



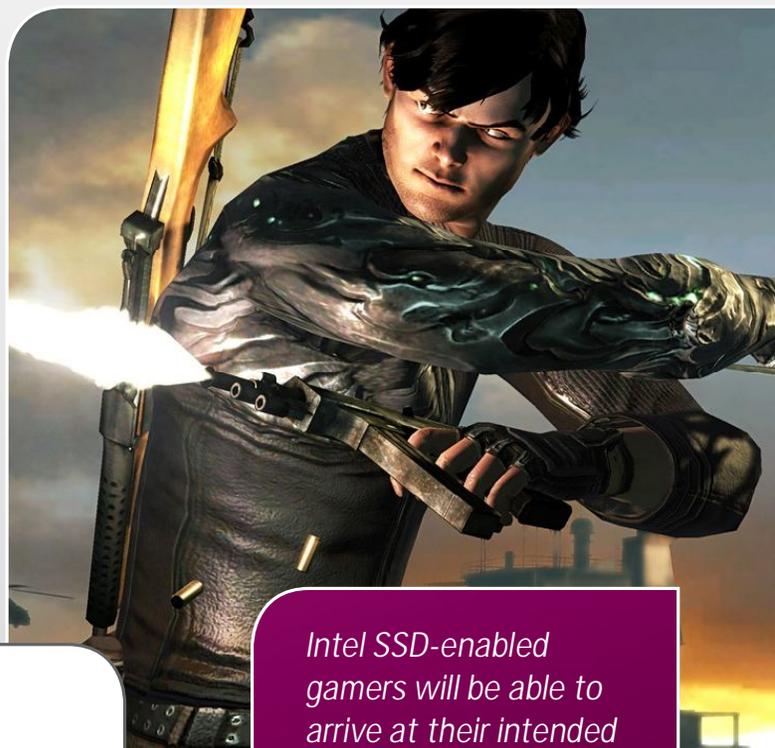
DELIVERING HITCH-FREE, IMMERSIVE GAMEPLAY AND INCREASED DEVELOPER PRODUCTIVITY

DEVELOPING WITH INTEL® SOLID-STATE DRIVES AND 2ND GENERATION INTEL® CORE™ FAMILY PROCESSORS

Intel® Solid-State Drives (Intel® SSDs) are revolutionizing storage performance on desktop and laptop PCs, delivering dramatically faster load times than hard disk drives (HDDs). When Intel SSDs are used as boot drives, OSs initialize faster, applications (including games and compilers) launch quickly, and projects typically load in seconds rather than minutes. For gamers, this leap in storage performance also delivers a visibly better gaming experience. For game developers, Intel SSDs accelerate iterations, improving operational efficiency and increasing ROI. Developers can also dramatically increase streaming requirements and utilize higher resolution assets more frequently, resulting in more immersive gameplay.

Blazing Launch Speeds and More Immersive Gameplay

Tests completed in Intel's labs (see Figure 1 on page 2) show that Intel SSDs improve load times by up to 78 percent compared to a Western Digital VelociRaptor* 10,000 RPM HDD. The chart shows



Intel SSD-enabled gamers will be able to arrive at their intended destination, pick up new weapons, and be ready for action while their less fortunate rivals . . . will lose valuable seconds waiting for the game engine to recover from a hitch.

