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## Hard drives reel as flash moves ahead

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In the face of falling [flash](#) memory prices, hard-disk drive makers are retreating from what they thought would be new growth markets in mobile consumer systems. Meanwhile, a growing crop of solid-state drive makers is gearing up to win designs in the traditional notebook, desktop and server markets where hard drives have reigned.

Hitachi, Seagate, Toshiba and startup Cornice have all discontinued development of their 1-inch and smaller drives for cell phones, MP3 players and digital cameras, where flash now holds sway. Nearly two dozen companies, by contrast, are developing high-capacity flash drives. Some are doing so in anticipation that innovative controllers from startups as well as established [chip](#) makers such as Marvell will help them gain entry into mainstream computers.

The shift is a dramatic reversal for the [hard drive](#) industry, which has routinely pioneered ever-smaller form factors, culminating in a 0.85-inch drive launched by Toshiba Corp. in early 2005. Now drive makers are rallying resources around higher-capacity 1.8-inch models, though analysts said those too will be overrun by flash alternatives by 2011.

Confronted with the transition, the leading hard drive trade association is about to propose to its membership that it reinvent itself as a generic storage group and open its doors to flash drive makers. Joel Weiss, a former Seagate researcher newly installed as the president of the International [Disk](#) Drive Equipment and Materials Association, wants to give [flash drive](#) companies a seat on an expanded IDEMA board and invite them to exhibit and present at the organization's annual conference in September.

Flash is typically much more expensive than hard-disk storage, especially at high capacities. But mobile systems want flash for its significantly lower power, smaller size and greater ruggedness, while high-end systems want it for its faster throughput.

The multibillion-dollar hard drive industry, which ships more than 400 million drives a year, is not going away anytime soon. But these days, the more interesting question is how fast the flash business will grow.

"We play a game around here called 'find the flash vendor.' These drive and [controller](#) guys are coming out of the woodwork," said Patrick Wilkison, vice president of marketing and business development at Stec Inc. (Santa Ana, Calif.), which claimed it had 40 percent of the \$260 million market for flash drives in 2005.

At the high end, Stec offers server makers the 3.5-inch Zeus drive, with up to 146 Gbytes of flash. The drive delivers 50,000 I/O operations per second, an order of magnitude greater performance than a disk drive.

High-capacity flash drives used to be confined to military and other embedded systems, which would pay a premium for the drives' ruggedness and performance. But with falling prices, mainstream notebook and server makers are beginning to offer flash drives as options.

"The markets are absolutely on fire right now. It's great. The gating item has been pricing," said Wilkison, adding that Stec expects to get its first notebook design wins soon.

Only eight companies produce the world's hard drives, but as many as 20 have emerged in flash drives so far, said Jeffrey Janukowicz, who was hired by International Data Corp. in February to track the rising market.

"The price declines in NAND flash--more than 50 percent a year--have been much steeper than for hard drives in the past few years," Janukowicz said. The declines drove Apple to shift from drives to flash for its mainstream iPods, and now "some people are wondering if we might see a similar shift in computing markets," he added.

### Multilevel hurdles

The limits of multilevel-cell flash stand as the biggest inhibitor to the growth of flash in computers. MLC offers significantly higher capacities than single-level-cell chips. MLC chips have much higher bit-error rates, however, and can only be written about 10,000 times, one-tenth the number of cycles for single-level cell flash.

Those factors are not problems for media playback on consumer devices, but they cause real issues in computing jobs. "You won't find a [computer](#) OEM that is willing to take a product with any MLC in it today, but that may change in two years or so," said Wilkison of Stec.

That's because a rising tide of controllers and standards aims to manage the issues with better error correction and other techniques. One startup attacking the area is Fusion I/O (Salt Lake City), which claims its controller will handle MLC flash and enable a whopping

4 million I/O operations per second. The controller will be released later this year, the company said.

"That's an impressive number," said Wilkison.

For its part, Stec designs its own controllers. Some support hybrid MLC/SLC drives, which Stec thinks could eventually secure a toehold in the market.

Sources who asked not to be named said Marvell will enter the flash controller market, perhaps this year. Marvell makes read channels and controllers for a variety of hard disks, especially in the troubled ultramobile area.

Marvell's entry could quash the plans of a handful of startups rumored to be getting into flash controllers. The company will also present a challenge to the existing flash controller companies, typically Taiwanese organizations aiming at low-cost chips.

Intel Corp. is paving the way with standards for greater use of flash in computers. It helped define the Open NAND Flash Interface (ONFI) with Hynix Semiconductor Inc. and Micron Technology Inc. late last year to bring commonality to chip interfaces, which vary widely by vendor.

A version 2.0 ONFI is in the works that could quadruple the current, 40-Mbyte/second data rate. It will also provide an abstraction layer, shielding applications and systems software from the details of how chip makers manage bad memory cells.

The standard could be finished by the end of the year. In addition, it will define a standard module and connector for the 1- to 2-Gbyte flash [cache](#) modules Intel defined for notebook computers.

"This starts in notebooks because that's where there is the most value in power savings, but there are performance benefits available for all platforms," said Knut Grimsrud, a senior principal engineer in Intel's storage group.

The flash modules sport far less capacity than full flash drives and are initially focused on speeding up the time it takes to [boot](#) systems and load applications. Intel is working on more applications for the modules, however, that complement rather than replace hard disks.

"We're very bullish about flash in the platform. As it matures, people will find new uses for it," Grimsrud added.

"There's a whole road map of things we want to do," said Rick Coulson, a director of I/O [architecture](#) at Intel who is helping define a companion software interface standard for the modules. Many of the new uses for those modules are still considered confidential by OEMs working on them, he said.

Wilkison of Stec said he wants the Intel standards to gain traction and be applied to flash drives as well. So far he is skeptical about that scenario, however. "There are big question marks," he said. "There are no standards yet for flash chips or drives; it's a green-field area where companies are putting their smartest people to work, but there is no clear path.

"We hope ONFI takes hold because we work with everyone's NAND chips, so we'd like to see something meaningful come out of ONFI 2.0. But Samsung, which is not part of ONFI, still makes 50 percent of all NAND, and if they don't support something, it won't go far."