Technical Brief

Micron 5300 MAX SSDs Set a New Benchmark for OLTP Performance

Micron's 5300 MAX Drives OLTP Workloads With Fast, Consistent Results

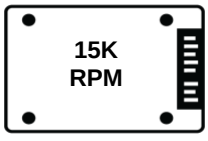
Overview

This technical brief highlights the business impact of high-performance Micron 5300 SATA SSDs in OLTP environments by comparing new orders per minute (NOPM), a measure of business throughput, with average and 99.9th percentile latency using standardized online transaction processing (OLTP) performance metrics and a very large data set (too large to fit into available system memory). Also included are results for a legacy configuration (15K RPM HDDs) for reference.

Three storage configurations were tested: two with 5300 MAX SSDs and a third with 15K RPM HDDs as a reference baseline. Each configuration used the same base hardware (server, CPUs and DRAM).

x4 Micron 5300 MAX SSDs
1.92TB each, RAID 10

x8 Micron 5300 MAX SSDs
1.92TB each, RAID 10



x16 15K RPM HDDs
RAID 10 (baseline configuration)

Results show the Micron 5300 MAX SSDs generate 13x to 15x higher business throughput, bringing real value to OLTP workloads on Microsoft® SQL Server.

Additionally, the 5300 MAX SSD configurations responded quickly and consistently, with 96% lower average latency and 91% lower 99.9th percentile latency compared to the baseline configuration.

Micron 5300 MAX SSDs enable up to:

13x **Higher business throughput***

96% **Lower average latency***

15x **Greater power efficiency***

*Relative to performance-focused, legacy baseline configuration. Performance is defined as new orders per minute (NOPM). Power efficiency is defined as workload (NOPM) divided by system-level power consumed. Results may vary with workload, optimization, access patterns and other deployment-specific conditions.

Increased Throughput, Fewer Drives

SSDs are a mainstay of high-performance, low-latency IT systems. High-capacity, performance-focused enterprise SSDs like Micron's 5300 MAX push those systems farther and faster, processing more data and bringing more value than 4-8 times as many hybrid HDDs.

In OLTP systems, higher NOPM can represent more orders entered and fulfilled, bringing more value. The magnitude of NOPM difference found between a Micron 5300 MAX-based platform and one using 16 hybrid HDDs is shown in Figure 1. Each configuration's relative transaction rate shown is at system load, just before the test reached a stop condition (see How We Tested for stop condition details).

Both 5300 MAX configurations' NOPM values are extremely high. The x4 5300 MAX configuration reached 15X the baseline NOPM and the x8 5300 MAX configuration reached 13X the baseline NOPM.

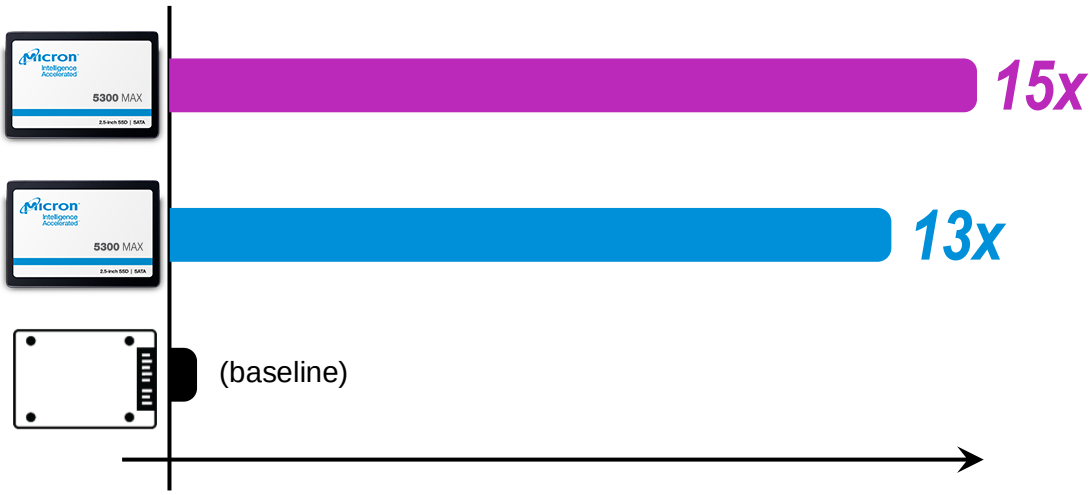


Figure 1: Relative NOPM by Storage Configuration

Fast, Consistent Transaction Response

High transaction rates (as seen with NOPM) are required for many applications, while quick and consistent database response (latency) may be more important for time-sensitive applications.

We measured and compared the mean latency and the 99.9th percentile latency (a good indicator of latency consistency) at system load just before the test reached a stop condition (see How We Tested for stop condition details) for the three storage configurations. We used the same metrics, database and test conditions.

Figures 2a and 2b show these results (lower is better in both figures).

