Quad-Level Cell Storage Technology Delivers Power-Efficient, Lightning-Fast Analytics

Analytics Thrive With Micron's 5210 ION SSD

Overview

Our quest to find and use locked-up data value along with the need for fast analytics and enhanced in-place data analytics drive new ways of thinking about storage. Some are evolutionary; some are revolutionary.

For years we used hard disk drives (HDDs) for our business intelligence (analytics) systems. When we wanted faster performance,[1] we used HDDs with more revolutions per minute (RPM) — an evolutionary approach.

When Micron introduced our 5210 ION — the industry's first quad-level cell (QLC) SSD[2] — we narrowed the affordability gap between performance HDDs and SSDs, enabling more workloads to benefit from SSDs — a revolutionary approach.

This technical brief highlights the business intelligence/ decision support systems (BI/DSS) platform capabilities of a Micron® 5210 ION-based platform compared to legacy platforms using 10K RPM 2.4TB hybrid HDDs.[3]

We found that compared to a legacy configuration, the 5210 ION delivers:

- 10 times faster complex query processing on average
- Greater power efficiency, consuming 89% less power
- 8.6 times higher storage throughput

Fast Facts

10x — 5210 ION query processing rate advantage

89% — energy efficiency improvement – systems and data centers run cooler

8.6x — 5210 ION storage throughput advantage

Four — bits per cell NAND – more applications and workloads move to SSDs more affordably

First — SSD manufacturer to bring QLC benefits to enterprise-class SSDs[2]

Figure 1: The Micron 5210 ION SSD

1. We use the term performance to indicate queries per hour (QPH), a common measurement of a BI platform's ability to deliver results (completed QPH). See the Configuration Details section for system-specific testing information.
2. http://investors.micron.com/releasedetail.cfm?releaseid=1068052
3. As of this document's publication, 2.4TB is the maximum 10K RPM hybrid HDD capacity broadly available from a major HDD vendor. See the Configuration Details section for system-specific testing information.

Complete Complex Queries 10 Times Faster

When comparing BI/DSS platforms, the primary metric of interest is time to complete a stream of queries (also known as stream run time). When stream run time is lower, the queries process faster. This, in turn, enables faster answers, the abilty to iteratively query (run additional queries in the same timeframe) or both.

Figures 2a and 2b show the single stream relative completion time for each configuration. Figure 1a shows the 5210 ION configuration's completion time. Figure 1b shows the legacy HDD configuration stream run time as a baseline. In these figures, lower elapsed time is better.

Figure 2a: Stream Run Time for a 5210 ION Configuration

Figure 2b: Stream Run Time for a Legacy Configuration

Figures 2a and 2b show that the 5210 ION drives provide a significant performance boost over the legacy configuration, completing the test stream ten times faster.

Realize 89% Better Energy Efficiency

The Micron 5210 ION drives these impressive results with far better energy efficiency. We calculated the energy efficiency — the amount of energy consumed to complete the test query set — of our 5210 ION and baseline legacy configurations. We used two servers that, aside from storage, were identically configured (hardware and software). We recorded the power each configuration consumed (watts) and the time each took to complete the query set.

Figures 3a and 3b below show the energy each configuration consumed to complete the test query set. Figure 3a shows energy consumed by the QLC configuration and Figure 3b shows energy consumed by the legacy configuration. Both figures show kilowatt hours (KWh) — lower is better. These figures show that the QLC configuration consumed about 89% less energy to process the same query set.
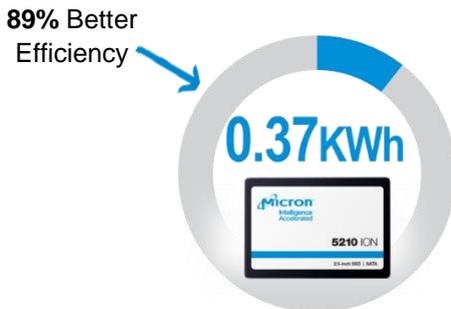

89% Better Efficiency

0.37KWh

Figure 3a: 5210 ION Configuration

3.27KWh

Figure 3b: Legacy Configuration

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Summary

We compared two BI/DSS platforms — one with the Micron 5210 ION SSD and the other with 10K RPM HDD — by measuring how long it took to complete a single stream of 22 queries and the resulting energy efficiency. The queries were executed with a degree of parallelism (DoP) of 96. We found that the 5210 ION configuration completed the query set 10 times faster while consuming 89% less energy.

