

Four reasons NVMe is right for business

Businesses can now access an unprecedented amount of data to help drive insights and improve decision making. A top priority for data-driven organizations — efficiently storing data, making it easier (and faster) to access and understand, and using it to develop better business decisions.

It's not just the largest companies or those with the most complex data centers who are investing in storage technology innovation to make best use of these resources. Modernizing legacy IT has become a critical and savvy move for medium and smaller business as well. That's why Micron® solid state drives (SSDs) with NVM Express™ (NVMe™) make good business sense. Micron NVMe SSDs, offered in industry leading storage densities, provide strong security and performance at a compelling value for businesses of all sizes. And, with Micron's approach, SSDs are optimized for key workloads and applications.

SSDs have proven to be fast and power-efficient option for data centers and client devices, 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) dominated the field.

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). When your customer's organization asks for better performance from real-time applications and for more storage flexibility, NVMe SSD storage should be the first step. Cut through the industry noise with Micron, a global storage leader. Here are four good reasons.

Designed for next-generation data centers, enterprises, and workforces

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



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1 Overcome the limitations of legacy storage

Businesses and consumers alike expect near-instant application response times. When SSDs were first introduced into data center workloads, 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 were 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.

Sequential writes for NVMe storage vs. SATA storage

NVMe delivers

2x

more MB/s per watt than SATA¹

For road warriors with data-intensive workloads, NVMe SSDs launching 1GB Photoshop PSD files² can be:

up to
12x
faster than SATA SSDs

nearly
46x
faster than HDDs

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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	<10 μ – 225 μ s	<1ms – 100ms	<100 μ – 100ms

Table 1: High parallelism in NVMe supersedes previous protocols

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.

Plus, NVMe SSD capacity continues to expand. The Micron 9400 or 6500 ION NVMe SSDs reach capacities of 30.72TB (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. For organizations that require large pools of NVMe storage, this is simple to set up and manage compared to physically installing all NVMe SSDs directly into servers without sharing. Unleash the pent-up IOPS and capacity of server-local NVMe!



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2

Accelerate your workloads

NVMe delivers almost 12x³ 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 critical. Again, NVMe delivers. The Micron 9400 NVMe SSD consistently reads up to 7GB/s of sequential data (see Figure 1) and offers up to 1.6 million IOPS for random data⁴.

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, optimize your infrastructure now with Micron's easy to deploy purpose-built storage.

