Micron’s P420m SSD Supercharges MongoDB
More Than 3.5X Better Performance and 27X Lower Latency vs. Disk Arrays

Introduction
MongoDB is a document-based NoSQL database with a schemaless structure, making it popular in architectures where the type of data varies considerably from record to record.

Because MongoDB is a shared database (data records are spread across multiple nodes in a database cluster), overall performance is typically scaled by adding nodes to the cluster; however, adding nodes also increases complexity, management costs, and space requirements.

A better approach to improving MongoDB performance is to use Micron’s P420m PCIe solid state drive (SSD) as the primary storage device in each node. The P420m can increase node performance by 5X and reduce node latency by as much as 138X compared to legacy disk arrays.

Smaller, More Powerful Clusters
Making cluster nodes more powerful increases the capability of the entire cluster and reduces the overall footprint (fewer nodes). As clusters are scaled smaller, they become easier to manage and more cost-effective to maintain.

Gauging overall cluster-level performance as part of the design process can be challenging; measuring the performance of a single node configuration before the cluster is deployed enables better performance estimation and more accurate planning.

How Fast Is “Fast”?
Node performance sizing metrics must support a variety of workloads. These workloads must also align with how MongoDB is deployed.

Yahoo Cloud Serving Benchmark (YCSB) provides a measurement framework for evaluating document-oriented database performance. It is very effective in determining expected node performance for different configurations and in assisting with cluster design and planning.

YCSB’s built-in workloads span a broad range of common document-oriented database workloads, as shown in the table below:

<table>
<thead>
<tr>
<th>WORKLOAD</th>
<th>READ %</th>
<th>WRITE %</th>
<th>USAGE EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B: Read Mostly</td>
<td>95</td>
<td>5</td>
<td>Photo tagging</td>
</tr>
<tr>
<td>C: Read Only</td>
<td>100</td>
<td>0</td>
<td>User profile cache (profiles constructed elsewhere, e.g., Hadoop)</td>
</tr>
<tr>
<td>D: Read Latest Workload</td>
<td>95</td>
<td>5</td>
<td>User status updates (most activity is on the latest data)</td>
</tr>
<tr>
<td>F: Read-Modify-Write</td>
<td>5</td>
<td>95</td>
<td>User record changes</td>
</tr>
</tbody>
</table>

*Table 1: Common Document-Oriented Database Workloads in YCSB*
Measuring P420m Benefits

Baseline performance for legacy storage was measured using an array of 20 SAS 2.5-inch hard disk drives (HDDs) capable of 15,000 rotations per minute (RPM) configured in RAID 10 hardware in a single node. Baseline performance for the P420m SSD was measured using one P420m in a node with the same configuration.

Better Performance

For each tested workload, a single P420m SSD offered performance far superior to the HDD array—an increase of between 4X and 5X operations per second, as shown in Figure 1.

Lower Latency

While the number of operations per second is an excellent measure of the overall capabilities of a MongoDB node, measured latency translates into an equally important metric: application responsiveness.

A single P420m SSD offers between 27X and 138X lower average latency than the HDD array, as shown in Figure 2.

The improvement in maximum latency with a P420m was just as dramatic, with a reduction ranging from 4X to 14X, as shown in Figure 3.
The Bottom Line

MongoDB uses local storage (inside each node) for each node in the cluster. Accelerating that local storage translates into improvements in both node and cluster-level performance.

When comparing legacy (15,000 RPM HDDs) storage, a single P420m far surpasses a 20 HDD RAID 10 array in every measured metric.

While it’s possible to scale out an HDD-based node to reach the performance of the P420m SSD, it would take 80 to 100 HDDs to get there—and the HDD-based latency would still be 27X to 138X inferior.

Faster, lower-latency local storage results in better node performance, better cluster performance, a far more responsive application, and a much simpler cluster design. With its PCIe interface, Micron’s P420m SSD enables higher data transfer rates at far lower latency than legacy HDD storage.