Improve Power Efficiency for MongoDB

Low Power and High Performance Meet in the Micron 7100 MAX SSD

Rising Interest in Power-Efficient Performance

A growing awareness in reducing environmental footprints and operating costs is driving new interest in the power-efficient performance SSDs can bring to enterprise NoSQL databases like MongoDB.

Data center planners are now thinking about environmental impact as well as overall capability of future enterprise deployments, and it's resulting in new storage designs centered around power efficiency.

In this technical marketing brief, we compare the power efficiency of two MongoDB clusters:

- A legacy design 4-node cluster consisting of three 300GB 15,000 RPM HDDs per node (configured RAID 0).
- A 4-node cluster consisting of one Micron 7100 MAX 1.6TB NVMe SSD (U.2 form factor) per node.

Using Yahoo Cloud Serving Benchmark (YCSB), we measure MongoDB operations per second and recorded power consumption to analyze power efficiency (measured in operations/second per watt). Results show the 7100 MAX cluster enables far greater power efficiency and performance for each tested workload and thread count as compared to HDDs.

7100 MAX vs. HDD

MongoDB Power Efficiency[1]

YCSB Workload	Improvement
A	28X to 37X
B	26X to 43X
C	32X to 49X
D	19X to 44X
F	63X to 69X

1. 7100 MAX and MongoDB; improvement depends on loading—stated range is from measured low to high. Several common uses (workload and thread count) show 30X improvement. See text for details.

Micron's 7100 MAX is designed for MongoDB performance efficiency, consuming lower power vs. HDDs.

7100 MAX: Power-Efficient Performance

We calculated power efficiency for the HDD and 7100 clusters by measuring database operations per second (for thread counts from 48 to 500), then divided that value by the watts consumed by a cluster node, in five different YCSB workloads.

Workload A (Session Action Recording)

Workload A is an update-heavy workload, with 50% of the total I/Os writing data. At the application level, this workload is similar to recording recent session actions.

Figure 1 shows the Workload A power efficiency (database operations/second per watt) for the HDD and 7100 clusters, by thread count as well as the ratio of these values.

The HDD cluster efficiency ranges from approximately 5 to 5.5. The 7100 cluster ranges from approximately 150.6 to 198.5. The ratio of the two (7100 efficiency divided by HDD efficiency) ranges from about 28 to 37. This ratio expresses the additional power efficiency of the 7100 cluster.

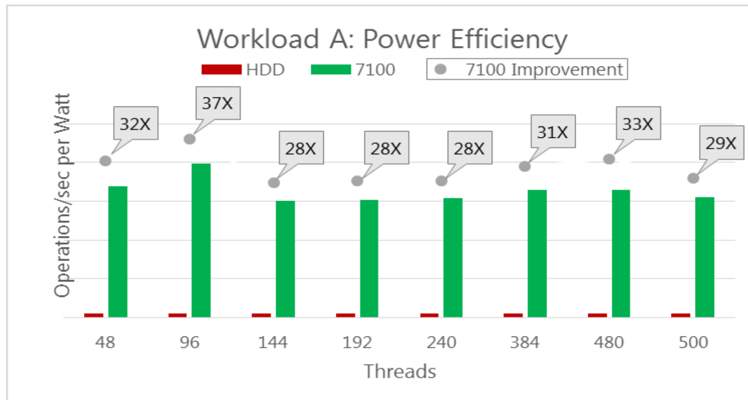

Figure 1: Workload A Power Efficiency

Workload B (Adding Metatags)

Workload B is an update-light, read-mostly workload, with 5% of the total I/Os writing data. At the application level, this workload is similar to adding metadata to existing content, such as tagging photographs or articles.

Figure 2 shows the Workload B power efficiency for the HDD and 7100 clusters by thread count as well as the ratio of these values.

The HDD cluster efficiency ranges from approximately 7 to 7.6. The 7100 cluster efficiency ranges from approximately 194.4 to 310.4. The ratio of the two ranges from about 26 to 43. This ratio expresses the additional power efficiency of the 7100 cluster.

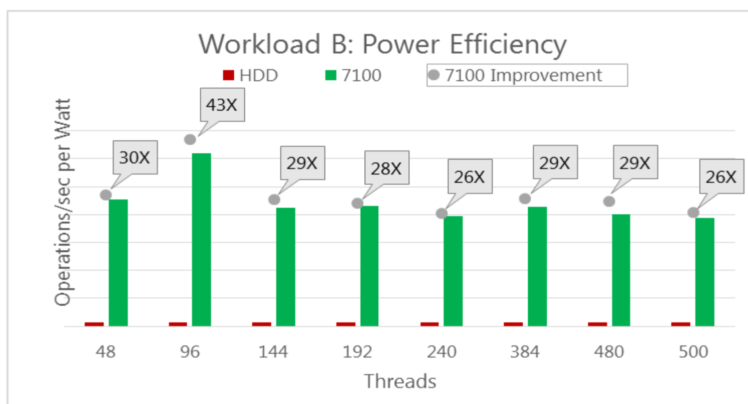

Figure 2: Workload B Power Efficiency

Workload C (Static Data Cache)

Workload C is a read-only workload (100% of the total I/Os read data; there is no write traffic). At the application level, this workload is very similar to reading user profiles or other static data where profiles are constructed elsewhere.

Figure 3 shows the Workload C power efficiency for the HDD and 7100 clusters by thread count as well as the ratio of these values.

