The Ultimate Data Center PCIe Gen4 SSD

Industries around the globe are leveraging data for insight and innovation, making it an ever more precious resource. And experts forecast that the amount of data created globally will more than double by 2025 — up to 180 zettabytes.[1] A cavalier approach to moving, ingesting, analyzing and storing this information deluge is not an option. Data must be treated like the valuable commodity that it is.

Next-Gen Data Center Technology

GPU Storage on
NVIDIA® GDS

High Performance
NoSQL Database

Extreme Mixed-Use
Database Performance

Multi-Tenant
Cloud Architectures

The Ultimate
Data Center SSD

Building next-gen data center technology

There can be no concessions for performance-critical workloads, even when they're complex and difficult. For these applications, fast ingest alone is not enough — responding in microseconds can deliver a true competitive advantage.

Introducing: The Micron® 9400 NVMe SSD, which is already breaking industry benchmarks for PCIe® Gen4.0 NVMe 1.4 server technology with amazing test results. Micron tested the 9400 SSD against three of our top performance-focused NVMe SSD competitors[2] on challenging data center workloads, and the real-world performance comparisons are in. Versus competitors, the 9400 SSD showed:

- **Up to 2.1x better performance**[3] on the Aerospike NoSQL database
- **Up to 70% better app responsiveness**[4] on RocksDB
- **Up to 33% higher storage**[5] throughput for AI workloads with NVIDIA GDS
- **Up to 62% better app responsiveness**[6] and **2.3x better throughput**[6] on multi-tenant cloud architectures

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Workload:

GPU storage on NVIDIA® GDS

NVIDIA is a pioneer in artificial intelligence training and inference platforms. NVIDIA® Magnum IO GPUDirect® Storage (GDS) delivers a direct memory access (DMA) data transfer path between an SSD and GPU memory without going through the CPU or main memory, which itself improves performance by up to 33% over legacy IO. GDS accelerates the loading of large datasets to speed application performance, such as AI inference programs.

Results:

We structured our tests to show the maximum GDS performance improvement and response time improvement for small (4KB), intermediate (128KB) and larger (1024KB) transfers. The Micron 9400 SSD versus legacy IO showed significant advances for all sizes of transfers.

GDS 4KB transfers[5]
33% performance improvement
25% faster response time

GDS 128KB transfers[5]
11% performance improvement
11% faster response time

GDS 1024KM transfers[5]
16% performance improvement
16% faster response time

Why it's useful:

Artificial intelligence, machine learning and high-performance computing have shifted computation from the CPU to faster GPUs. The primary bottleneck to overall application performance has become the IO into and out of the GPU, which the Micron 9400 significantly improves. NVIDIA continues to profess its support for solving AI challenges and delivering technology to accelerate transformation of the world's largest industries.

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Workload:

