Micron

Big capacity. Bigger value.

Test results for four common NoSQL workloads show that the Micron 6500 ION SSD demonstrates consistently higher performance and better latency compared to the competition.

The Micron 6500 ION's massive capacities and purpose-built performance make the competition look small by comparison

The Micron® 6500 ION NVMe™ SSD provides immense capacity and optimized performance without compromising responsiveness[1].

Building the perfect cloud architecture or content delivery network has traditionally been a balancing act where IT teams are forced to sacrifice cloud storage performance for capacity or pay for speeds and endurance that will never be used. The high-capacity, 30.72TB[2] Micron® 6500 ION NVMe™ SSD solves these challenges, delivering TLC performance at QLC price points — all while achieving up to 25 times more 4KB random write IOPS, up to 54% better read QoS, and up to 56% better power efficiency than the competition[3].

This ebook uses Yahoo!® Cloud Serving Benchmark (YCSB)[4] standard workloads to compare the Micron 6500 ION SSD (a TLC SSD) and the Solidigm™ D5-P5316 (a QLC, capacity-focused SSD). Both tested SSDs have 30.72TB capacity[5].

Note that these tests were conducted in house, and that actual results may vary.

Best for

Cloud storage

Content delivery networks

Features and results

How can we compare a TLC SSD to a QLC SSD?

Simple. Micron's advancements in NAND technology (including 200+ layers) enable the Micron 6500 ION SSD to be offered at a comparable price[6] to the Solidigm D5-P5316. And when cost is similar, features and workload results dominate the choice to make.

Test results show that the Micron 6500 ION SSD demonstrated consistently higher performance (database operations per second, "ops/sec.") and better (lower) 99.99% latency compared to the Solidigm D5-P5316 SSD.

SEE RESULTS

Figure 1: Apache Cassandra™ maximum performance summary by workload

Fast facts

The capacity-focused Micron 6500 ION SSD offers up to 30.72TB per drive[4]. This high-capacity NVMe SSD enables innovative design opportunities and performance thresholds not offered in the Solidigm D5-P5316.

YCSB workloads A–C and F[5] compare single node Cassandra results for the Micron 6500 ION SSD and the Solidigm D5-P5316. Both are 30.72TB SSDs.

We found that the cluster using Micron 6500 ION SSDs offered:

- **Workload A:** Recording user sessions
  - **1.5x** better performance
  - **7x** lower latency
- **Workload B:** Adding metadata
  - **2.4x** better performance
  - **4.3x** lower latency
- **Workload C:** Reading profiles
  - **2.6x** better performance
  - **3x** lower latency
- **Workload F:** Recording user activity
  - **1.9x** better performance
  - **9.2x** lower latency

A closer look at Micron 6500 SSD Apache Cassandra™ performance

The following figures show YCSB workload performance (operations per second) and 99.99% latency results for four common NoSQL workloads. Performance is shown on the x-axis (farther to the right is better) and 99.99% latency (in milliseconds) is shown on the y-axis (lower is better). Each point on the figure represents workload performance with the thread count scaled from 8, 16, 32, 64, and 128. Arrows are added for visual assistance.

Workload A

This is an update-heavy workload where approximately 50% of all the storage I/O is written and 50% is read. An example of this workload can be seen when user sessions are recorded.

Performance analysis

Figure 2 shows that the Micron 6500 ION SSD performance is consistently higher (farther to the right) than the Solidigm SSD at every tested thread count, reaching a maximum improvement of 1.5x (154,815 versus 101,593 operations per second).

Latency analysis

The Micron 6500 SSD ION SSD performance versus latency curve is much flatter than the Solidigm SSD curve. This indicates that the Micron 6500 ION SSD 99.99% latency remains more consistent with only a slight increase at the far right. The Solidigm SSD response times show a substantial increase at its far right, indicating that this workload level is extremely difficult for the Solidigm SSD.