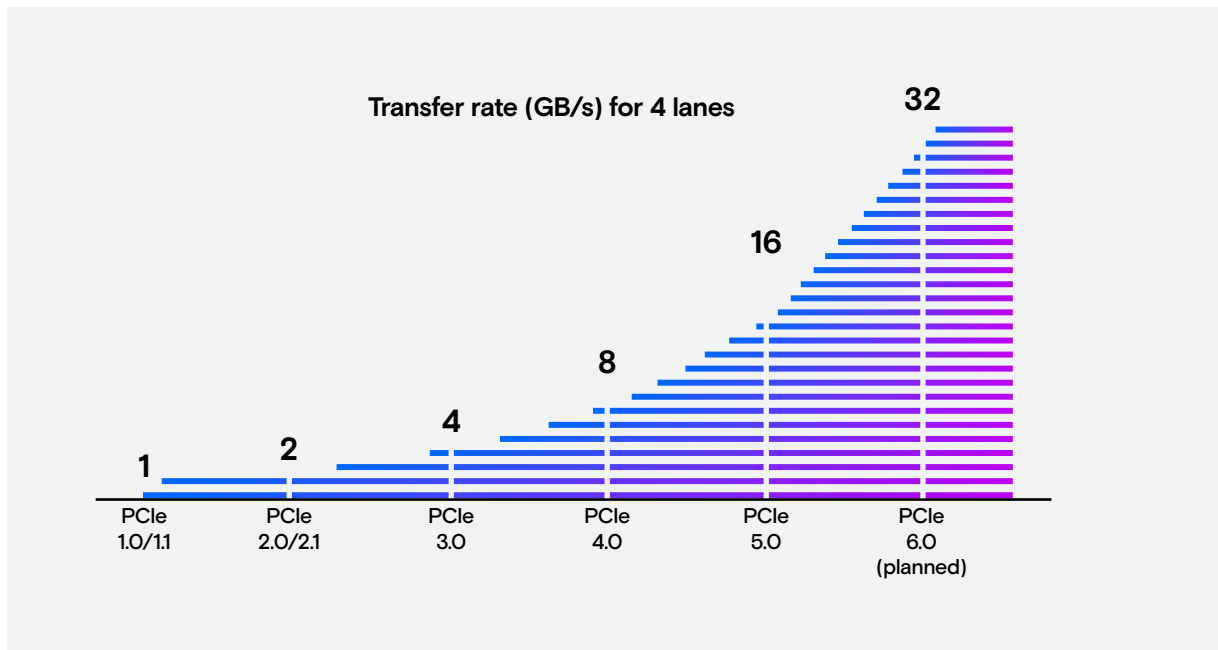
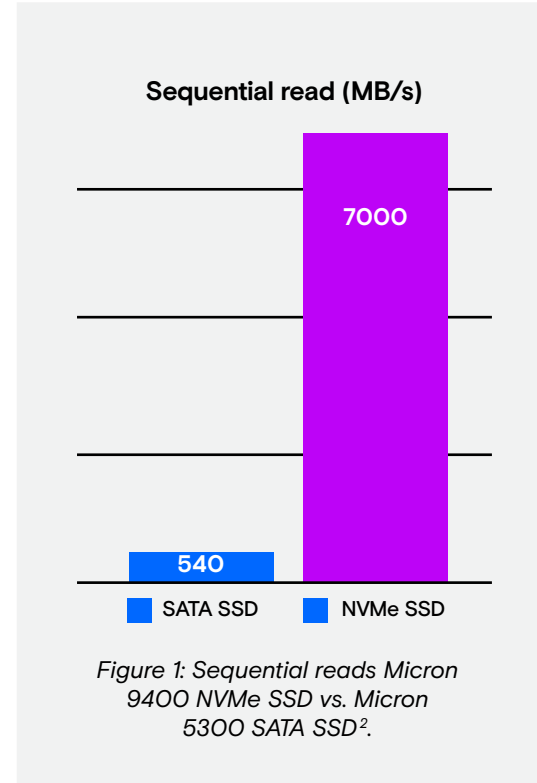


Figure 2: Growth of maximum PCIe transfer rates (actual and predicted)

Source [PCIe 6.0 spec announced](#) | TechSpot

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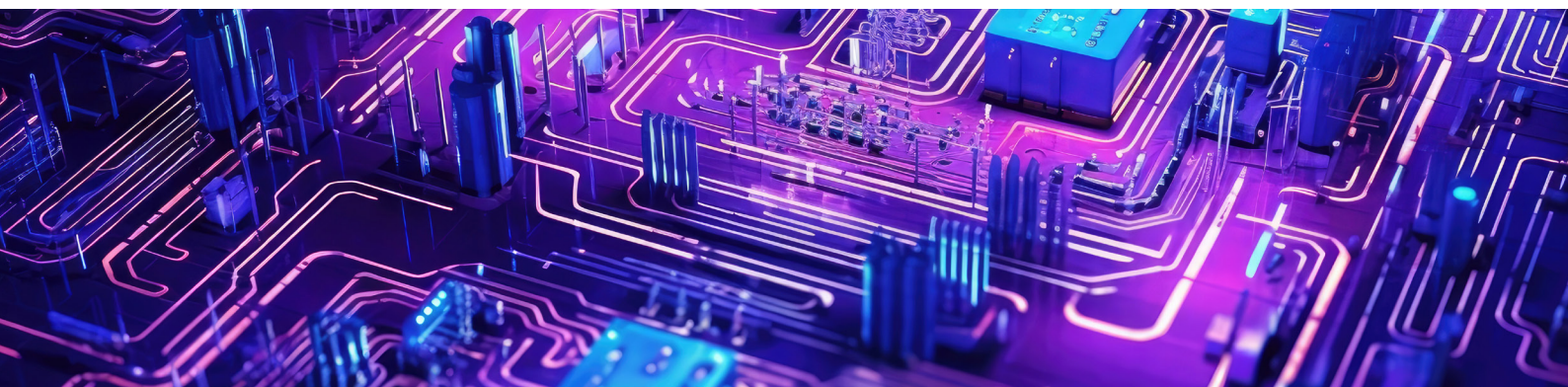
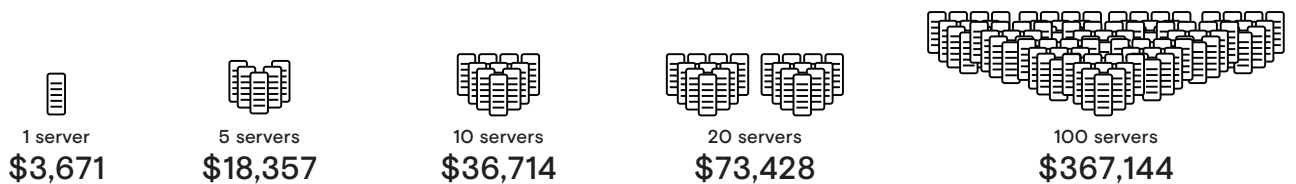
Get power efficiency and data security

