

Samsung Teams With Microsoft to Develop First Hybrid Hard Drive With NAND Flash Memory

April 25 2005

Samsung Electronics Co., Ltd., the world leader in advanced memory technology, today announced that its OneNAND Flash memory has been incorporated into the design of Microsoft Corp.'s prototype Hybrid Hard Drive (HHD), the first fully functional disk drive to combine NAND-based Flash with rotating storage media. The hybrid drive, designed to work with the next version of the Windows operating system, code-named "Longhorn," is being exhibited for the first time at the Windows Hardware Engineering Conference (WinHEC) in Seattle at the Washington State Convention Center from April 25 to April 27.

Instead of replacing the HDD, the hybrid hard drive architecture incorporates a small OneNAND device from Samsung that works within the hard disk's architecture. The hybrid device promises to leverage the benefits of magnetic storage and solid state storage without compromising the cost of the computer housing it. The ultra-high-density benefits of magnetic storage technology are preserved, while the ultra-low-power, ultra-high-reliability and fast read/write access of advanced NAND technology such as OneNAND enhances the overall value of the hybrid drive at little or no additional cost.

Since late 2003, Microsoft has been working closely with Samsung to develop the next generation of ultra-low-power disk drives for notebook computers. The hybrid hard drive will eliminate costly inefficiencies caused by the need for the hard disk drive to continue to spin whenever

the computer is on. Additionally, the hybrid drive design also can provide significantly faster boot times when a computer running "Longhorn" computer starts up.

"Hybrid drive architecture is extremely important to the future design of mobile computers. It is an advancement that will improve the performance and reliability of any computer using the Windows 'Longhorn' operating system. We are delighted with the performance in our initial testing of the Samsung hybrid hard drive prototype," said Tom Phillips, General Manager of Windows Hardware Experience Group for Microsoft. "This is another example of where Microsoft is working with the industry to dramatically improve the overall Windows computing experience for our customers."

The hybrid hard drive prototype uses 1 Gigabit OneNAND(TM) Flash as both the write buffer and boot buffer. In the hybrid write mode, the mechanical drive is spun down for the majority of the time, while data is written to the Flash write buffer. When the write buffer is filled, the rotating drive spins and the data from the write buffer is written to the hard drive.

The hybrid drive saves power by keeping the spindle motor in idle mode almost all the time, while the operating system writes to the OneNAND write buffer. Moreover, by using OneNAND Flash with hard disk drive technology, disk drive performance is not compromised relative to conventional disk drives. This is due, in large part, to OneNAND's ultra-fast read speeds, which can be fully leveraged during the flushing of the contents of OneNAND's write buffer to the rotating drive. In addition, since the Samsung hybrid disk drive operates at a lower temperature than traditional rotating media, it greatly reduces the possibility of shock and impact damage, improving the overall reliability of the disk subsystem.

While the cost of hybrid disk drives may slightly increase with the

addition of OneNAND, any increase will be mitigated by several factors, including lower maintenance costs, 95 percent power savings when the disk is not spinning, faster boot time and substantially increased reliability. All of these changes are crucial to the ever increasing needs of today's mobile customer, making it likely that hybrid hard drive technology will enjoy rapid market adoption.

"Through our collaboration with Microsoft, Samsung OneNAND Flash memory supports the most advanced and cost-effective solution to enhance the performance of a HDD in mobile computing. PC manufacturers will recognize the improved performance and increased battery life made possible through the use of NAND Flash technology," said Jon Kang, senior vice president, technical marketing group, Samsung Semiconductor.

The HHD prototype will be converted into products manufactured and marketed by Samsung's HDD division as well as other HDD OEMs. Samsung's OneNAND will integrate with the HHD SOC via its NOR interface as a standalone memory device or in a multi-chip package. Samsung and Microsoft have worked together developing a robust set of ATA (advanced technology attachment) commands that will be used to fine-tune the efficiency with which HHD supportive software controls the Longhorn-based computer in which it is used.

"Samsung, in cooperation with Microsoft, will work aggressively with drive manufacturers to transition the hybrid disk drive prototype into world-class commercial products. When they take a close look, they will find that OneNAND is the memory device most ideally suited for hybrid hard drives," said Ivan Greenberg, director of strategic marketing for Samsung Semiconductor.

Samsung expects HHD-enabled notebooks to begin shipping in large quantities in late 2006.

Citation: Samsung Teams With Microsoft to Develop First Hybrid Hard Drive With NAND Flash Memory (2005, April 25) retrieved 24 April 2024 from <https://phys.org/news/2005-04-samsung-teams-microsoft-hybrid-hard.html>

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