High performance NoSQL database

Aerospike is one of the fastest NoSQL databases for time-critical web applications (e.g., fraud detection, recommendation engines, real-time payment processing). Micron's tests highlighted typical application peak performance *(Figure 1)* versus three NVMe, high-performance competitors.
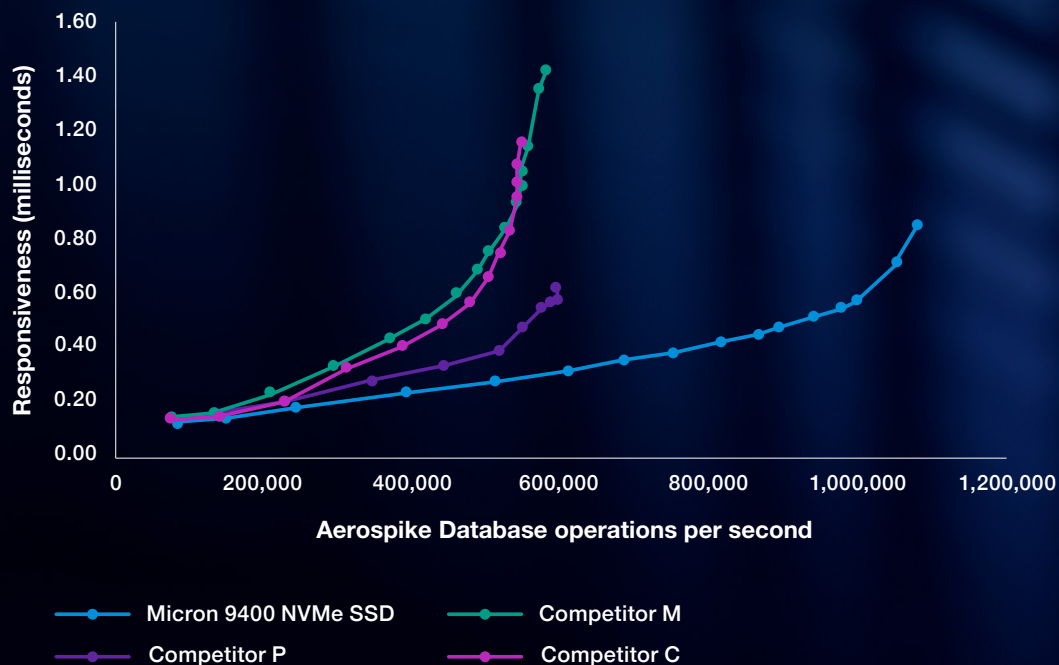
Workload A: Performance vs. Application Responsiveness

Figure 1: The Micron 9400 vs. competitors on Workload A tested on Aerospike in an update-heavy workload where 50% of storage IO is written and 50% is read; the flatter curve for the 9400 shows the SSD application responsiveness remains extremely consistent as demand increases

Results:

Tests were performed on the Micron 9400 and three competitors using Aerospike Database and four common workloads like the Yahoo! Cloud Serving Benchmark. As demand increased (increasing thread count) on workload performance and responsiveness, the Micron 9400 was a class leader:

- **Up to 2x better**[3] than competitors
  – recording user sessions

- **Up to 1.9x better**[3] than competitors
  – tagging existing assets

- **Up to 1.4x better**[3] than competitors
  – caching user profiles

- **Up to 2.1x better**[3] than competitors
  – users modifying records

Why it's useful:

The Aerospike Real-time Data Platform is known for enabling organizations to act in real time, even with billions of transactions, by using massive parallelism. It also uses a hybrid memory model for the smallest possible server footprint. The Micron 9400 excels in these massively large data workloads.

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Workload:

Fast and extreme mixed-use database performance

RocksDB is commonly used for benchmarks showing extreme performance because it's optimized for fast, low-latency storage. It is running some of the most demanding database workloads in the IT world at Facebook as well as other mission-critical environments.

Results:

We tested the Micron 9400 against those same three top competitors on mixed-use workloads. The tests were focused on two areas: general performance and responsiveness (i.e., low latency) of the workloads when run with the Micron 9400 SSD on RocksDB.

Random Read[4]
25 to 34% performance improvement
32 to 34% better app responsiveness

Random Read / Random Write[4]
32 to 34% performance improvement
43 to 50% better app responsiveness

Random Read / While Writing[4]
23 to 54% performance improvement
47 to 70% better app responsiveness

Why it's useful:

This quote from a Facebook developer says it clearly:

"RocksDB is used extensively for storing persistent data on SSD at Facebook, and is also used by various services that serve online queries on hard drives. Through RocksDB, we [can] create various data compression algorithms tools for production support and debugging in a way that is adaptive and automatic."[7]

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Workload:

Multi-tenant cloud architectures

A multi-tenant database architecture is where a single instance of a software application serves multiple users or tenants. Several instances of the application may be working to serve many users within a cloud environment. Multi-tenant cloud software demands flexible, strong hardware infrastructure like flash storage or it can create "noisy neighbors," where one tenant negatively affects the performance of the others.

