Latest Generation Storage Technology Brings Value and Density

Quad-Level Cell Storage Reclaims High-Value Rack Space

Overview

Overcrowded data centers and swelling data lakes. A quest for fast analytics and the search for locked-up value. These demands have driven two opposing goals: decrease data center footprint while managing ever growing data sets.

10K RPM hard disk drives (HDDs) were a common compromise for performance-focused[1] mostly read workloads like business intelligence (BI). While their 10K RPM speed drove some results, their limited per drive capacity and high power needs resulted in data center sprawl and power inefficiency.

Solid state storage (flash) is now a mainstay of cloud-scale deployments and new flash technology, like quad-level cell (QLC), helps achieve both goals—reducing data center space while enabling real value from massive data.

Micron® QLC storage narrows the affordability gap between performance HDDs and flash. QLC stores four bits in each NAND cell (33% more bits per cell than the prior generation) helping drive a more approachable price point for solid state storage.

Envision a data center that is smaller, runs cooler, needing less human interaction for maintenance.

Micron is the first to make QLC benefits available in an enterprise-class SSD.[2]

This technical brief highlights the BI platform consolidation capabilities of QLC compared to legacy platforms using 10K RPM 2.4TB hybrid HDDs.

Fast Facts

- Micron is a leader in QLC NAND and is the first SSD manufacturer to bring QLC benefits to enterprise-class SSDs.[2]
- QLC packs 33% more bits in each NAND cell, enabling immense gains at the system, rack and data center levels.
- Four bits per cell NAND enables more applications and more workloads to transition to SSDs more easily, more affordably.

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 queries per hour). See Configuration Details for system-specific testing information.
2. All capacity and performance statements are based on a Micron 5210 ION 7.68TB SSD.

QLC Enables Platform Consolidation to Reclaim Rack Space

Combining QLC with standard servers (like a 1U, 10 bay or a 2U, 24-bay chassis) builds platforms with enough raw capacity to meet today's demands with room for tomorrow's growth.

Figure 1 shows two example configurations. If we fill a 1U, 10-bay chassis with QLC, the extra density enables us to store 76.8TB raw capacity per 1U platform. For 2.4TB 10K HDDs, a 24-bay chassis offers the highest raw capacity, 57.6TB.

QLC enables much higher density to reclaim rack space by half over the HDD configuration[3] while increasing per-platform capacity.

Figure 1: Maximum raw capacity (1U chassis with QLC, 2U chassis with legacy HDDs)

The capacity difference is large for a single system and becomes immense when viewed from a rack-level or data center row-level perspective. QLC also enables future growth to future-proof your investment.

Energy-Efficient Insights

QLC drives more than data center consolidation. It drives energy efficiency.

We calculated the energy efficiency—the amount of energy needed to complete a set of 22 queries—of our example QLC and HDD configurations using two servers that, aside from storage, had the exact same hardware and software configuration. We recorded the power each configuration consumed (watts) and the time each took to complete the query set. We used Max DoP = 96[5] for both configurations.

Figures 2a and 2b below show each configuration's energy consumed to complete the test query set. Note that Figure 2a shows energy consumed by the QLC configuration while Figure 2b shows energy cosumed by the legacy configuration. Both figures show kilowatt hours (KWh).

These figures show that the QLC configuration consumed about 10% less energy to process the same query set.

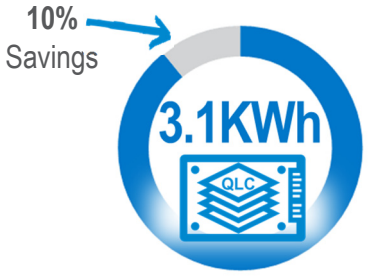

Figure 2a: QLC configuration

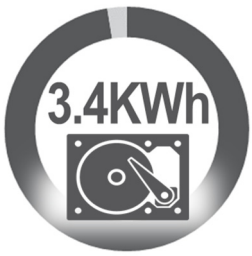

Figure 2b: Legacy configuration

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 Configuration Details for system-specific testing information.

Summary

Micron QLC storage packs four bits in every storage cell, storing 33% more than prior generation triple-level cell (TLC) technology. As a world wide leader in flash technology, Micron is the first SSD manufacturer to bring QLC benefits to enterprise-class SSDs.

Consolidate your platforms. Reduce data center footprint. Improve power efficiency. For mostly read workloads like BI, QLC helps you manage overcrowding effectively, efficiently and more affordably than ever before.

Learn more at micron.com.

How We Tested

We used the TPC-H benchmark tools for all query performance tests.[4] It uses 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 Max DoP = 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
RAID	5 (all configurations)
Controller	Dell H740P
HDD Storage	10K RPM 2.4 TB HDD (x8)
SSD Storage	Micron 5210 7.68TB SSD (x4)

Item	Configuration Details
CPU	Intel® Xeon® Platinum 8168 (x2)
DRAM	384GB, DDR4
SQL	Microsoft SQL Server® 2017 Enterprise Core Edition
OS	Windows Server® 2016 Datacenter Edition

Table 1: Hardware and Software Configuration

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.