Yesterday's data center infrastructure, with its sprawling racks and huge, growing numbers of bulking HDD-based servers, is being replaced by a smaller footprint with more efficient hardware. With higher density NVMe SSDs, organizations can store more data in fewer servers, helping tame data center complexity. NVMe SSDs can also improve power efficiency over the mechanical design of HDDs⁵.

With Micron's high-capacity 30.72TB 6500 ION SSD you have a solution that makes it possible to reduce storage footprints by packing much higher storage densities into each server while also reducing power consumption. This reduces the number of racks, significantly lowering your infrastructure costs, which is a cornerstone of long-term sustainability. The 6500 also reduces power consumption, delivering up to 57% better power efficiency than the competition⁶.

What does it look like when you save 57%?

If you can save more than \$3k on one server, imagine how much you could save across an entire deployment.



NVMe SSDs are also at the leading edge of security⁷ with hardware-driven performance. At Micron, our 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.

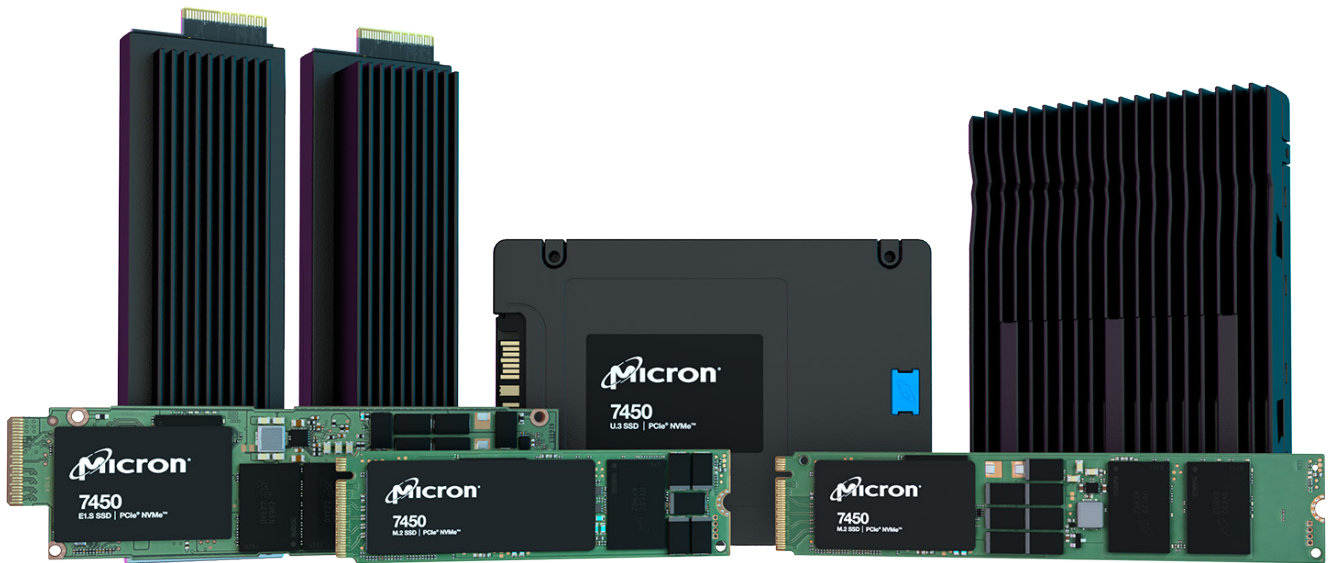
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Improve performance now and position business for the future

