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Intel SSDs Are Ready for Prime Time

Stop spinning and let your workstation live up to its potential.

By Robert Green, *Cadalyst* Contributing Expert

Since the personal computer came on the scene about 30 years ago, we've seen radical improvements in processor technology, graphics formats, and memory architectures, but one thing has remained constant: We still save our work on mechanical hard drives. Of course, the hard drives we use today are smaller, lighter, and hold a lot more data than their primitive counterparts. They now cache their data and this speeds up performance, but they are still mechanical devices that must spin and therefore are slow, prone to failure, and not very tolerant of abuse.

Enter the modern Intel Solid-State Drive (SSD) that is, in essence, a drive that is completely made of memory chips. In the past few years, SSDs have become more visible but hardly common-place. This is in the process of changing.

Hard Drives — A Performance Gate

See figure 1, from Intel for a historical look to compare hard disks and their mechanical data access performance. With multi-core CPU performances increasing 175 times in the 13 years spanned by the study, hard disk mechanical data access performance only went up 1.3 times. Compared to 1996 numbers, Intel SSDs have the potential to offer up to 190 times better performance than hard drives when accessing data.

Not shown is the fact that hard disk drives cache data, and this moves the data into an electronic transfer state, substantially increasing speed, so long as the data being processed isn't larger than the drive's cache. In this state, they are much more comparable to an SSD drive. However, when processing huge files that overflow a hard drive's cache, you can save time by using SSDs where the mechanical access time is completely eliminated.

Screen image courtesy of Autodesk

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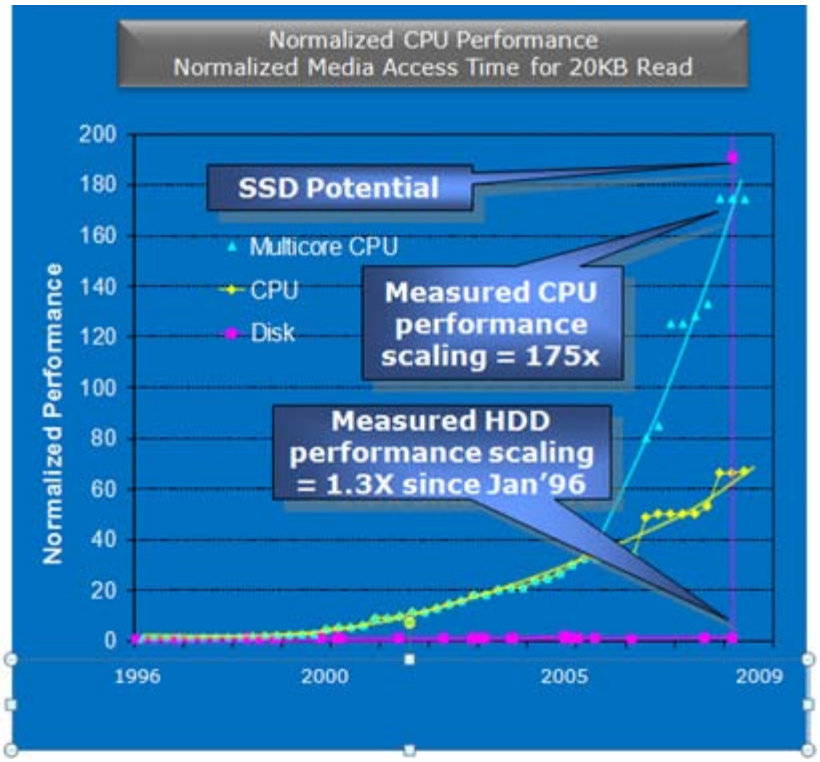

Figure 1. Compared to potential SSD performance, new multi-core CPU's hard drives are much slower.

For workstation users, more cores, faster graphics cards, and more system RAM provide great performance increases. But to really get the most from your system resources, a faster hard drive is required. That's where Intel SSD devices come into play.

Hard Disk vs SSD — Now Is the Time To Change

Intel has been making SSDs for some time, progressing through three generations of technology (figure 2) to arrive at its new Intel® SSD 520 Series devices. The 520 Series boasts higher densities, faster transfer rates, longer life spans, and lower cost of ownership than prior models — all making them worthy of examination for anyone running data heavy applications such as CAD, analysis, or rendering.