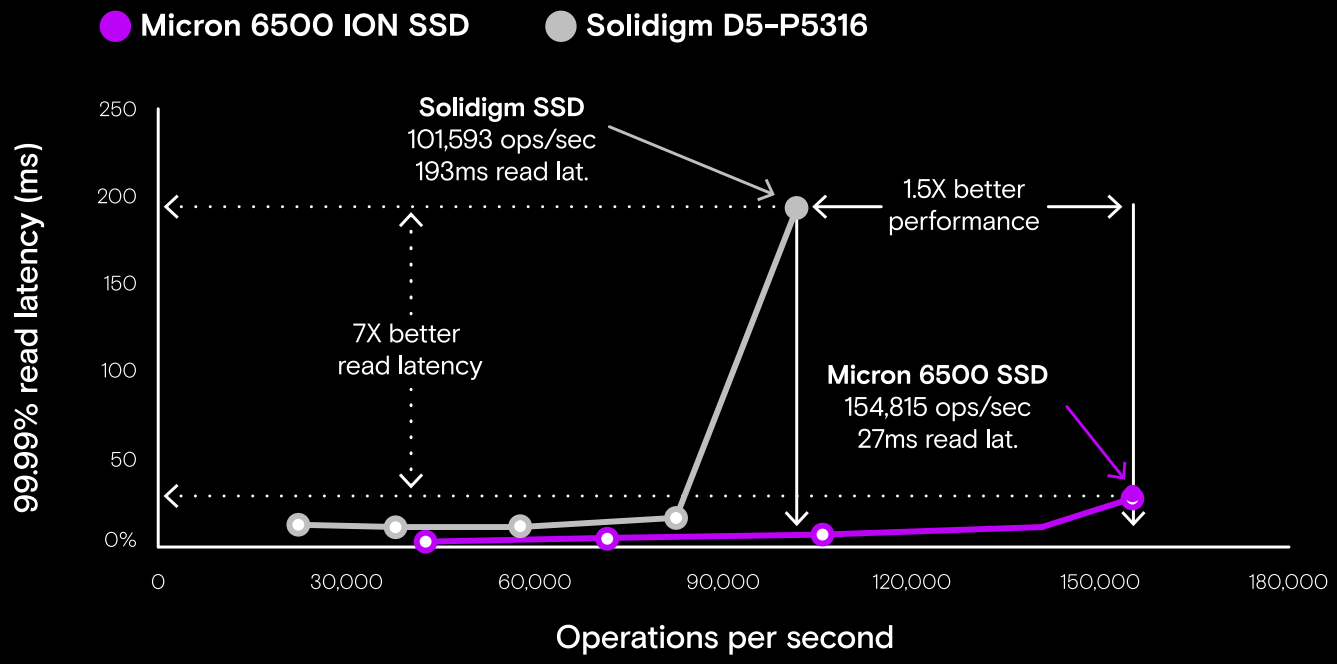

Figure 2: Workload A performance vs. latency

Workload B

This read-mostly workload comprises approximately 95% read and 5% write storage I/O. An example of this workload includes adding metadata to existing data (tagging) where most of the tags are read (only a few tags are written or rewritten).

Performance analysis

Figure 3 shows that the Micron 6500 ION SSD performance is consistently higher (farther to the right) than the Solidigm SSD at every tested thread count. The maximum improvement is 2.4x.

Latency analysis

The Micron 6500 ION SSD performance versus latency curve gradually increases as operations per second increases, showing no peaks. The Solidigm SSD showed vastly different responsiveness versus operations per second characteristics.

The Solidigm SSD again shows dramatic increase in latency, indicating that the Micron 6500 ION SSD latency remains lower and more consistent as the workload increases.

