Marketing Bulletin

SSHD goes the Distance

Acquire Maximum Performance and Reliability with Seagate® Solid State Hybrid Drives

With new technology breakthroughs seeming to emerge almost daily, it is easy to become a bit jaded. Claims of *newer, faster, better* are so commonplace that it is difficult for genuinely innovative products to capture the attention they deserve. A noteworthy exception is solid state drives (SSDs), which fire the imagination of business laptop users with their extraordinary speed and implicit (no moving parts) reliability. Could SSDs spell the end for hard disc drives (HDDs)?

Well, not so fast. Cost is an immediate obstacle, as even consumer-grade SSDs cost an order of magnitude more than comparable-capacity HDDs; and high-performance, enterprise-class SSDs are much pricier. More worryingly, SSDs have issues with data integrity and long-term durability. Like a battery, SSDs gradually lose their ability to *hold a charge* (retain data) with frequent use (erasures/writes). Wear levelling delays this phenomenon but fragments data and slows performance... and defragging to restore speed adds to disc wear.

The bottom line is that SSD speed comes at a price, in terms of both cost and diminished resilience. But what if SSDs could be paired with another technology, so that their respective strengths could complement each other, in effect making a whole greater than the sum of its parts? Melding SSD performance with HDD economy and capacity sounds ideal, but this hybrid approach only makes sense if the stumbling block of SSD's long-term reliability issues can be resolved.

Seagate has done precisely that, using sophisticated algorithms to monitor data usage dynamically, and intelligently determine what data should be copied to its hybrid drive's solid state memory. This enables SSD-like performance when accessing a user's most frequently needed files, while reducing the workload (and increasing the reliability) of the solid state storage. Simply put, Seagate solid state hybrid drives (SSHDs) deliver the best of both worlds.

Flash Memory grows up

Awareness of NAND flash memory (the functional core of SSDs) became heightened with the increasing popularity of digital camera memory cards, USB thumb drives and MP3 players. In those devices, photos/files/songs are typically written to the flash memory once, read as many times as

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desired and eventually deleted, to be replaced with new digital material. In the context of this read-heavy usage, the finite number of erase/write cycles offered by flash is largely irrelevant.

As the price of flash memory components began to fall, the feasibility of using flash for higher-capacity computer storage applications grew. This new class of storage devices, dubbed solid state drives, uses one of two different types of NAND flash memory: multi-level cell (MLC) or single-level cell (SLC). MLC stores more data per cell than SLC, and thus MLC flash-equipped SSDs cost far less for a given capacity than SLC-based SSDs.

But there are two significant drawbacks to consumer-grade MLC flash memory. Firstly, it is much slower than enterprise-class SLC flash; secondly, it is rated to withstand only one tenth as many write/erase cycles as its costly cousin.

Protecting the Write Stuff

Business users employ their laptops (the most common personal devices for MLC flash SSDs) to continuously add, revise and edit documents, presentations and other business-critical files. Every such action entails a write/erase cycle for the laptop's storage device. HDDs effortlessly shrug off such repetitive duty (the magnetic particles on a disc last practically forever), ensuring the integrity and safety of the user's valuable business information.

But the memory cells in SSD-equipped laptops are different; each write/erase cycle shortens the working life of an SSD's flash memory. The high cost/GB of SSDs guarantees that any business laptop fitted with an SSD will offer far less storage capacity than a similarly priced version of the same laptop carrying an HDD; that means less room (fewer cells) to which data can be written and rewritten, increasing the potential workload (and wear) on any given SSD memory cell.

To combat this, SSDs employ wear-levelling algorithms that spread write/erase workloads more evenly across the drive's cells. But this also accelerates disc fragmentation, as wear levelling can prevent parts of a single file from being written in close proximity to one another, which is key to ensuring optimal access speed. Defragmenting an SSD in order to boost performance is not practical, as it is a complicated, time-consuming process that imposes heavy wear on the SSD.

The solution? Use solid state only for what it does best — delivering lightning speed — and partner it with the complementary strengths of conventional hard disc drives (low cost, high capacity, proven reliability) for less performance-intensive storage duties. But how would this *hybrid drive* approach be implemented in actual practice?

How it works: Seagate Adaptive Memory™ Technology

From the outset, the design brief for the Seagate Momentus® XT family of solid state hybrid drives demanded that the performance benefits of solid state storage must not come at the expense of reliability or data integrity.

A number of key steps were taken to achieve this goal:

- Seagate engineers developed Adaptive Memory technology, a suite of innovative algorithms that enable drives to decide intelligently what data should be written to the solid state memory portion of the drive, and to revise that allocation dynamically as data usage changes over time.
- Because Adaptive Memory technology makes such efficient use of the drive's solid state memory, only 4GB of flash capacity was needed. This in turn reduced costs so much that it was practical to employ enterprise-class SLC NAND flash memory, the fastest and most reliable type of flash memory on the market. The result: major gains in terms of performance and data integrity.
- To further safeguard users' valuable files, Adaptive Memory technology ensures that any data copied to the solid state memory of the drive is first written to the drive's hard disc storage; this *belt and braces* approach elevates data protection and reliability above that which is possible with any SSD-only storage solution.
- And to ensure seamless operation and functionality, Adaptive Memory technology was designed to work transparently in the background, with absolutely no user action or intervention required.

The performance benefits of Momentus XT hybrid drives with Adaptive Memory technology are impressive: they can outperform laptop-class 7,200 RPM drives by up to 80% and are twice as fast as traditional 5,400 RPM drives. Furthermore, this first generation of Seagate SSHDs can even decrease boot and start-up times by up to 50% in some systems.

Learning, Discerning, Updating

Seagate performance and reliability benefits by:

Learning

Adaptive Memory technology constantly monitors which Logical Block Addresses (LBAs) or sectors are read on a drive to learn what information is most relevant to the user at any

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given time. Once a file is identified as important to the user, parts of it are copied and placed in the solid state memory. The next time the user needs to access that data, the computer will respond very quickly. When the file is then edited and saved, it is first written to the hard disc and then copied to the solid state memory.

Discerning

Note that in the above example, Adaptive Memory technology would not automatically copy every part of the file into the solid state memory. Instead, it discerns which parts of the file the user needs and how long it would take to access the LBAs holding each part's data. Above a specific time threshold (measured in milliseconds), a part will be copied into the solid state memory. If file parts can be accessed very quickly, they are not copied, freeing up the solid state memory for more pressing needs.

Updating

Adaptive Memory technology is constantly at work. Its maintenance routines involve updating the drive's solid state memory by removing older files no longer being used, and inserting new files that dynamically match the latest usage patterns. This keeps system performance running at that *new PC feeling* level, while also ensuring that, with transitions to new applications and files, drive performance will adapt to match the user's needs.

Conclusion

Everyone welcomes the chance to have a faster computer, but business laptop users know that speed cannot come at the price of reliability — the integrity of the valuable company data they carry on their computers must not be compromised. SSDs offer remarkable performance, but their inherent durability and reliability constraints are troubling (as is their cost). A 512GB SSD's street price is US$1,000 or more, while a 500GB Momentus XT hybrid drive costs about US$100.

Seagate solid state hybrid drives bridge the gap between SSD speed and HDD value, capacity and reliability. Using enterprise-class SLC NAND flash memory, the Momentus XT line of SSHDs rivals the performance of consumer-grade SSDs at a fraction of the cost, while delivering superior data integrity and long-term reliability. By melding the best features of two complementary storage technologies, the Momentus XT drive ensures that your data can go the distance.

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