Figure 2. The Intel SSD 520 Series improves write speeds, capacities, and warranty lifetime by a factor of two over prior generation devices. (IOPS means inputs/outputs per second — the higher the number, the faster the SSD device.)

With sizes of up to 480 GB, the Intel SSD 520 Series are large enough to function as the primary drive in many desktop and mobile workstation devices, and their speed far

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exceeds the hard drive devices. As a result, Intel SSDs are now optional on all HP Workstations.

Expert Interview

To get a more technical perspective on SSD technology and how they are being put to use, I had a conversation with Kevin Crow, Non-Volatile Memory Solutions Group Channel Marketing Specialist at Intel Corporation. Intel has recently launched its new line of SSDs, so this was a perfect chance to get the latest information. Here's what we talked about:

Basic Parameters and Cost

Robert Green (RG, hereafter): Can we start the discussion by agreeing that SSDs can be thought of as a much faster hard drive with no unusual care requirements? Other than being faster than a hard drive, the user doesn't really see a difference, right?

Kevin Crow (KC, hereafter): Right — that's a good way to put it.

Figure 3. Externally, SSDs look like a hard drive, but inside they are all electronic with no moving parts.

RG: There's a perception that SSDs are very expensive. Can you give us some basic pricing information to understand how the pricing compares?

KC: Great question. Mainstream SSDs are, in fact, more expensive per gigabyte of storage. But, you must look past hard costs and explore the benefits an SSD has to offer. Remember that "utilized capacity" is usually much less on a high performance hard disk, as they need to remain fairly empty to achieve full performance. So over time as you fill up your disk drive, the performance of your drive suffers.

Speed and Disk Interfaces

RG: In much of your data, I see you referencing SATA 3.0 disk controllers instead of the SATA 2.0 controllers that most computers in the market have installed. Why is it so critical to use SSDs with SATA 3.0 drive controllers?

KC: Because it's about twice as fast! The SATA 3.0 standard, with throughput capable of 6 Gbit/second, offers 2 times more throughput than the 2.0 standard, with throughput capable of 3 Gbit/second. Hard disk drives are not capable of fully keeping up with the SATA 2.0 interface let alone the higher SATA 3.0 rates. Conversely, the high data transfer rates of SSD devices can actually come close to saturating SATA 3.0 interfaces. In one case, the hard drive is limiting the workstation, but in the SSD case, the computer has trouble keeping up with the SSD. That's a huge performance differential. If you invest in SSDs, I would look for workstations that support the SATA 3.0 standard, such as the new HP Z420, HP Z620 and HP Z820 Workstations.

RG: If I do have an old machine with SATA 2.0 drive controllers, can I still benefit from SSDs?

KC: Absolutely, because the SSD transfers much more data than a hard drive does on a SATA 2.0 interface. But when upgrading to an Intel® Xeon® processor-based HP Z

Workstation with SATA 3.0, a user will see even greater CPU utilization on a more powerful CPU than they would just upgrading an old machine.

RG: What does it mean that they'll see higher CPU utilization?

KC: In computer systems with hard drives, the CPU is often waiting on the hard drive — especially in data intensive applications such as CAD and CAE — and especially at start up when the hard disk drive has not yet cached any data, so you're paying for a CPU that isn't fully working for you. By installing an SSD, the CPU doesn't have to wait as long, so it spends more time working and less time waiting. If you add in more cores and a SATA 3.0 interface the workstation user can see much more effective performance.

RG: So, in a weird sort of way, an SSD can almost be thought of like a CPU booster?

KC: Almost right. An SSD plays a key role in the plumbing (or I/O infrastructure) of a workstation. It accelerates the pace that the data is made available to the CPU and that means the overall efficiency of the workstation is positively affected. Anytime your data and application cannot be stored entirely in the main memory, SSDs will help performance.

RG: So, if I have an existing computer, how hard would it be to upgrade it with an SSD?