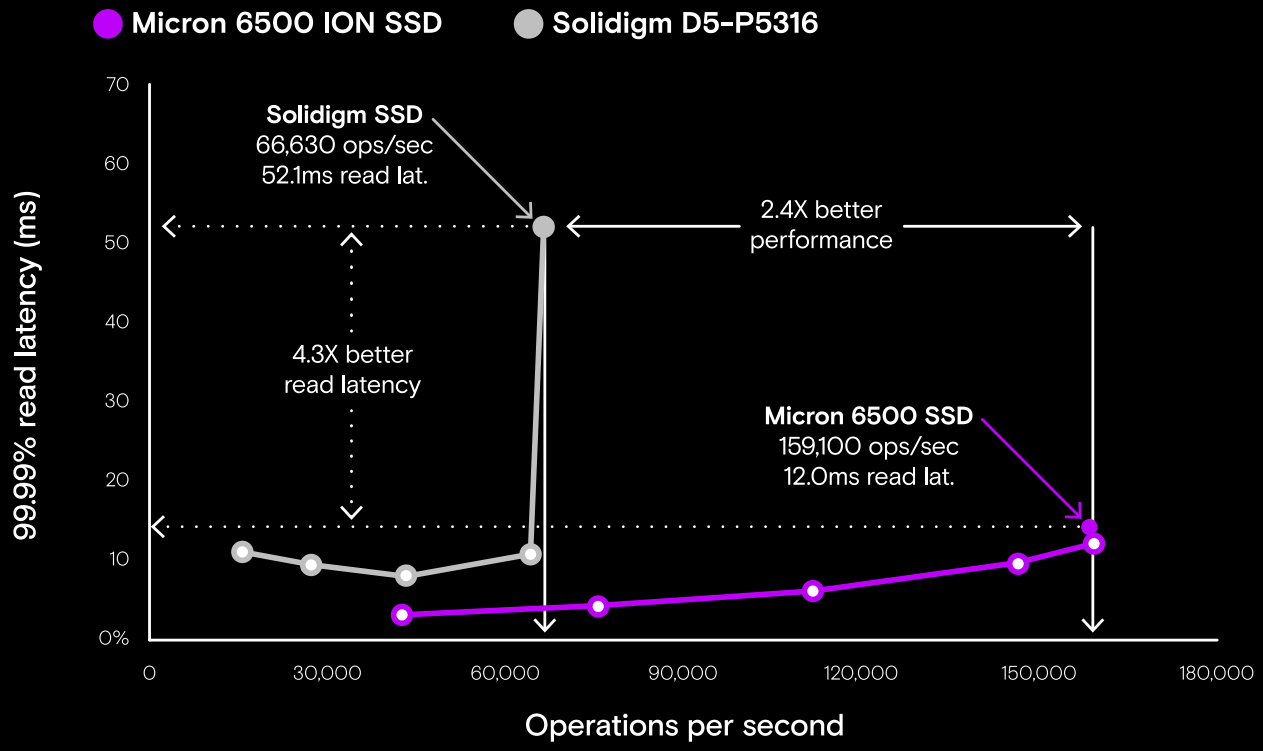

Figure 3: Workload B performance vs. latency

Workload C

This workload is 100% read (data does not change). Examples include reading immutable data for user authentication or reading a profile cache (when a user or system profile was created elsewhere).

Performance analysis

The Workload C results seen in Figure 4 again show that the Micron 6500 ION SSD performance increases as the workload increases (left to right) and there are no latency spikes.

In the Solidigm SSD results, the highest performance data point shows little performance improvement over the prior data point, suggesting that this SSD has reached its performance limit in this test.

Latency analysis

Latency results again show that the Micron 6500 ION SSD latency increases gradually as its performance increases. The Solidigm SSD maximum performance reflects extremely high latency (the line is nearly vertical at this point). This behavior aligns with the behavior seen in Figures 2 and 3 for this SSD – extremely high latency with little performance improvement.