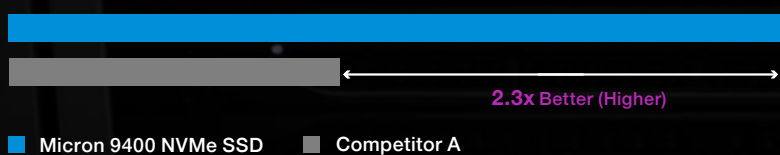### Throughput Effects of Noisy Neighbors

2.3x Better (Higher)

■ Micron 9400 NVMe SSD   ■ Competitor A

*Figure 2:
A series of "noisy neighbors" tests with the Micron 9400 SSD on a cloud platform shows throughput was 2.3x better than a competitor*

Response Time Effects of Noisy Neighbors

62% Better

16KB

52% Better

8KB

37% Better

4KB

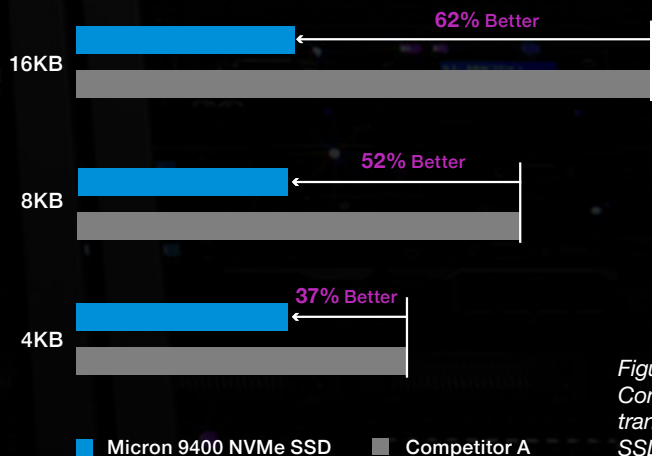■ Micron 9400 NVMe SSD   ■ Competitor A

*Figure 3:
Comparing workload response times for 16KB, 8KB and 4KB transfer sizes in noisy neighbor tests shows the Micron 9400 SSD's is up to 62% smaller (better) than a competitor*

Results:

The Micron 9400 compared to the same three top competitors showed several advances, including reducing response time to deliver higher throughput.

- **Up to 2.3x higher**[6] throughput *(Figure 2)*

- **Up to 62% better**[6] app responsiveness *(Figure 3)*

Why it's useful:

Storage technology can have major effects on servicing multi-tenant cloud workloads. One ongoing challenge is mitigating the "noisy neighbors" problem, where data and compute performance from one account interferes and slows performance for the others. Also, many cloud-based applications depend on consistent response, which the Micron 9400 delivers with high QoS.

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Meet the ultimate
data center NAND SSD

Micron's decades of experience in NAND storage have led to the Micron® 9400 NVMe™ SSD. It packs in over 30TB of usable capacity,[8] outperforms competitors in many workloads, and improves power efficiency up to 77% over Micron's previous generation SSD[9] in the 9000 Series. Built on Micron's world-leading 176-layer 3D NAND, the Micron 9400 delivers PCIe® 4.0 NVMe server storage.

Plus, it's best-in-class or at the top of its class in:

