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Bye-bye hard drive, hello flash

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The world as notebook users know it is about to change in a flash.

Manufacturers of NAND flash memory say they will expand the market for their chips over the next few years and colonize devices that now rely on hard drives or other types of memory. In turn, this could mean phones that can record several hours of video, or smaller notebooks with twice or more the battery life.

The NAND noise will be particularly strong at the Consumer Electronics Show (CES) this week in Las Vegas, with manufacturers showing off the solid-state technology as an increasingly important component in cell phones and talking up how it will find its way into notebook hard drives in 2006.

What's new: Flash memory is on track for an ever larger role in gear like cell phones and notebook computers.

Bottom line: Hard drives may have a cost advantage as a way to store data, but they're bulky, take longer to start up and use more energy. Plus, flash prices are dropping.

By about the turn of the decade, NAND could even replace hard drives entirely in some mini notebooks because of the increasing amount of data the chips can hold, according to Steve Appleton, CEO of Micron Technology, one of the world's largest memory makers. Flash also takes up less space and uses less energy.

"The average notebook has 30GB (of hard drive storage). How long is it before the notebook has solid state memory? Five or six years," he said. "I'm not saying drives will go away. There will always be a need for storage, but when was the last time you tapped out a drive?"

Jim Handy, an analyst at Semico Research, says NAND won't replace notebook hard drives as long as Microsoft keeps expanding the number of storage-heavy features in its software, but it will become standard in video cameras, displacing tape, recordable DVDs and mini drives. Flash-based cameras, already a staple in Japan, are smaller, and the cost premium associated with the chips can be hidden in a \$500 camera.

"Video is not a hard-drive area. I expect it will go with flash," Handy said.

NAND flash will also begin to appear in car navigation systems and play a role in large data storage systems at corporations and government agencies in the relatively near future, said Jon Kang, senior vice president of Samsung Electronics' technical marketing group. Kang's enthusiasm is understandable: Samsung is the world's largest maker of NAND in terms of bits shipped.

"It is really creating a boon in consumer applications," he said.

As with many other technologies before it, costs are coming down as capacities are heading up.

The NAND evolution fits the pattern established in Moore's Law, which states that the number of transistors on a given chip will double every two years. Doubling the number of transistors on a memory chip allows manufacturers to put more memory cells on it.

Actually, the technology is moving a little faster than Moore's Law. A few years ago, NAND got produced on trailing-edge manufacturing lines. Now manufacturers are putting it on their cutting-edge processes. The shift has thus accelerated product development.

Currently, NAND chips double in memory density every year. The cutting-edge 4-gigabit chips of 2005, for example, will soon be dethroned by 8-gigabit chips. (Memory chips are measured in gigabits, or Gb, but consumer electronics manufacturers talk about how many gigabytes, or GB, are in their products. Eight gigabits make a gigabyte, so one 8Gb chip is the equivalent of 1GB.)

Another driving factor in the uptake of the technology is cost: NAND drops in price about 35 to 45 percent a year, due in part--again--to Moore's Law and in part to the fact that many companies are bringing on new factories. 1GB of flash costs a consumer electronics manufacturer about \$45, said Handy. That will drop to \$30 in next year, \$20 in 2008 and \$9 by 2009.

At \$45 a gigabyte, flash is nearly 100 times more expensive than hard-drive storage, which can sell to manufacturers for around 65 cents a gigabyte. Even in the most optimal comparisons for flash, the technology invariably costs more, say analysts. On the other hand, flash has advantages in space and energy consumption.

When and how NAND flash gets incorporated into a product category depends upon a host of factors. In cell phones, the advent of fancy gadgetry is driving adoption. Historically, cell phones only required 64Mb or so of memory, mostly to store basic system instructions. The chip of choice has been NOR flash, a different type that in some ways is more reliable. More than 90 percent of the phones made today store their software code in NOR flash, according to research firm iSuppli.

Adding photo, video and MP3 capabilities, however, has forced phone makers to add NAND to store files. Similarly, smart phones that handle e-mail and Web surfing require far more memory. NAND is more dense than its counterpart: NOR chips for cell phones generally top out at 512Mb. By 2007, Samsung will produce 16Gb NAND chips and 32Gb ones a year later, said Kang. The growth rate for NOR isn't nearly that fast, so the density gap shows signs of widening.

As a result, the use of NAND chips--with some help from additional, inexpensive DRAM memory--is growing in phones. Some manufacturers are even contemplating displacing NOR with NAND for code storage, although that requires rewriting code.

"I don't see many (cell phone makers) sticking with NOR when they go to 512Mb densities. NOR is going to be designed out," said Samsung's Kang. "It is a pain in the neck to switch software so people now use NOR, but let's say you have a gigabit of density. There is no reason to use NOR."

NOR manufacturers hotly dispute this and are working on packaging techniques to eliminate opportunities for NAND to intrude.

In MP3 players and notebooks, meanwhile, performance issues will drive adoption. The motor that spins hard-drive platters is one of the more energy-hungry components in a notebook. A hard drive developed by Samsung and Microsoft in which flash memory caches data for an idle hard drive will arrive in late 2006. The hybrid drive will extend battery life by 36 minutes, according to Samsung. A full NAND notebook would even use less power.

"How would you like 15 hours of battery life on a notebook rather than three or four? What if you didn't have to go through that stupid boot-up sequence?" said Appleton of Micron Technology. "Anytime a solution for storage can be \$50 or \$60 or less, the mechanical guys are out and the solid-state guys are in."

NAND would allow PCs to start up instantly because data wouldn't have to be retrieved from the drive platters. Intel, meanwhile, has developed a technology called Robson that cuts boot-up time by storing the most recently used software and files in flash.

Sam Bhavnani at Current Analysis said most consumers will continue to want big hard drives, but still, he added, "some high-end ultraportables could go that way"--to flash--"in a few years."

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