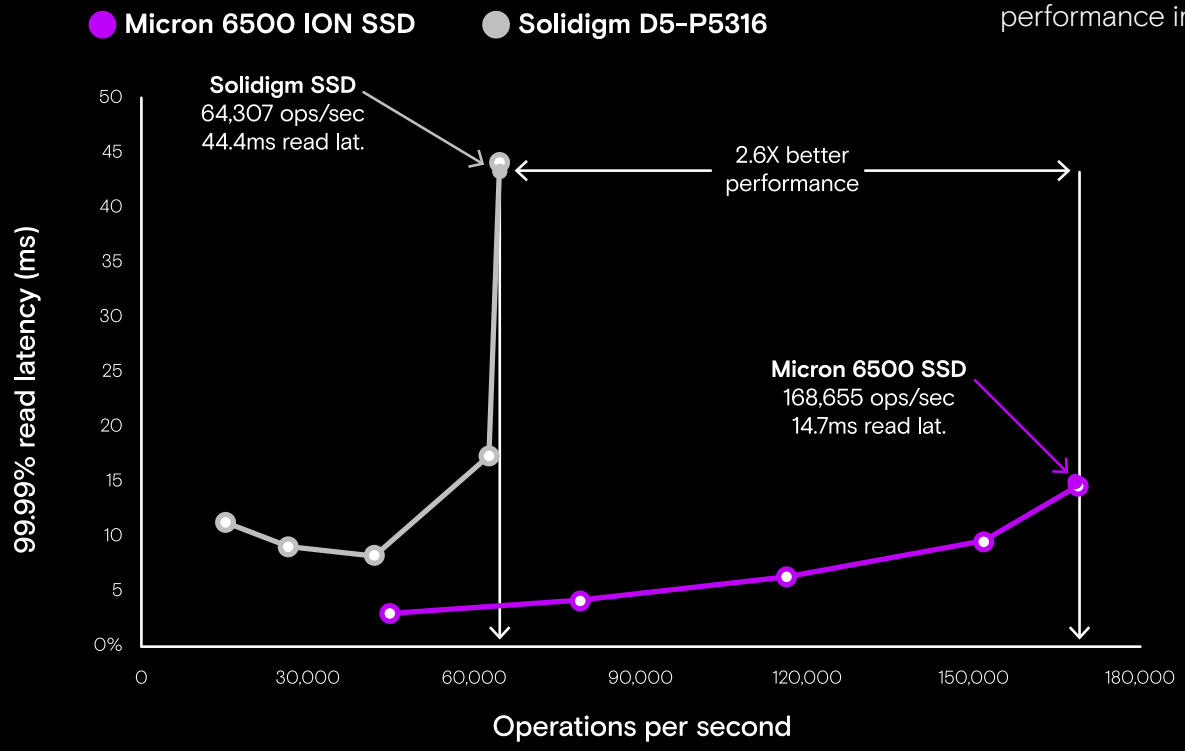

Figure 4: Workload C performance vs. latency

Workload F

In Workload F, the client reads a record, modifies it, and writes back the changes. Application examples include a user database where user records are read and modified by the user and written back. This workload is also used to record user activity.

Performance analysis

Workload F results shown in Figure 5 again show that the Micron 6500 ION SSD performance increases as its workload increases (left to right). Its resultant curve shows no abrupt latency spikes.

The Solidigm SSD results are like those observed in previous figures. Its farthest right data point shows a small performance improvement of the prior data point, and its latency spike again indicates that this SSD has reached its performance limit in this test.

Latency analysis

Latency results show that the Micron 6500 ION SSD latency increases very gradually as its performance increases. The Solidigm SSD maximum performance reflects extremely high read latency at its highest performance.