KC: Plugging in an SSD into your current Intel® Xeon® processor-based HP Z Workstation is really simple. Go to www.intel.com/go/ssdinstallation and follow the instructions there. Intel provides cloning software and the copying process can be achieved easily with a USB to SATA cable. Remember many older Intel® Xeon® processor-based workstations will only have SATA 2.0. Today's new HP Z Workstations bring SATA 3.0 to all dual-socket workstations. That means you may be able to double the I/O performance from an SSD to the CPU. That is something to think about. In addition to I/O performance throughput rates will greatly increase with an SSD. SATA 2.0 SSDs can see sequential throughput up to 270 MB per second while SATA 3.0 SSDs can see throughput more than twice that. Both are significantly greater than what is seen off of an HDD.

RG: To get maximum performance from an SSD, would I want to install my operating system and applications programs on it or just my application data?

KC: Use your SSD for your operating system, applications, and storage for data that is accessed frequently. Having your executables on your SSD greatly accelerates launch performance and has a positive impact on use performance. If you keep your working files on your SSD, it helps ensure that your current projects execute as fast as possible.

RG: I've heard that SSDs go a long way towards eliminating digital "skipping" in rendering and computer audio. Why is that?

KC: SSDs have a lower "latency" than HDDs, meaning that SSDs can respond faster, which is critical in rendering and audio applications. Imagine if you just spent hours rendering a photo-realistic ray-traced image of a new product and now you want to replay it as an animation. That is a lot of data and an SSD may offer you tremendous speed increases for this type of work.

RG: Our readers are focused on CAD. Do you have any data for CAD applications benefiting from SSDs?

KC: Most, if not all, CAD and CAE applications benefit from SSDs. Test data varies by application.

Reliability and Power Metrics

RG: I've seen specifications that SSDs can withstand mechanical shock up to a thousand G's. Is that a misprint?

KC: Not at all! Because Intel SSDs use chips and not spinning disks, they are much more tolerant to shock, vibration, and overall movement. Now on the topic of reliability, Intel SSDs are some of the most reliable in the industry by a significant amount.

RG: So if I wanted to ruggedize mobile workstations, could SSDs help me achieve that goal?

KC: Absolutely! Not only would SSDs be more tolerant to shock and vibration, they complete reads and writes quicker.

RG: For mobile workstations, would SSDs have a positive or negative impact on battery as compared to a hard drive?

KC: Like anything, battery life depends on the specific hard drive, monitor settings, etc., as well as tasks being compared. SSDs help in that they do not require as much power as the hard drives that typically go into workstations.

Return on Investment

RG: How can a CAD manager or power user really quantify the benefits of SSDs to their IT department or boss so they have a chance at getting their purchases approved? After all, nobody's boss is going to buy them an SSD just because it sounds cool, right?

KC: Right. To help understand the value of Intel Solid-State Drive we created a simple Total Cost of Ownership (TCO) Tool that quickly captures what users do in a typical day such as opening/closing large files, applications, web browsers, user productivity tools, and more. Based on the answers to these questions, we can predict with reasonable accuracy how long it will take a user to recapture the cost of the SSD. It is a great tool that helps you look at cost in terms of opportunity cost — imagine if you are significantly more productive in a day because you use technology that dramatically reduces the time it takes to access and store data.

Wrapping Up

I hope you've found this look at solid state drives (SSDs) thought provoking. I have to admit that as I spoke with Kevin I came to understand a lot more about the productivity potential that is lying untapped in my desktop and mobile workstations. So, if you're replacing workstations this year, or just looking to upgrade existing ones, it really would pay to do your homework with the Intel resources provided in this newsletter and perform a fast ROI study to see if SSDs will be worth it for your company.

2012 may be the year that SSD technology goes mainstream.

Authors note: I'd like to personally thank Kevin Crow from Intel for making himself available for our interview.

About the Author

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Robert provides CAD implementation, consulting, and programming services for a variety of companies throughout the United States and Canada. He holds a degree in mechanical engineering from the Georgia Institute of Technology and is the author of *Expert CAD Management: The Complete Guide*. Reach him via his web site at www.cad-manager.com.