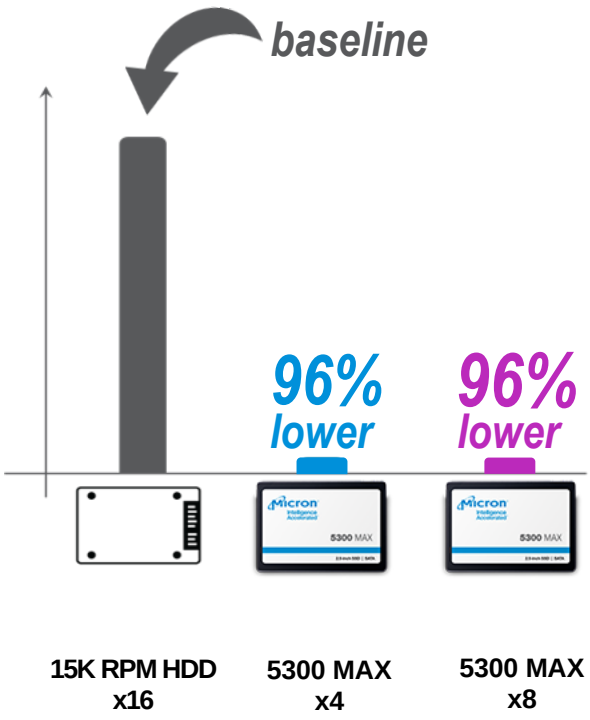


Figure 2a: Mean Transaction Time

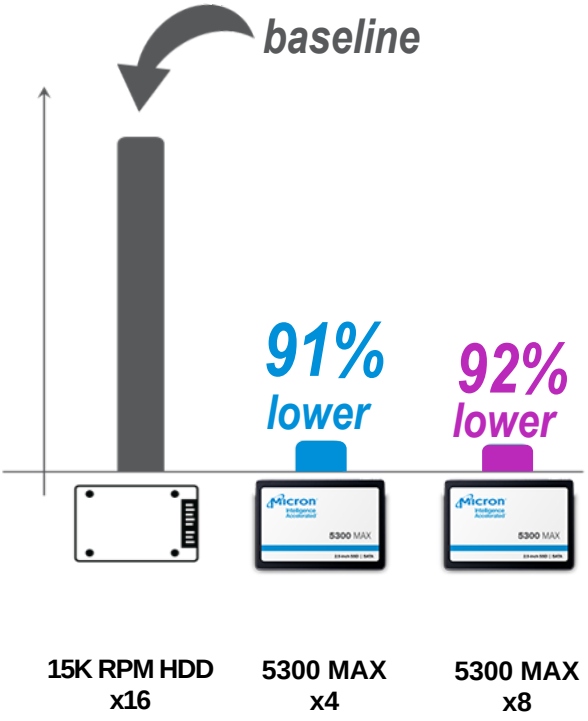


Figure 2b: 99.9% Transaction Time

Both SSD configurations showed significantly lower mean transaction times compared to the baseline configuration. Figure 2a shows that both the x4 5300 MAX and x8 5300 MAX configurations measured 96% lower than the baseline. Figure 2b shows that the 5300 MAX configurations' response times were more consistent than the baseline configuration's response time (lower 99.9% transaction response time). The two comparisons indicate that both 5300 MAX configurations respond more quickly and consistently than the baseline configuration.

Calculating Power Efficiency

We derive power efficiency by combining system power (in watts) measured at reported NOPM with each configuration's NOPM value (inverting watts per NOPM to get NOPM per watt). Figure 3 shows relative power efficiency for all three configurations (higher is better). Values in figure 3 are relative to the baseline configuration.

Figure 3: Power Efficiency

The Bottom Line

The 5300 MAX SSDs demonstrate tremendous benefits with Microsoft SQL Server and an OLTP workload. Both 5300 MAX configurations support far higher transaction rates while demonstrating lower, more consistent latency.

The Micron 5300 SSDs bring new capabilities to one of the most popular database management systems and one of the most challenging yet ubiquitous workloads.

Customers doing online banking or buying products from websites, or those with complex manufacturing and test infrastructures and other time-sensitive production-critical workloads, won't wait. Access delays or inconsistency can lose hard-won loyalty or diminish production—each of which can be extremely costly. Using 5300 MAX SSDs enables rapid transaction processing and fast, consistent response times.

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How We Tested

To ensure a fair assessment of each configuration's capabilities, including the maximum expected transaction rate, we used a configuration-specific approach. Each configuration's NOPM was measured at the maximum load the platform could reasonably support (as opposed to comparing these rates and latency at an arbitrary load).

Tested Server Configuration Details

Table 1 shows the hardware and software configuration details of our testing.