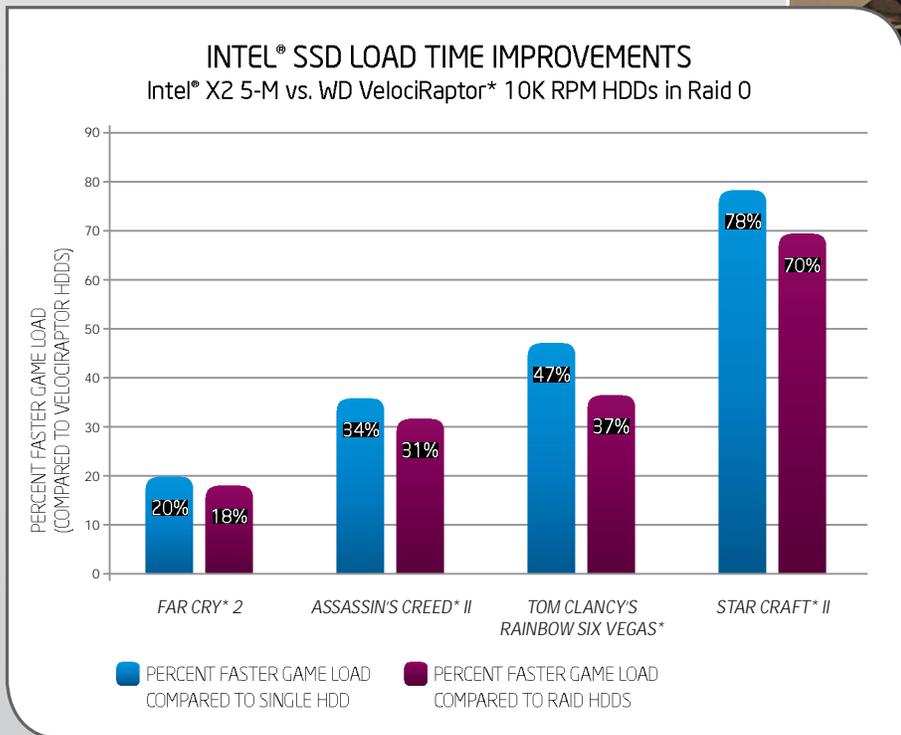
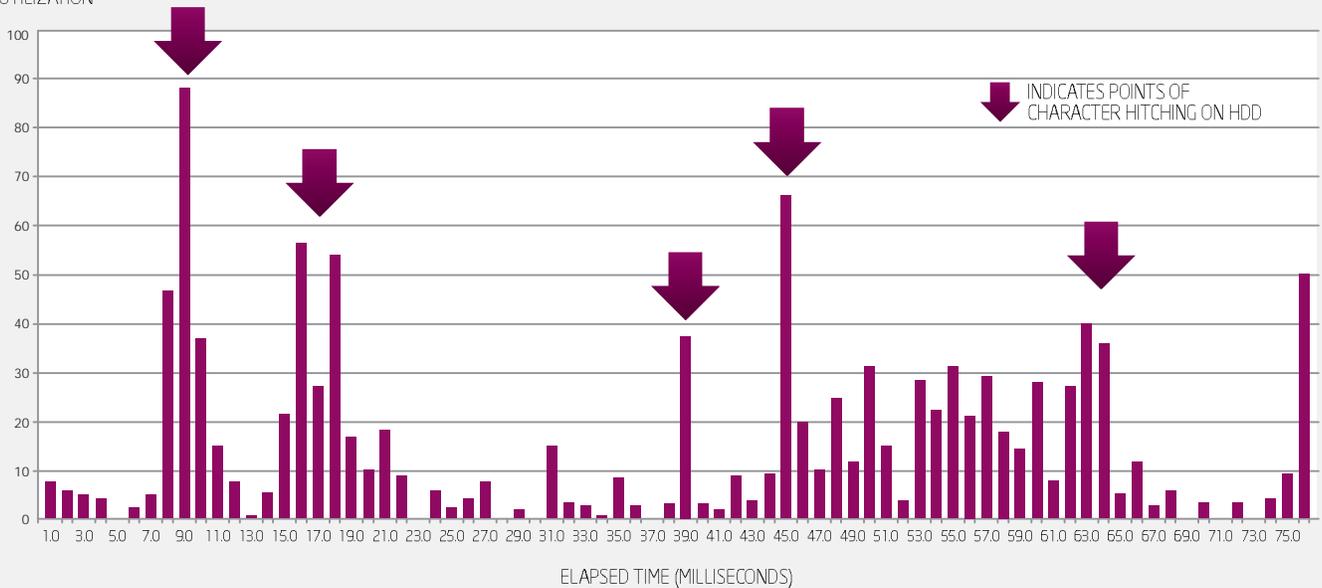


Figure 1. Intel® SSDs significantly reduce game load time compared with Western Digital VelociRaptor* HDDs.