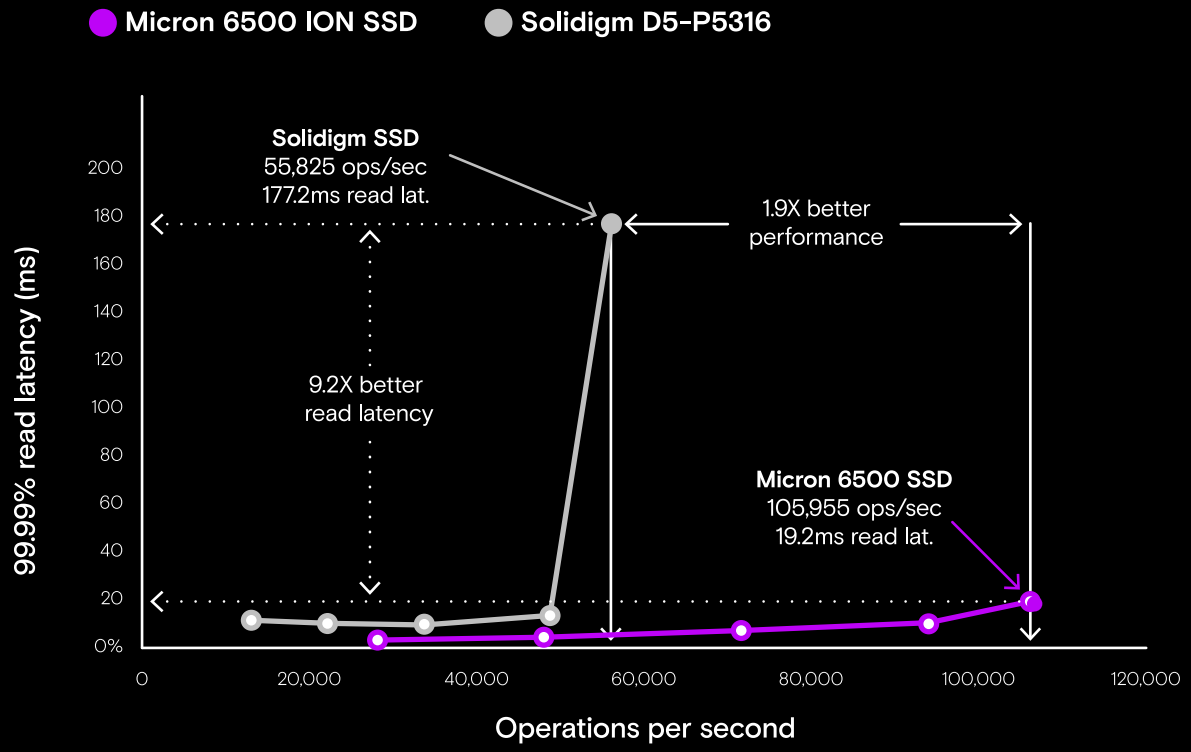

Figure 5: Workload F performance vs. latency

Conclusion — Faster and more consistent

Results show that the 30.72TB Micron 6500 ION SSD consistently demonstrated higher peak performance and better (lower) 99.99% read latency than the 30.72TB Solidigm SSD. This means that the Micron 6500 ION SSD responds faster and more consistently.

Performance improvements ranged from 1.5x in Workload A (recording use sessions) to a maximum of 2.6x in Workload C (where immutable data like user profiles is used for authentication). Latency improvements range from 3x in Workload C to a maximum of 9.2x (recording user sessions) in Workload F.

These improvements across a broad range of common NoSQL use cases will often have a material impact in the data center, making the Micron 6500 ION SSD the clearly preferred capacity-focused, NVMe storage building block in Apache Cassandra deployments.

For more information on the testing methodology, download the “Micron 6500 ION SSD Delivers Breakout noSQL Database Performance Without Breaking the Budget” technical brief.

Capacity without compromise

As you've seen, the Micron 6500 ION SSD evens out the traditional balancing act between cloud storage capacity, performance and value. It delivers capacity without compromise, and gives TLC performance at QLC price points.

Learn more at micronpg.com/6500

LEARN MORE

Sources

1. In this document, application responsive means 99.99% latency, meaning that 99.99% of storage accesses complete within the stated time value. Thus, the terms application responsiveness, responsiveness consistency, and 99.99% latency are used interchangeably in this document.
2. 30.72TB capacity is the largest option. User capacity: 1GB = 1 billion bytes; formatted capacity is less
3. All comparisons to public datasheet values for 30.72TB Solidigm® D5-P5316 QLC SSD as of March 2023
4. We did not test Workload D (read latest) as its record updates results in a storage profile similar to Workload B. We did not test Workload F as it is not supported in all NoSQL databases. Additional details on YCSB are available from https://github.com/brianfrankcooper/YCSB
5. Unformatted capacity. 1GB = 1 billion bytes, formatted capacity is less. TLC = three data bits per cell. QLC = four data bits per cell
6. Based on publicly available information at the time of this document's publication

Rev. 05/2023