THE MICRON® 9400 NVMe™ SSD PROVIDES DOUBLE THE PERFORMANCE OF LEADING COMPETITOR IN NOISY NEIGHBOR TEST[1]

Multi-tenant cloud architectures, where multiple tenants have access to shared resources, have become the standard in cloud computing. In a cloud multi-tenant architecture, a tenant that monopolizes shared resources like storage, network or compute is called a “noisy neighbor.” Noisy neighbors become problematic when they compromise the performance of other tenant environments or workload performance.

This technical brief shows how the Micron 9400 SSD manages noisy neighbors better than the other leading competitor’s performance-focused NVMe SSD (Competitor A).[2] These SSDs show very different results in their ability to manage noisy neighbors, despite similar results in standard, four-corners testing (small transfer random read and write, large transfer sequential read and write).

In fact, the Micron 9400 SSD demonstrates more than double the performance and up to 62% better (lower) response[3] time than Competitor A.

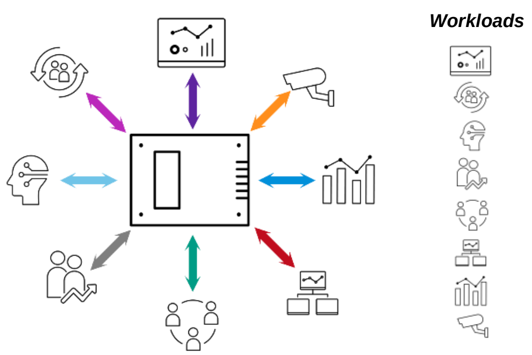

Figure 1: Different workloads competing for the same shared SSD resources

Fast Facts

The Micron 9400 SSD demonstrates higher performance and better, more consistent workload responsiveness than the leading competitor’s performance-focused NVMe data center SSD.

Higher Overall Performance

Performance results show that the Micron 9400 SSD offers more than double the overall performance of the competitor’s SSD.

2.3X Better Performance

More Consistent Workload Response

The Micron 9400 SSD demonstrates up to 62% better response time consistency compared to Competitor A.

High-performance, multi-tenant workloads must be consistently (or deterministically) responsive. Some SSDs may not be designed with this requirement in mind.

62% Better Response Time

Figure 2: Micron 9400 SSD (U.2/U.3)

1. In this document performance is understood to mean megabytes per second (MB/s, or throughput) or workload responsiveness.
2. Leading competitor as per market share date from SSD Insights Q4/22 (analyst firm Forward Insights).
3. In this document, workload response time is time value for which 99.99% of IO requests successfully completed. A lower value indicates a better workload response time.

Creating Noisy Neighbors

Each SSD was configured with six namespaces. Three of these namespaces (#1, #2 and #3) have data constantly written to them at a queue depth of 8, creating the effect of noisy neighbors (write rates differ for transfer size and SSD under test). Namespace 1 has 4KB transfer size data constantly written during testing. Namespace 2 is treated similarly using 8KB transfer size, and namespace 3 is also treated similarly with a 16KB transfer size. These simulate the noisy neighbors who are writing a lot of data, potentially affecting other workload performance, specifically read performance in this test.

The other three namespaces (#4, #5 and #6) each perform a read workload at a queue depth of 1 as shown in Figures 3 and 4. These namespaces represent the workloads that may be affected (showing potentially lower throughput or degraded response time) by the noisy neighbors.

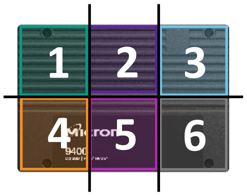

Figure 3

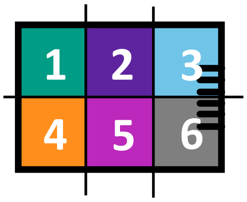

Figure 4

Measuring the Effects of Noisy Neighbors

Figure 5 compares the throughput effect of noisy neighbors, showing summed 4KB, 8KB and 16KB QD1 performance values for the Micron 9400 SSD (in blue) and Competitor A (in grey). The data in Figure 5 shows that the Micron 9400 SSD delivered 2.3X higher throughput than Competitor A, indicating that the Micron 9400 SSD throughput is less affected by noisy neighbors.

