Business Environment

Data-intensive businesses that thrive in today’s environment move quickly, and data centers must move with them. To that end, various technologies—such as 10 gigabit Ethernet and multicore servers—are chasing latency out of the data center. One of the easiest targets: the spinning platters of a server’s direct-attached storage. Fast solid state drives (SSDs) are quickly replacing hard disk drives (HDDs) to squeeze more performance, measured in I/O operations per second (IOPS), from servers.

While using SSDs over HDDs can significantly improve application performance, the potential gains are even more dramatic with SSDs that connect directly to the PCI Express (PCIe) bus. And now, with innovative technology from Dell, it’s possible to deploy hot-swappable PCIe SSDs that add capacity and performance. And it can be accomplished in less than one minute, without downtime, simply by adding drives to the front plane.

SSD Landscape

SSDs are available on various drive interfaces: SAS, SATA, fibre channel, iSCSI, and PCIe. Most of these interfaces require a host bus adapter (HBA), controlled by the operating system, to communicate with the computing architecture. All of these drive types offer remarkably better performance than HDDs, but their performance is subject to limits imposed by the OS driver stack. One drive type, the directly connected PCIe SSD, enables much faster performance because it isn’t subject to the OS driver stack and HBA.

As a result, PCIe SSDs are at least 23 times faster than SAS SSDs and exponentially faster than 15,000 rpm HDDs (see Figure 1). The Dell™ PowerEdge™ Express Flash PCIe SSD can deliver up to 1.8 GB/s sequential throughput on reads and 1.2 GB/s on writes. This raw speed can translate to noticeable performance gains in I/O-intensive workloads that require low latency, such as those running on cloud and data center servers, video-on-demand, and virtualization appliances, among others.

Figure 1: Performance Comparison of HDD, SAS SSD, and PCIe SSD
Dell internal tests: 15,000 rpm 300GB HDD vs. 149GB SAS SSD vs. Dell Express Flash 350GB PCIe SSD
While PCIe SSDs are much faster than other SSDs, speed alone is not reason enough to make the switch. Eye-popping IOPS won’t help if service-level agreements aren’t being met because servers have to be taken offline to replace drives or increase capacity.

In these cases, reliability, availability, and serviceability (RAS) should figure prominently. That means choosing SSDs that are hot swappable and easily accessible to avoid having to shut down a server and open the chassis to add capacity or replace a failing drive. Dell, with their PowerEdge PCIe SSDs, is among the first to market with these types of hot-swappable drives.

### Phenomenal Performance Provides Savings

Dell PowerEdge Flash Express drives lead the industry in head-to-head speed tests, clocking in at 415,000 random read IOPS.1 With existing PowerEdge servers, performance and throughput can quickly and easily be increased by replacing spindles with much faster PCIe SSDs.

But it’s not just about speed. Suppose that a Microsoft® SQL Server online transaction processing (OLTP) database serves 200 simultaneous users. To achieve sufficient IOPS to serve that many users without performance degradation, data could be spread across 16 HDDs. A benchmark test measured such a scenario using 16 (RAID 10) SAS 15,000 rpm HDDs. With all 200 users accessing the database, the HDDs delivered an average of 10,583 IOPS with an average response time of 223µs.2 Under the same workload, a single Dell Express Flash PCIe SSD delivered more than 107,000 IOPS with an average response time of 26µs—a tenfold improvement over the 16 HDDs.

### Dramatically Less Energy Use Lowers Costs

In addition to breakthrough performance, PCIe SSDs cost less to run than HDDs and other types of SSDs. Overall, they save money despite the comparatively high initial acquisition cost.

While application performance—not storage capacity—is the primary reason for an upgrade, many still mistakenly use cost per gigabyte as the primary metric to justify an upgrade. That is why the initial investment can be misleading—because cost per gigabyte doesn’t factor in performance advantages. Instead, the metric to consider should be cost per IOPS. This metric shows the value that SSDs deliver when they’re doing what they were installed to do: store and quickly deliver data to applications. Figure 2 shows that PowerEdge Flash Express PCIe SSDs cost a mere two cents per IOPS, which is at least 50 times less than the cost per IOPS for a 15,000 rpm HDD.

Energy consumption is another important consideration. PowerEdge Flash Express drives draw a maximum energy load of 25 watts at peak operation, compared to 11 watts for a 15,000 rpm HDD.3 However, one PCIe SSD can replace many HDDs. For example, consider again the OLTP server that uses 16 HDDs and draws 176 watts at peak operation versus a PCIe SSD that can perform the same work or more for 25 watts. That’s a sevenfold reduction in energy use.
Furthermore, PowerEdge Flash Express drives can be managed more efficiently than many other types of drives through onboard device monitoring. This technology monitors the drive and the underlying NAND Flash medium for signs of wear and proactively retires blocks to help maintain data integrity. Additionally, Dell warranties its drives to a specified maximum amount of data written to the device in total bytes.\(^4\) Dell management software sends a notification when these limits are reached so that data can be moved before any loss occurs. With greater insight into the device life cycle, drive replacement can be scheduled in advance to avoid costly surprises.

Dell PowerEdge Express Flash PCIe SSDs: More than Speed

It makes good business sense to upgrade Dell PowerEdge servers with Express Flash PCIe SSDs. Because of the drive’s incredible performance, hundreds of HDDs can be replaced with one or a few Express Flash PCIe drives, which will provide a huge reductions in the cost per IOPS. The upgrade drastically cuts energy use under load and more efficiently manages drives through integrated device-life monitoring capabilities. These benefits add up to big savings that can more than offset the comparatively high acquisition cost of PCIe SSDs.

Why settle for speed alone when Dell PowerEdge Express Flash PCIe SSDs can deliver reliability, accessibility, and serviceability—all while reducing costs?

Footnotes

1 See Enterprise 2.5-inch PCIe SSDs Product Summary at: http://www.micron.com/~/media/News Releases/Products/Product%20Flyer/p320h_2.5_ssd_product_brief_lo.pdf


4 The maximum amounts are 12.5PB (pedabytes) on a 175GB Flash Express drive and 25PB on a 350GB drive.