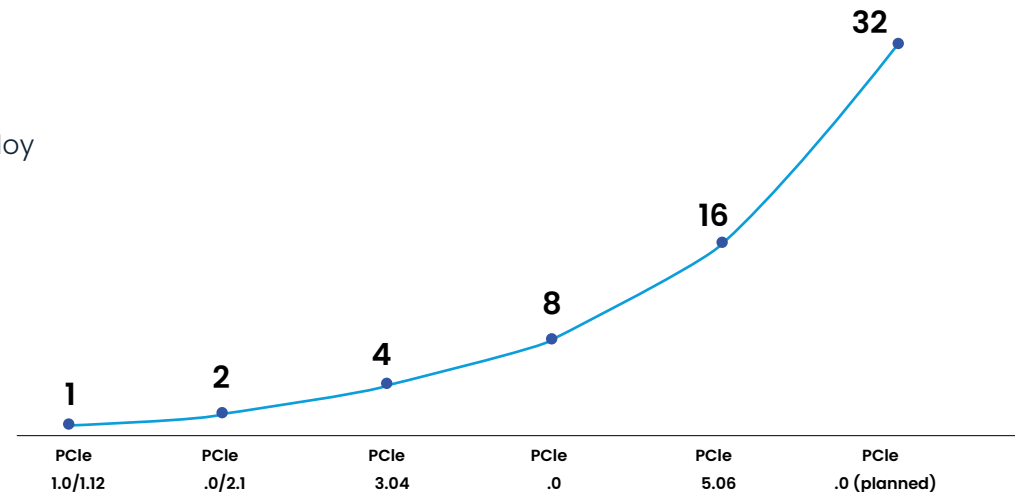


Figure 2: Growth of maximum PCIe transfer rates (actual and predicted)
Source PCIe 6.0 spec announced | TechSpot

03 Adds Power Efficiency and Data Security

Yesterday's data center infrastructure, with its sprawling racks and huge, growing numbers of bulky HDD-based servers, is being replaced by smaller footprint and more efficient hardware. The smaller your solution architecture, the more competitive it can be.

With NVMe SSDs and their higher density per SSD, applications can store more data with SSDs in less space. SSDs with NVMe can also improve power efficiency by 2.5x (see Figure 3). What's more, flash is well known to improve drive power efficiency over HDDs³ with their mechanical drive systems.

NVMe SSDs are also at the leading edge of security⁴ with hardware-driven performance. Micron's enterprise SSDs can include support for TCG Opal 2.01 and TCG Pyrite 2.01 as well as hardware write protect. The one-time programmable (OTP) flash blocks programmed at the Micron factory help prevent accidental or purposeful attacks and loss of data.

Sequential writes for NVMe storage vs. SATA storage

NVMe delivers

2x

More MB/s per watt
than SATA



04 Improve Performance Now and Position Your Technology for the Future

Along with the host of benefits that move next-gen system designs to NVMe now, it is also one way to future-proof your technology. Upgrading platform configurations simply to catch up with the competition is counterproductive. Instead, the forward-thinking performance of NVMe helps position your technology for the data center evolution.

Another evolution from legacy storage is the flexibility that NVMe helps provide. This enables platform configurations to balance the evolving capacity, power and thermal needs demanded by next-gen data centers. The Micron 7000-Series SSD is a perfect example, offering the world's broadest PCIe Gen4 NVMe SSD portfolio¹. The Micron 7000-Series SSD form factors support standard server storage (U.3 – with full U.2 interoperability), cloud and IU server platforms (performance and density focused, using the E1.S form factor) and even system boot (with a power-loss-protection enabled M.2 SSD).

As workload diversity grows and data sets become even more complex, extreme capacity, real-time performance and the ability to process entire data sets are already providing positive ROI quickly for fast storage investment. Choosing NVMe now also positions technology developers to take advantage of the benefits of NVMe 2.0, which is focused on gaining extra throughput for compute-intensive workloads such as AI and ML.

Tiering storage while SSDs and HDDs approach price parity?

HDDs allow high capacity at a budget, but can't deliver the performance needed for 5G, AI and other cutting-edge, data-intensive applications. Analysts like Wikibon predict that the investments in flash fabs and hybrid flash/tape technologies will complete the takeover of HDD by the end of the 2020s. What can you do for your cost-sensitive technology deployments to prepare to join the data economy?

Hybrid HDD and SSD data infrastructure, or NVMe SSDs paired with SATA SSDs, can help. When SSDs were first introduced, their higher prices and smaller capacities vs. HDDs tended to limit their use to specialized, high-performance workloads with smaller datasets. As the switch to flash progresses, cache-tier NVMe SSDs can deliver high speed, low latency and endurance by bringing data closer to the processor. They minimize latency and provide consistently fast throughput. Even a few low-latency NVMe SSDs in the cache tier with high-capacity SATA SSDs in the capacity tier can help optimize performance for a variety of platform configurations.

Highlights Of Micron's NVME-Based Storage

Micron Technology serves the global memory and storage market with two distinct and complementary brands: Micron for enterprise, cloud, and data center applications, and Crucial for home, office, and gaming systems. Micron's Commercial Products Group offers the industry leading B2B solutions, while Crucial NVMe SSDs for the client/consumer market can unlock the performance of laptops and workstations to deliver quicker load times and faster data transfers.

Upgrade your platform configuration with NVMe storage solutions that are optimized from the storage core to the application level (see Table 2). When data security is critical, reinforce your system with SEDs that deliver some of the strongest data storage security⁴ available – without compromising performance or affordability. Learn which Micron storage solutions may be right for your technology.

Table 2: Micron NVMe SSDs

SSD Series/Model	Form Factor	Capacity (TB)	Suitable for						
			Caching/A	I/ML/DLA	Streaming CDN	Primary Storage	analytics	Digital Workflow	Boot
7000 Series MAX 7000 Series PRO	U.3 / 7 mm	0.96 to 7.68 0.8 to 6.4							
7000 Series MAX 7000 Series PRO	E1.S	0.96 to 3.84 0.80 to 3.2							
7000 Series MAX 7000 Series PRO	M.2 / 2280	0.48 to 3.84 0.40 to 3.2							
7000 Series MAX 7000 Series PRO	M.2 / 22110	0.48 to 3.84 0.40 to 3.2							
3400	M.2 / 22800	.5 to 2.0							

Best Fit
 Good Fit
 Other Options are Ideal

MAX - Highest Performance
PRO - High Performance

Why Micron is built different

AHEAD can leverage Micron's in-house storage expertise and vertically integrated storage manufacturing. From sand to NAND, every phase of Micron development stays in-house — from design to manufacturing to testing — to help mitigate a volatile market. Micron infuses purpose into everything they touch — from people to products to partners, to thrive in the tech-forward world.

AHEAD

AHEAD builds and manages digital platforms that power the most successful organizations in the world. Our consultative approach, unmatched engineering, and innovative solutions combine to accelerate the impact of technology for every client we serve.

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