Getting High Performance and Endurance With High Write IOPS SSDs

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Introduction

Most systems receive a noticeable boost in application performance when their hard disk drives (HDDs) are replaced with solid state drives (SSDs). The SSDs’ increased input/output per second (IOPS) rate enables applications that are constrained by storage access to process faster.

Typically, SSDs provide much higher IOPS when applications are reading data compared to when they are writing data because supporting high rates of write transactions can be more costly for vendors to implement. However, even applications that only require a small number of writes (15,000 writes per second or more) can receive significant performance benefits from SSDs designed to support high write IOPS versus SSDs that only support high read IOPS.

When Are High Write IOPS Needed?

Paying more for SSDs that have high write IOPS may not be required for applications that primarily read stored data, requiring less than 15,000 write IOPS. For example, applications that support a web site’s storage needs may only require data to be written infrequently (e.g., for web page updates a few times a week)—so support from a high read IOPS SSD may be sufficient.

On the other hand, applications like online transaction processing (OLTP) and virtual desktop infrastructure (VDI) require more frequent write updates to the storage media, so support for high write IOPS are a must so that users aren’t kept waiting.

Why High Write IOPS Don’t Come Cheap

SSDs use NAND Flash memory technology to store data in silicon devices. Writing data is a two-step process of first erasing blocks of data and then storing the new data in those blocks. The erase process causes Flash devices to wear down. For example, after up to 10,000 erases, multilevel cell (MLC) Flash begins to lose the capability to reliably retain data. Fortunately, SSD manufacturers can use these common techniques to mitigate wear:

> **Wear Leveling:** SSD vendors arrange data so that WRITE/ERASE cycles are distributed evenly across all Flash blocks, which slows down Flash wear while maintaining a more cost-effective price point. However, because the Flash blocks can contain data that needs to be retained, wear leveling requires this data to be rewritten in another area of the Flash device before the block is erased. This technique can take more time, making it difficult to support high write IOPS.
Over-Provisioning: SSD vendors install additional Flash capacity to slow down Flash device wear; this technique also enables the SSD to support higher write IOPS because erasing and writing data in one large area of the SSD (versus in several smaller blocks) is more efficient. The downside of the added capacity required for this technique is an increase in the price of the SSD.

The bottom line is that while SSDs without excess Flash capacity are generally cheaper, they may either wear out more quickly when supporting write-intensive applications, or they may not provide the high write IOPS required to satisfy user needs.

How High Are High Write IOPS?
The number of write transactions supported per second by an SSD is typically specified by manufacturers separately from read transactions. High write IOPS generally refer to rates above 90,000 transactions per second using a PCIe Flash card and above 25,000 transactions per seconds using a SATA or SAS drive.

Enterprise SSDs are designed to support this performance over the life of the product. Client SSDs—designed for consumer applications—may specify “up to performance” because their performance typically drops by some amount over the SSD lifetime.

Conclusion
When supporting applications that require 15,000 write IOPS or more, qualifying a high write IOPS SSD—and potentially paying more than an SSD designed to primarily support high read IOPS—can provide significant performance and endurance advantages for your system. Ultimately, this helps to reduce the number of servers and software licenses required over the life of the system, lowering your total cost of ownership—especially for applications like OLTP databases.

Learn more about Micron’s M500DC enterprise SSD that supports both high write IOPS and high endurance as discussed in this brief.

<table>
<thead>
<tr>
<th>CAPACITY</th>
<th>RANDOM READ IOPS</th>
<th>RANDOM WRITE IOPS</th>
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<tbody>
<tr>
<td>120GB</td>
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<td>23,000</td>
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<td>240GB</td>
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<tr>
<td>800GB</td>
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TABLE 1: Micron M500DC SATA Enterprise SSD Performance Specifications

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