- Capacity, which ranges from 6.4TB up to a class-leading 30.72TB,[8] for a smaller footprint and 2x the storage
- Class-leading data center performance of up to 2.3x in real-world, mixed workload applications[2]
- Low, consistent 6x9s (six-nines) read latency that leads the industry by as much as 3.2x[10]
- Sequential read/write performance up to 7GB/s is the industry's fastest by up to 66%[2]
- Random read/write performance up to 1.6M IOPS read is also industry fastest,[2] with 600K write
- Improves power efficiency up to 77% over the Micron 9300 SSD[9]
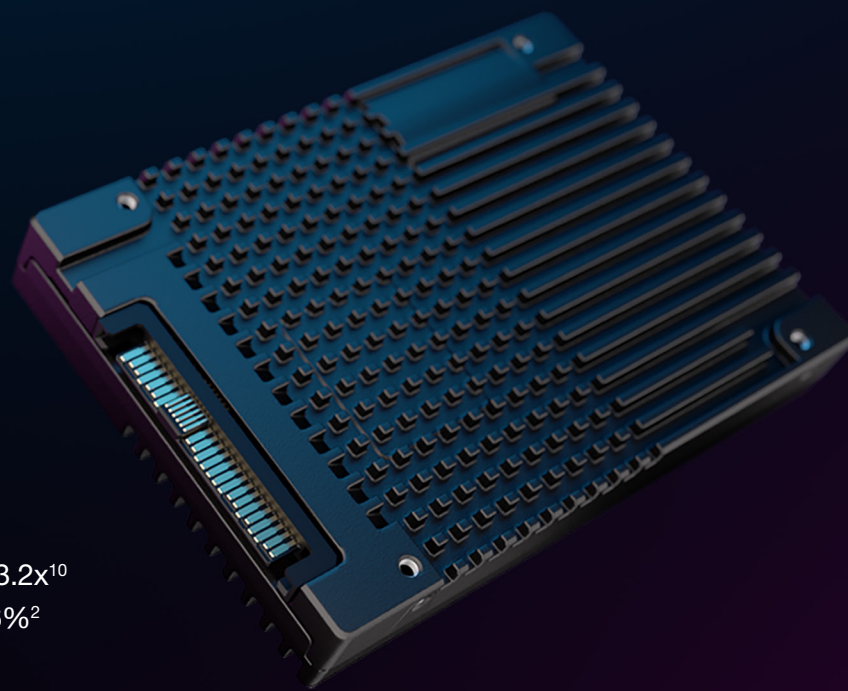
Learn more about
the performance workhorse
for challenging workloads

The Micron 9400 SSD is optimized for workloads that require strong mixed performance and massive capacity. This includes high-performance computing workloads like caching and database acceleration; high-speed massive OLTP such as multi-tenant cloud applications; block and object stores in NoSQL databases; and training/caching for AI and machine learning. Visit the Micron 9400 web page to download the tech briefs quoted here.

For more information, visit microncpg.com/9400

Fortify your IT infrastructure

Sources

[1] According to analyst firm IDC's Worldwide Global DataSphere Forecast, 2021–2025, business and consumer data has been amassing at a compound annual growth rate (CAGR) of about 23% since last year, with a 28% CAGR attributed to enterprises, and is expected to reach 180 zettabytes by 2025.

[2] Best-in-class and competitive comparisons in this document were made based on other leading PCIe Gen4 Data Center U.2/U.3 NVMe SSDs based on data center market share as noted in the Forward Insights SSD Supplier Status Q2/22 report and available on the open market at the time of this document's initial publication.

[3] Performance analysis and hardware configuration details in the Micron tech brief: Micron 9400 NVMe SSD Aerospike Performance

[4] Performance analysis and hardware configuration details in the Micron tech brief: Micron 9400 NVMe SSD RocksDB Performance

[5] Performance analysis and hardware configuration details in the Micron white paper: Examining Micron 9400 NVMe SSD Performance With NVIDIA Magnum IO GPUDirect Storage Platform, which also has more specific comparisons of the Micron 9400 SSD vs. a Samsung PM 1733 NVMe SSD.

[6] Performance analysis and hardware configuration details in the Micron tech brief: Micron 9400 NVMe SSD Noisy Neighbor Performance Test

[7] From a blog by Cami Williams, Head of Platform Advocacy at Meta, in the Facebook Open Source Presents series, "Eli5: RocksDB: Fast Data Storage," https://developers.facebook.com/blog/post/2021/08/09/eli5-rocksdb-fast-data-storage/. Open sourced in 2013, owned by Meta, RocksDB continues to be widely used in the community and at Facebook/Meta to manage persistent data and server queries.

[8] The Micron 9400 SSD 30.72TB capacity is its largest option and is the largest available server SSD capacity available in the open market as of the time of this document. 1GB = 1 billion bytes; formatted capacity is less.

[9] 77% power efficiency improvement is vs the Micron 9300 SSD. Efficiency is defined as performance per watt.

[10] Latency was measured using 7.68TB SSDs at queue depth (QD) = 256 with FIO (additional details on FIO are available here: https://fio.readthedocs.io/en/latest/).

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