Component	Description
Server	2U, 2-socket (Intel-based)
CPUs	Intel® Xeon® Platinum 8168 24-core (x2)
SATA SSDs	Micron 5300 MAX 1.92TB (x4, x8)
Baseline HDDs	15K RPM, 2.5-inch
RAID Controller	PCIe, hardware
Storage Configuration	SSDs: RAID 10 Baseline: RAID 10
Operating System	Microsoft Windows Server® 2019 Datacenter (x64)
SQL Server	2017 Enterprise Edition (x64)

Table 1: Tested Configurations

Determining Maximum Load by Configuration (Stop Conditions)

This section shows the test condition(s) that established each configuration's maximum load.

Before testing, stop conditions were established. During testing, the load was increased until the test reached a stop condition, at which point we stopped increasing the load and used the NOPM and latency values recorded just prior to reaching the stop condition. Table 2 shows the stop conditions used with all configurations.

Conditions	Value at which we stopped increasing load
CPU utilization	80%
90th percentile transaction response time	5 seconds
Average storage log (partition) write latency	5 milliseconds
NOPM plateau	NOPM does not increase with increasing load

Table 2: Stop Conditions

Baseline Stop Configuration: Log Write Latency

Figure 4 shows increasing load versus log write latency (grey vertical bars) and the stop condition of 5ms maximum allowable log write latency for any load (orange dashed line). Where the point just before the baseline configuration exceeds the 5ms transaction log limit is the maximum load used for this configuration.

All baseline configuration data in this document was collected at this maximum load point.

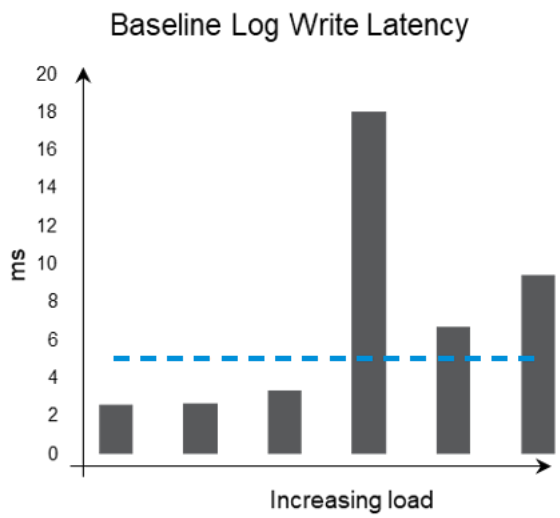

Figure 4: Baseline Stop Condition

x4 5300 MAX Stop Configuration: NOPM Plateau

Figure 5 shows increasing load versus NOPM for the x4 5300 MAX configuration. The load at which NOPM plateaued is marked with an orange pointer. Increasing load further decreased NOPM. All x4 5300 MAX configuration data in this document was collected at this load point.

x8 5300 MAX Stop Configuration: NOPM Plateau

Figure 6 shows increasing load versus NOPM for the x8 5300 MAX configuration. As with Figure 5, the load at which NOPM plateaued is marked with an orange pointer. Increasing load decreased NOPM. All x8 5300 MAX configuration data in this document was collected at this load point.

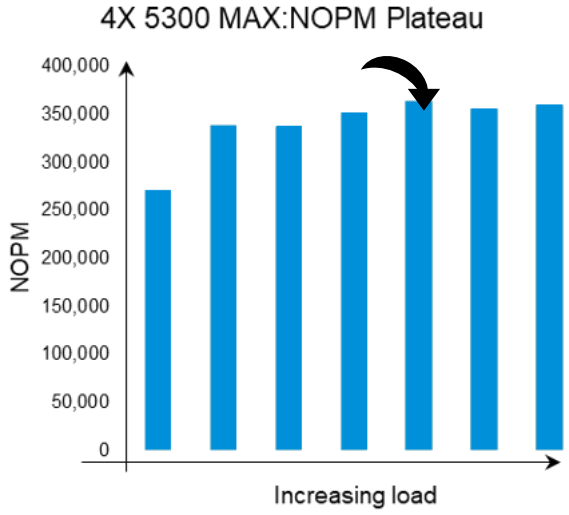

Figure 5: x4 5300 MAX Stop Condition

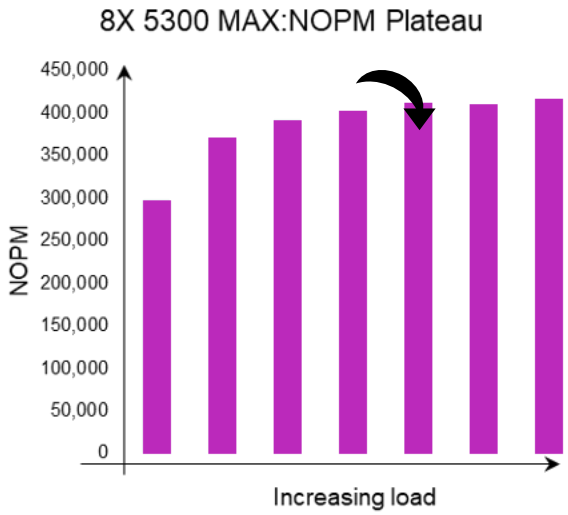

Figure 6: x8 5300 MAX Stop Condition

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