There are a host of benefits that are now moving savvy system builders to NVMe. At the top of the list? It's a great way to future proof IT. Upgrading servers simply to catch up with the competition is counterproductive. Instead, the forward-thinking performance of NVMe helps position organizations for what is soon to come in data center evolution.

Another evolution from legacy storage is the flexibility that NVMe helps provide. This enables organizations to balance their evolving capacity, power and thermal needs for next-gen data centers. The Micron 7000-Series is a perfect example, offering the world's broadest portfolio of PCIe Gen4 NVMe SSDs for data center infrastructure. The mainstream Micron 7000-Series SSD form factors support standard server storage (U.3 – with full U.2 interoperability), cloud and 1U 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 helping data center managers find positive ROI quickly for fast storage investment. Choosing NVMe now also positions organizations 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.






Investigate our 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 to mid-sized and smaller organizations that IT giants depend on. 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 system 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 security⁷ available – without compromising performance or affordability. Learn which Micron storage solutions are right for you and your customers.

Table 2: Microns NVMe SSDs

SSD series/model	Form factor	Capacity (TB)	Suitable for						
			Caching	AI/ML/DL	Streaming CDN	Primary storage	Analytics	Digital workflow	Boot
7450 Series MAX	U.3 / 7 mm	0.96 to 7.68	●	●	○	◐	○	○	○
7450 Series PRO		0.8 to 6.4	◐	◐	●	●	●	●	◐
7450 Series MAX	E1.S	0.96 to 3.84	●	○	○	◐	○	○	○
7450 Series PRO		0.80 to 3.2	◐	◐	●	○	●	○	◐
7450 Series MAX	M.2 / 2280	0.48 to 3.84	●	○	○	◐	○	○	◐
7450 Series PRO		0.40 to 3.2	○	○	●	◐	○	●	●
7450 Series MAX	M.2 / 22110	0.48 to 3.84	●	○	○	◐	○	○	◐
7450 Series PRO		0.40 to 3.2	○	○	●	◐	○	●	●
9400 Series MAX	U.3 / 15mm	6.40 to 25.60	●	●	○	◐	○	○	○
9400 Series PRO		7.68 to 30.72	◐	◐	●	●	◐	○	○
6500 ION	U.3 / 15mm	30.72	○	●	●	○	○	○	○