PERCENT DISK UTILIZATION

DEMIGOD DISK UTILIZATION HDD



PERCENT DISK UTILIZATION

DEMIGOD DISK UTILIZATION SSD

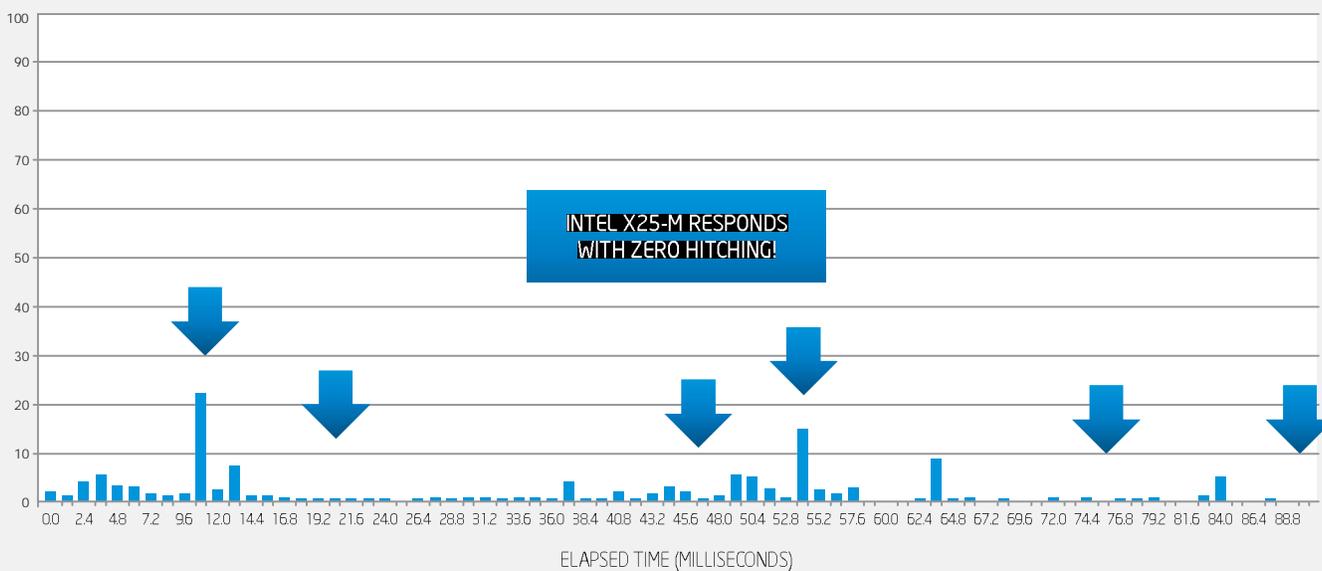


Figure 2. HDDs (top, in purple) produce hitching when assets are demanded quickly, whereas Intel® Solid-State Drives (Intel® SSDs) (bottom) respond to the same demands with zero hitching. The tests measured pixel changes during gameplay of Stardock's *Demigod*®.

that a single Intel SSD also significantly outperforms two VelociRaptor drives in RAID 0. Independent tests by AnandTech also show that Intel SSDs also speed up the game installation process. For example, installing Blizzard's *World of Warcraft*® and Microsoft Windows *Defender*® on an Intel® X25-M SSD is over twice as fast as a HDD. Faster storage has another visible benefit during game run time.

During lab tests, Intel realized that Intel SSDs improve frame to frame coherency during game play (best seen in this demo video: www.intelssdgaming.com). Frame rate does not fully characterize this effect—it is necessary but insufficient to fully

characterize stalls and pop-ups during game play. Serious gamers play games at their maximum settings driving HD monitors. Whenever they experience low visual fidelity, they may blame the graphics processor, when in fact, the effects could be caused by storage I/O bottlenecks.

Games typically load content in the background as the player traverses a level or progresses through a scene (makes progress through space or time). When that happens, the game has to request data from the storage media. The longer this takes and the more the OS has to intervene, the greater likelihood the user will notice and they will lose their sense

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DELIVERING MORE IMMERSIVE GAME EXPERIENCES

When Intel® SSDs are paired with 2nd generation Intel® Core™ processors, amazing things become possible. The 2nd generation Intel Core processors offer deep parallelism and a massive increase in IO compared to previous-generation processors. By optimizing games to exploit all the performance of 2nd generation Intel Core processor microarchitectures and change to Intel® 510 Series SSDs, game developers can create games featuring innovations that give players a wider field of view, higher definition assets, and more.