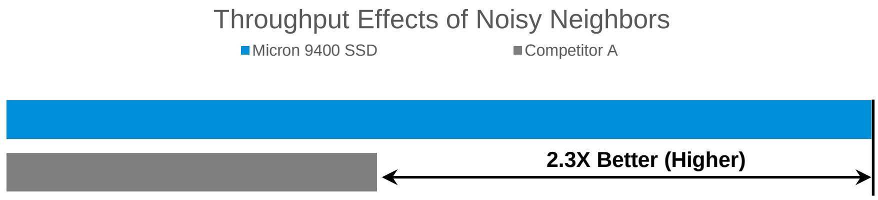

Figure 5

Figure 6 shows better workload response time[3] for 16KB, 8KB and 4KB transfer sizes for the Micron 9400 SSD and Competitor A. Lower values in Figure 6 are better, indicating that the noisy neighbors are causing less of an impact on response time consistency. This metric is important to measure as response time consistency impacts performance as the workload waits on data.

A 16KB transfer size shows that the Micron 9400 SSD delivers 62% better response time consistency than Competitor A. An 8KB transfer size shows the Micron 9400 SSD has 52% lower response time. Finally, a 4KB transfer size shows a difference of 37%. As clearly shown in Figure 6, the Micron 9400 NVMe SSD enables substantially better results than Competitor A, necessary in workloads where response time is critical.

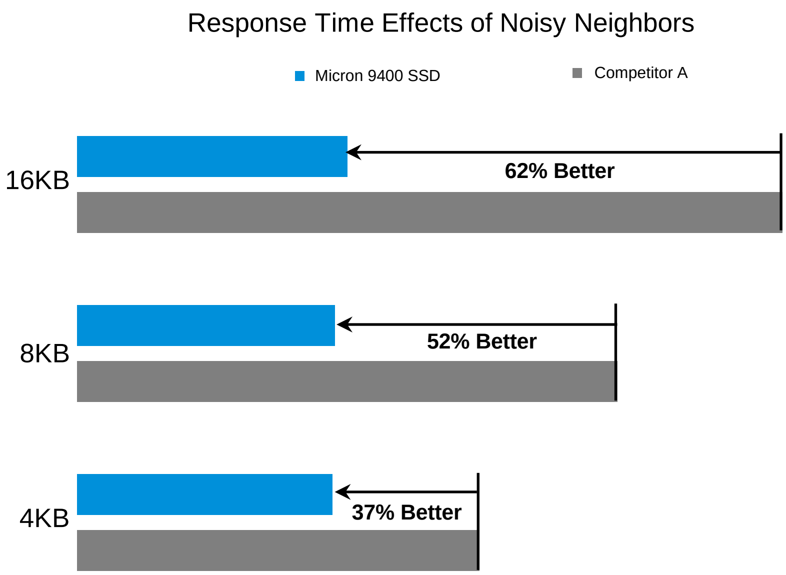

Figure 6

An Example of Why Response Time Consistency Is Important

In “Why Deterministic Storage Performance Is Important” (Architecting IT blog),[4] Chris Evans noted that the importance of response time consistency is workload-dependent. He cites the example of dynamically generated web page ads, where the ad is placed as the page is being generated, as a workload where the ability to consistently respond (i.e., display a dynamically selected ad) is important. This is just one example of the value of response time consistency.

Conclusion

The Micron 9400 SSD demonstrated 2.3X higher throughput and up to 62% better response time consistency than a performance-focused NVMe SSD from Competitor A. Improved workload throughput and application response time consistency are important considerations for SSD selection in any architecture where noisy neighbors may exist. Data center operators should carefully consider this while architecting their storage solutions.

How We Tested

Each SSD was configured with six namespaces, throughput and response time consistency measured using Flexible IO Tester (FIO).[5]

Server Hardware Configuration	
Server	Supermicro AS-1114S-WN10RT
CPU	AMD EPYC™ 7F72 24-Core Processor
Memory	256GB Micron DDR4-3200
Server Storage[6]	Micron 9400 SSD configuration: 1x Micron 9400 PRO 7.68TB NVMe SSD Competitor A configuration: 1x mixed-use, data center 7.68TB NVMe SSD
Boot Drive	Micron 7300 PRO 960GB M.2 NVMe SSD

Table 1: Server configuration

Server Software Configuration	
Filesystem	XFS version: 5.0.0; mount options: “noatime,discard”; Mount point: /mnt_db/nvme
Flexible I/O tester (FIO) version	3.297.4
OS	Rocky Linux™ 8.5
Kernel	4.18.0-348.720.1.el8_5.x86_64

Table 2: Server filesystem configuration

While performance and better response time consistency are paramount for multi-tenant workloads, workload average response comparisons were also measured. In this testing they showed negligible effect on the workloads noted in this document.

4. More information is available here: https://www.architecting.it/blog/deterministic-storage-performance/.
5. More information on FIO is available here: https://fio.readthedocs.io/en/latest/index.html
6. Unformatted. 1GB = 1 billion bytes. Formatted capacity is less.

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