

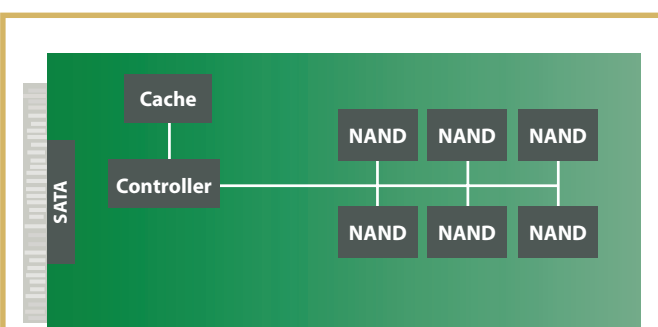
WHITE PAPER

BENEFITS OF SOLID STATE DRIVES IN DELL PRECISION WORKSTATIONS

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Solid state drives (SSDs) have made substantial inroads into client workstations, and Dell has been one of the market leaders in their adoption. As the technology has become more established, it has reached an inflection point. Its inherent reliability and performance advantages are now coupled with increasing capacities and falling costs. As a result, SSDs offer compelling advantages when compared to traditional hard-disk drive (HDD) technologies. Falling costs and continuing advances in flash memory are largely attributable to the adoption of more cost-effective multi-level cell (MLC) technology in SSDs.

SSD designs balance the technology's inherent reliability, quiet operation, form factor, energy efficiency and performance strengths with its cost and endurance characteristics. Though SSD technology is maturing rapidly, its implementation still requires careful attention to design quality. When implemented well, as in Dell Precision™ workstations, SSDs meet the needs of a growing range of customers.



The main elements of an SSD are the flash controller, internal cache, and the NAND flash components. Each flash component contains many NAND flash cells for storing data. Today, most SSDs use the Serial ATA (SATA) storage interface, though the PCI Express interface is also used for high-end data center applications.

Figure 1. Main SSD Elements

What is an SSD?

An SSD is a PC storage device that uses solid state memory to store information, instead of the magnetic heads and rotating media found in a traditional HDD. In most cases, an SSD uses nonvolatile NAND flash memory, which enables it to retain data when the power is removed.

The main elements of an SSD are the flash memory, controller and internal cache memory, as shown in Figure 1.

Flash controller: Handles overall management of the device, including error correction, interface with flash components and servicing host requests

Internal cache: Improves performance with fast-access volatile data storage for read-write buffers and device-specific management data

Flash memory: Provides non-volatile data storage

Reliable and rugged

One of the SSD's greatest strengths is its inherent reliability and ruggedness compared to HDDs. Because an SSD is an electronics-only device with no moving parts, there is no risk of the "head crashes" possible with HDDs or sensitivity to vibration while the HDD head is reading or writing data. The SSD also has wider tolerances to environmental factors such as shock and vibration, temperature and altitude (or air pressure), which makes them more durable overall.

In fact, industry data reveals that most SSDs have over 8x the shock tolerance of a standard notebook HDD1, making them particularly suited to mobile workstations such as the Dell Precision M6500 and M4500.

Low power consumption, silent operation

With no moving parts, SSDs operate silently and typically consume less power and generate less heat than mechanical HDDs. Unlike SSDs, the standard HDD motor can contribute significantly to its power usage in both active and idle modes. In contrast, SSDs consume little power when idle, usually drawing power only during actual read and write operations. This contributes to an SSD's overall lower power consumption.

Flexible form factors

With just solid state electronics and no motors or disks, an SSD can be made physically smaller than its HDD counterpart, enabling more flexible form factors. These range from traditional lightweight form factors shared by some HDDs to innovative new designs, such as SSD mini-cards that enable three-drive configurations in Dell Precision mobile workstations.

High performance

Typically, SSDs have higher sequential and random read performance than HDDs, particularly random reads. SSDs aggregate the bandwidth of multiple flash memory components and, in this way, achieve higher data rates than are possible reading from a single flash memory component. A central controller is attached to banks of flash memory through several channels, or communication paths. Reading and writing in parallel over these channels enables high SSD data rates.

While traditional HDDs can achieve reasonably high sequential data rates, random read performance is greatly hindered by the requirement for a mechanical actuator to move or “seek” between tracks of stored information. These seek times are significant, greatly limiting random performance. An SSD has no such limitation, so its random read rates are significantly higher than an HDD. More channels allow for even higher performance.

The SSD’s superior read and random-read performance is also an advantage with applications and tasks that call for intense storage activity. Going forward, SSD performance should continue to improve on storage tasks requiring high read or write performance.

Optimizing SSD design

When designing a new system with SSD technology, Dell takes into account the technology’s strengths and weaknesses, implementation challenges and how the SSD

will be used in a particular workstation. Dell works with partners early in the product design stage to ensure that the SSD technology offered in Dell Precision workstations is reliable and tailored to the customer need being addressed. Dell also evaluates technology partners’ development, testing and manufacturing processes to ensure they meet Dell’s requirements.

Moving into the mainstream

SSD cost per gigabyte continues to fall, and the price gap continues to narrow between SSDs and traditional HDDs. When coupled with SSD performance, reliability, power efficiency and other advantages, SSDs are appealing to a broader range of workstation customers than ever before (see Table 1). Although most SSDs still cost more than traditional HDDs, their use is no longer limited to niche scenarios or very high-end products.

Going forward, SSDs are expected to make further inroads into mainstream PC usage environments as the technology advances and costs continue to fall. Though unlikely to completely displace HDDs anytime soon, if ever, a tipping point will arrive when a typical workstation user’s needs can be met by an SSD more cost-effectively than a comparable HDD. If the industry continues as expected, this tipping point is possible in the next five years.

¹ Based on an operating shock tolerance of 1500G for 0.5 ms for Ultra Performance SSD vs.175G for 0.5ms for standard Dell 2.5” HDD, per Dell HDD specifications.

Usage Scenario	Environment	SSD Advantages over HDD
User is highly mobile	<ul style="list-style-type: none"> System often moved and subject to bumps/drops Subject to wide range of temperatures such as system being left in car for extended period Small size, low weight, and battery life are important 	<ul style="list-style-type: none"> Can better withstand damage if dropped or handles roughly Lower power usage Lighter weight Can withstand wider range of temperatures
User works at desk in congest office with space constraints	<ul style="list-style-type: none"> Noise/heat from multiple PCs in small space Small size is important Power efficiency is important, particularly for companies running desktop PCs 24x7 	<ul style="list-style-type: none"> Silent drive operation Lower power usage and heat emissions Smaller form factor can contribute to smaller system size
User works in harsh computing environment	<ul style="list-style-type: none"> Wide range of temperatures, altitudes, vibration, or moisture High level of dust/particles 	<ul style="list-style-type: none"> Can withstand wider range of temperatures, altitudes, vibration, or moisture

Table 1: SSD Advantages in Workstation Usage Scenarios