As Tim Sweeney of Epic Games explained, “I think the big opportunity with Flash is to eliminate all of the complexity of content streaming and scheduling from an engine, and go back to just-in-time demand-loading of data. With an Intel SSD, I figure we could add like 20-40 textures per-frame in real time during game play without any need for scheduling. From our point of view, there would be a breakthrough if we can load resources ‘just in time’ immediately before we access them with minimal impact on performance. Then we could build fundamentally more detailed and interesting games.”

With Sweeney’s idea in mind, Intel partnered with Iron Galaxy and Digital Extremes to deliver the first demo of its kind showing the resolution and scale of content made possible by exploiting the full headroom of the 2nd generation Intel Core processor combined with the Intel® SSD 510 Series (see Figures 2 and 3). Players can transport to richly detailed, diverse worlds on demand. See a live demo at the 2011 Game Developer’s Conference in San Francisco in the Intel theater or for a technical deep dive, attend our session: *Delivering Demand-Based Worlds with Intel SSDs* <http://schedule.gdconf.com/session/12419>. ■

Figures 3 and 4:
Screen captures
of high definition
assets utilized in
Demand Based
Worlds’ POC.



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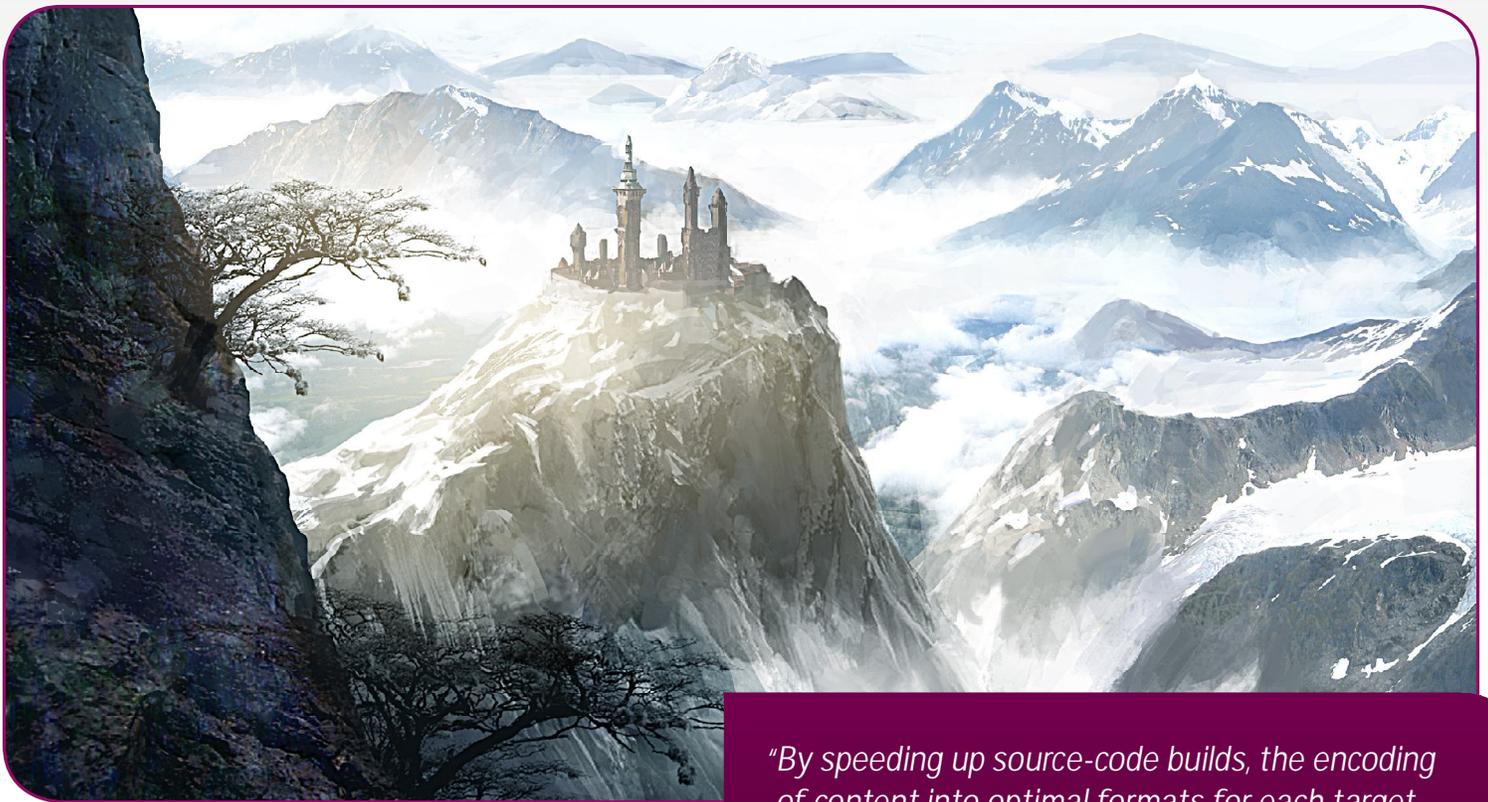
of immersion. This is because the game appears choppy or contains frames that appear discontinuous as the rendering engine tries to keep up with the actual game world clock. The game may stall if assets are not already loaded into graphics memory—phenomena developers call a “hitch.”