Micron's 5210 ION QLC SSD offers both extreme performance and power efficiency. It packs four bits in every storage cell, storing 33% more data than prior-generation triple-level cell (TLC) technology. As a worldwide leader in flash technology, Micron is the first SSD manufacturer to bring QLC benefits to enterprise-class SSDs.

For mostly read workloads like BI/DSS, the 5210 ION helps you manage growing demand for more detailed analytics with increasing pressure for energy efficiency — and do these more affordably than ever before.

Learn more

- Micron 5210 ION SSD Site

- See what this new QLC SSD can do for you. Watch the video.

- Micron Technical Paper Comparing SSD and HDD Endurance

- Unleash the value in SQL databases with the 5210 Workload SQL Business Intelligence.

- Keep up to date with the latest in Micron news. Follow us on Twitter @MicronTech.

How We Tested

We used a series of 22 business-oriented, ad-hoc queries and concurrent data modifications to gauge platform capability. We tested each configuration with one stream and maximum DoP of 96.[5]

Configuration Details

Table 1 summarizes the hardware and software configurations. Note that the total database size exceeds available memory to ensure a storage-centric workload.

Item	Configuration Details	Item	Configuration Details
RAID	5210 ION: Parity Storage Spaces Legacy: RAID 5	CPU	Intel® Xeon® Platinum 8168 (x2)
Controller	Add in card	DRAM	384GB, DDR4
HDD Storage	10K RPM 2.4TB HDD (x8)	SQL	Microsoft SQL Server® 2017 Enterprise Core Edition (x64)
SSD Storage	Micron 5210 1.92TB SSD (x8)	OS	Windows Server® 2016 Datacenter Edition (x64)

Table 1: Hardware and Software Configuration

Storage Throughput Drives Results

To better understand the results, we measured each configuration's storage throughput. Figure 4 shows that the 5210 ION configuration demonstrated about 8.6x higher storage throughput in testing.
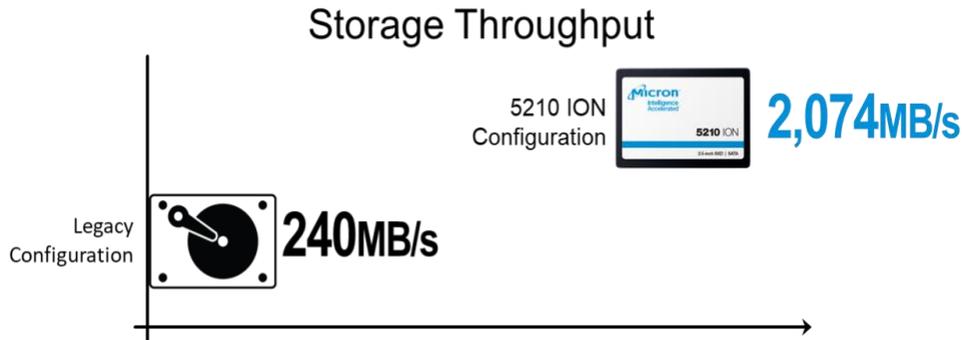

Figure 4: 5210 ION SSD vs. Legacy Storage Throughput

The legacy RAID 5 configuration attained just 240MB/s of total disk throughput while the 8x 5210 ION SSD configuration reached 2074MB/s (about 8.6x the HDD's throughput in the same single stream test). Storage throughput is a major contributing factor in read-centric application workloads.

4. For additional details on the TPC-H benchmark, see: http://www.tpc.org/tpc_documents_current_versions/pdf/tpc-h_v2.17.3.pdf.
5. Maximum degree of parallelism (Max DoP) is an adjustable parameter that tells the SQL Server Planner how many parallel operations it can use for a given query. Different deployments may use different values for Max DoP. Single stream used as HDDs did not support additional streams due to the completion time exceeding 12 hours.

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