The HDD cluster efficiency ranges from approximately 6.7 to 8.3. The 7100 cluster efficiency ranges from approximately 246.2 to 362.

The ratio of the two clusters ranges from about 32 to 49. This ratio expresses the additional power efficiency of the 7100 cluster.

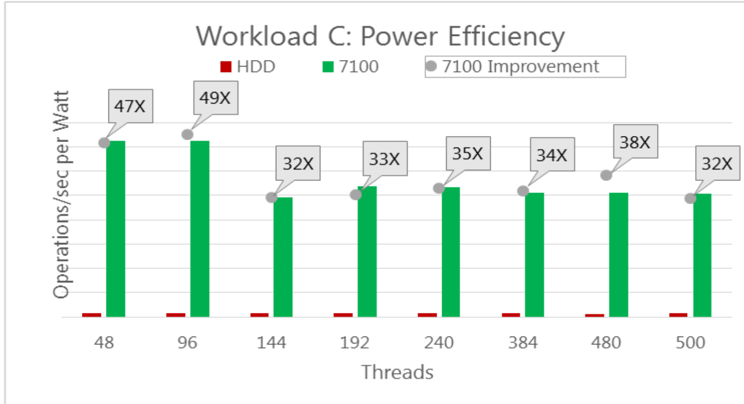

Figure 3: Workload C Power Efficiency

Workload D (Recent Statistics Tracking)

Workload D reads the latest entries (most recent records are the most popular).

At the application level, this workload is very similar to reading user status updates (where users want to read the most recent entries). Examples of this workload include social media, frequently changing product literature, or software development repositories.

Figure 4 shows the Workload D power efficiency for the HDD and 7100 clusters by thread count as well as the ratio of these values.

The HDD cluster efficiency ranges from approximately 9.8 to 12.4. The 7100 cluster efficiency ranges from approximately 241.3 to 530.3.

The ratio of the two ranges from about 19 to 44. This ratio expresses the additional power efficiency of the 7100 cluster.

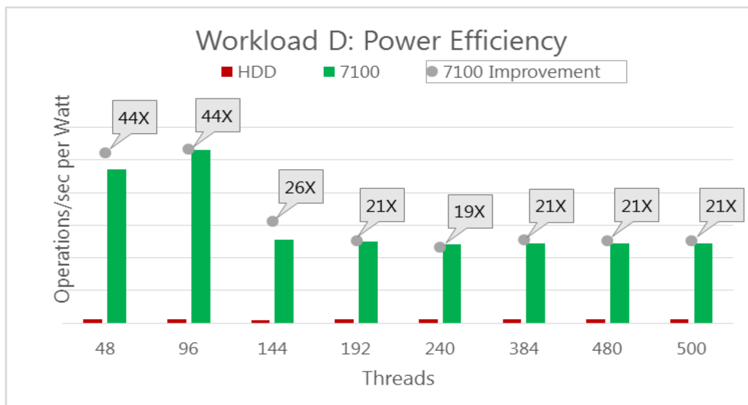

Figure 4: Workload D Power Efficiency

Workload F (User Record Changes)

Workload F is a read/modify/write workload in which records are read, changed and written back. At the application level, this workload is very similar to users reading and changing data or tracking user activity.

Figure 5 shows the Workload F power efficiency for the HDD and 7100 clusters by thread count as well as the ratio of these values.

The HDD cluster efficiency ranges from approximately 3.6 to 4.1. The 7100 cluster efficiency ranges from approximately 250.5 to 271.6.

The ratio of the two ranges from about 63 to 69. This ratio expresses the additional power efficiency of the 7100 cluster.

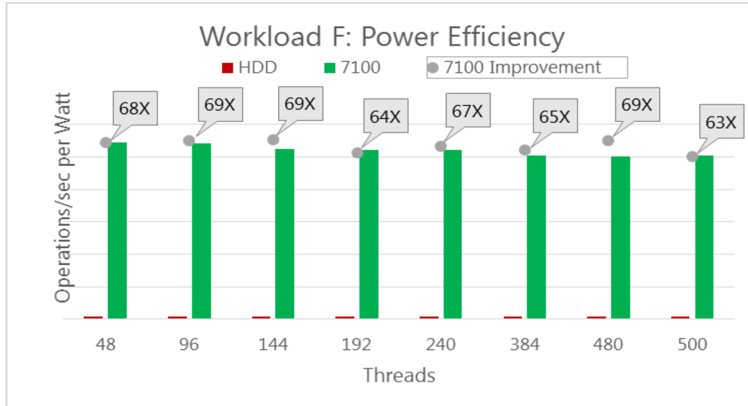

Figure 5: Workload F Power Efficiency

The Bottom Line

As we generate more and more content, we need to store and access that content quickly. Data center planners are finding themselves faced with the challenge of migrating from a "store all of it and enable better access to it" mentality to a "store all of it, enable better access to it, and enable power efficiency" mentality. Planners want to minimize environmental footprint without giving up fast access.

All of this drives deployment considerations. With emphasis on power-efficient performance, new storage designs are a natural and beneficial result. Micron's 7100 MAX NVMe SSD with MongoDB is a great example of speed and power efficiency.

When we compare the power efficiency of two 4-node MongoDB clusters – one a legacy design (with HDDs per node) and the other with a single Micron 7100 1.6TB NVMe SSD per node – the results are compelling with several workload/thread count combinations reaching or exceeding a 30X power-efficiency improvement with the 7100 MAX configuration.

Visit micron.com to learn more about the power-efficient performance of the 7100 MAX SSD.

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