Intel has developed a tool and methodology for measuring hitch density during game runtime, enabling the industry to characterize visual fidelity. Hitches occur whenever 0.1 percent or less of total display pixels change for a duration of at least five frames. By measuring hitch density in conjunction with I/O traces during game runtime, Intel determined that hitches are the result of storage I/O bottlenecks caused by the VelociRaptor HDD. The tests revealed that the Intel SSD responded with zero hitching, while the HDD yielded hitching 7 percent of the time (Figure 2).

exploit Intel SSD performance. Games typically utilize only a fraction of the Intel SSD's full bandwidth. Tapping into the full bandwidth and reduced latency offered by Intel SSDs allows developers to add more detailed texture maps, higher resolution geometry, and more assets within the field of view—all while knowing that players will still experience fluid, hitch-free gameplay. Streaming more content at higher resolutions when Intel SSDs are installed will result in more immersive gameplay.

Enhancing Developer Productivity and Creativity

Recognizing that Intel SSDs represented an opportunity to boost operational efficiency, Digital Extremes, co-creators of Epic Games' Unreal* hit series of video games, replaced the 250GB 7200 RPM hard drives in their programmers' and artists' workstations with 160GB Intel X25-M SSDs.



Hitch-free gameplay results in a better experience. Graphic transitions are smoother, and because there are no stalls during the game, players using Intel SSDs enjoy a distinct competitive advantage over their opponents. For example, Intel SSD-enabled gamers will be able to arrive at their intended destination, pick up new weapons, and be ready for action while their less fortunate rivals (the players using HDDs) will lose valuable seconds waiting for the game engine to recover from a hitch.

Delivering More Immersive Gaming Experiences

Most games today were developed with HDDs in mind, and Intel's tests revealed that game engines aren't optimized to

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— GLEN MINER, SR. ENGINE ARCHITECT, DIGITAL EXTREMES

“Transforming 1 million lines of content and 50GB worth of source code into a finished game can involve a number of time-consuming processes,” said Glen Miner, Digital Extremes Sr. Engine Architect. “We are continuously looking for ways to accelerate those tasks. By speeding up source-code builds, the encoding of content into optimal formats for each target platform,