 Best fit
  Good fit
  Other options are ideal

MAX - Highest performance PRO - High performance

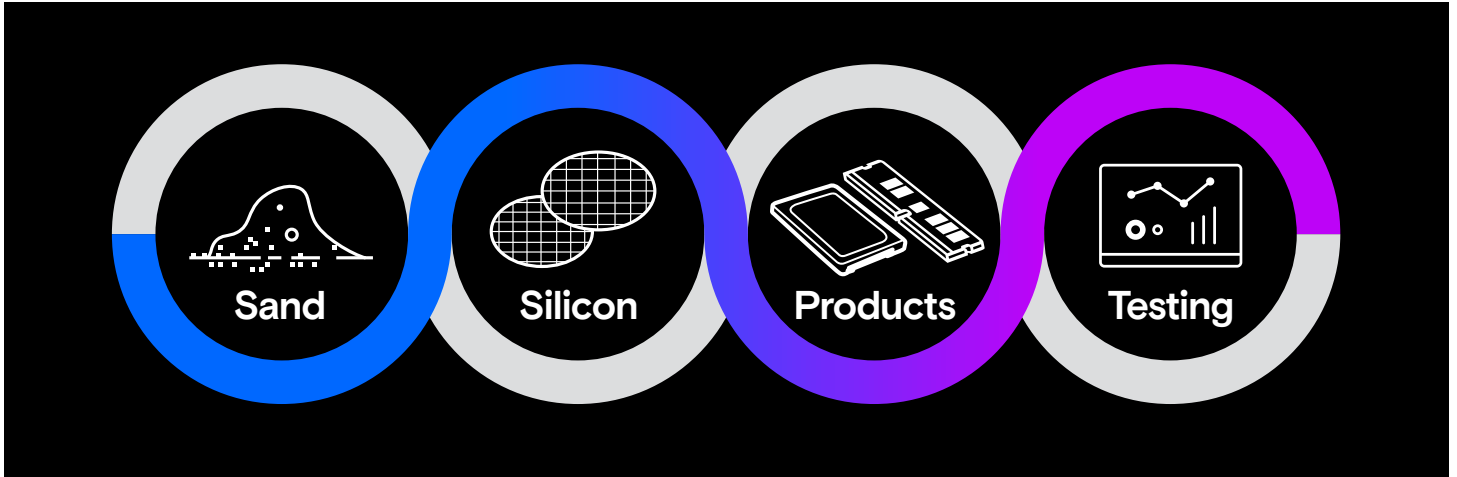
Tiering storage while SSDs and HDDs approach price parity?

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 most price-sensitive customers now to prepare them 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. hard drives tended to limit their use to specialized, high-performance workloads with smaller datasets. As the switch to flash progresses, high-capacity SSDs like the 30.72TB 6500 ION SSD help bridge the gap between HDDs and HDDs with high-density, low-cost storage that offers TLC performance at QLC price points⁸.

In addition, cache-tier NVMe SSDs like the mainstream 7450 and high-performance 9400 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 virtualized data centers, including a variety of platform deployments.

Why Micron? We're built different

Decision makers for storage can leverage our in-house 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. We infuse purpose into everything we touch — from our people to our products to our partners. We are built different for your business to thrive in the tech forward world.



For more info: [Sign up on our Business Partner Portal](#) at microncpg.com or contact your Micron salesperson.

The Micron difference

Customer support

Web support and 1:1 assistance from an experienced sales network

45 years of excellence

Micron's world-class leadership in innovative memory and storage solutions

Consistent inventory

Consistent supply from a trusted, experienced manufacturer

Quality assurance

Committed to both quality and innovation

1. Micron 7450 Pro NVMe SSD 1.92TB M.2 = 342MB/s per watt vs. Micron 5300 Pro SATA SSD 1.92TB M.2 = 133MB/s per watt.
2. Comparing Micron 9400 read speeds of 7,000MB/s to Micron 5300 read speeds of 540MB/s and to the average HDD read speeds of 150MB/s.
3. Comparing Micron 9400 speeds of 7,000MB/s to maximum SATA III speeds of 600MB/s.
4. Performance measured under the following conditions: Steady state as defined by SNIA Solid State Storage Performance Test Specification Enterprise v1.1; Drive write cache enabled; NVMe power state 0; sequential workloads measured using FIO with a queue depth of 32; random read workloads measured using FIO with a queue depth of 256 (1,000,000 IOPS statement based on 4K sector size; random write workloads measured using FIO with a queue depth of 128).
5. Based on widespread experience and testing, including this analysis from [Tom's hardware](#). Actual results depend on a variety of factors and may vary.
6. Comparisons to public datasheet values for 30.72TB Solidigm™ D5-P5316 QLC SSD as of March 2023
7. No hardware, software, or system can provide absolute security under all conditions. Micron assumes no liability for lost, stolen, or corrupted data arising from the use of any Micron products, including those products that incorporate security features.
8. All comparisons to public datasheet values for 30.72TB Solidigm® D5-P5316 QLC SSD as of March 2023