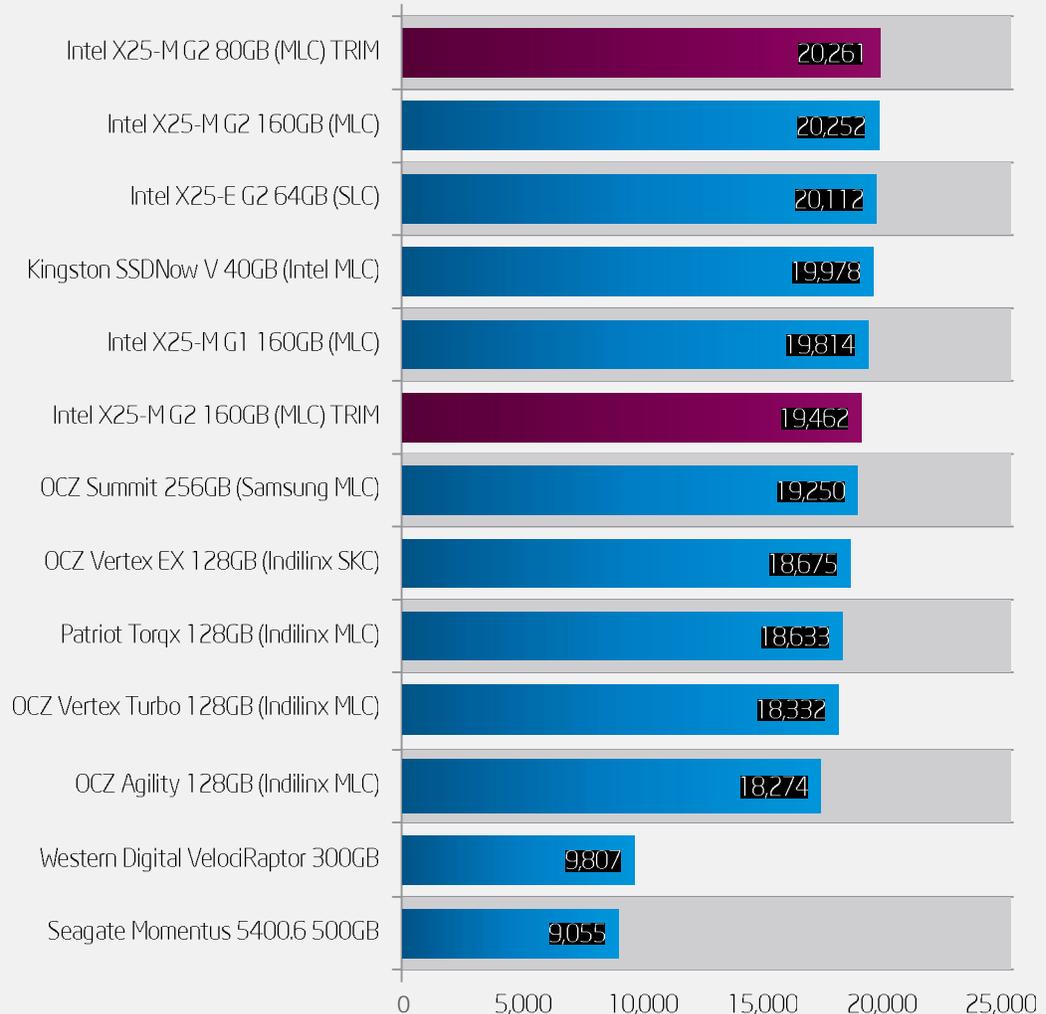
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HIGH SCORE: INTEL® SOLID-STATE DRIVES

AnandTech, a Web site focused on hardware analysis and news, evaluated solid-state drives (SSDs) running games using PCMark* Vantage. The 80-GB Intel® X25-M SSD earned top marks. The real-world test suite runs tasks such as appellation launches, searches, browsing, and video playback, pertinent to the class of applications being tested. When testing game performance, PCMark Vantage centers on reading textures and loading level data.

PCMARK VANTAGE—GAMING SUITE

Score in PCMarks (Higher is Better)



SOURCE: www.anandtech.com/show/2865/7

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and the creation of disc images, we can free up time for more creative activities.”

Digital Extremes found that deploying Intel SSDs accelerated Xbox 360 build times by 47 percent, layout optimizations by 3.5X, editor launch by 5.6X, and uncompressed level loads by 5X. These gains manifested in doubling the frequency design iterations, giving artists and programmers opportunities to explore additional creative options, which enabled them to add features and make the game more fun.

Game developers are under pressure to contain production costs and meet incredibly demanding production schedules, while tightly managing their available resources. By enhancing operational efficiency, Intel SSDs had a direct, positive effect on Digital Extreme’s bottom line. Peter Alau, Digital Extremes V.P. of Business Development explained, “If we can save a programmer a few minutes each time source code is compiled, we can save thousands of dollars every year.” ■



RESOURCES

To see the difference between an Intel® Solid-State Drive and Western Digital VelociRaptor* HDD, go to: www.intelssdgaming.com

Find the right Intel® Solid-State Drive solution for your business: www.intel.com/references/ssd

Results for AnandTech’s PCMark* Vantage can be seen here: www.anandtech.com/show/2865/7

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