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# Chipping away at the Flash market
## Memory makers address technology, pricing pressures

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Flash memory today is available not only in a variety of sizes but also packaged in formats for every conceivable brand of digital camera or handheld computer.

In 1997, a memory card for a digital camera with 10 megabytes of storage cost about $160. Today, a whopping 512-megabyte memory card costs a mere $42.

In other words, a megabyte of Flash memory cost $16 in 1997. Today, it costs a little more than 8 cents.

Because the small, dense memory chips hold onto information without electricity, they are considered a form of non-volatile memory. In the past decade the market for Flash – driven by new products like digital cameras, iPod music devices and smart phones – has followed steep development and price curves reminiscent of microprocessors and conventional computer memory. For the kind of Flash used as multimedia storage, the market grew from $2 billion in 2000 to more than $10 billion in 2005, according to market research firm Semico Research.

But now, just as Flash has become entrenched, new market needs beckon. Consumer electronics makers want to combine the Flash used for storing programs with the Flash used for storing data. Video iPods are hitting the scene, demanding more storage capacity, and computer makers are even tinkering with laptops that rely on Flash instead of hard drives. These and other uses demand greater capacity or speed than Flash can currently provide. People who say Flash isn't up the task add that the new applications might provide an opening for alternative memory technologies.

"Everybody believes that Flash can't be scaled (to ever-smaller features)," said Jim Handy, director of non-volatile memory services at Semico Research. The smaller the memory features, the denser the chip and, therefore, the greater its capacity.

Another problem with Flash memory is that it requires more voltage than what handheld electronics ordinarily use, necessitating special circuitry and more power.

In addition, Flash wears out. "It has a rather short lifetime and is too slow to be used as a computer memory," said Herb Goronkin, president of Technology Acceleration Associates and formerly a vice president at Motorola Labs.

However, says Handy, experts differ in their opinions of the scale at which further Flash development would be impossible. The industry previously saw 60 nanometer processes as the limit. Now it is looking beyond that.

While there may be disagreement on the technical side, however, there is general consensus about the economics of competing with Flash: difficult to impossible. Handy, Goronkin and others say that any new contender would have to not only beat Flash's performance but also meet or beat its price. And that's going to be a tall order, given the enormous capital expenditures and high volumes required for manufacturing memory at consumer prices.

It is actually a misnomer to speak of the "Flash" market, says Handy. It is, in fact, comprised of multiple markets served by two technologies – NAND and NOR. "It's kind of a shame they're both called Flash," he said.

NAND Flash is cheaper, so it can be made affordably in high-density versions. As a result, it is the technology of choice for portable photo and music storage. It is too slow for a processor to pull programs from but is more than sufficient for storing multimedia.

On the other hand, information can be read from NOR Flash very quickly. That makes it useful for storing the programs used by processors inside cell phones and other devices. However, it writes information relatively slowly.

NOR chips are also used in many areas within a PC, such as the controller of a hard drive or CD-ROM. By Handy's count, the average PC today comes with about six of them.

Many in the industry would like to reduce those numbers, especially within portable devices like cell phones and PDAs. Fewer chips would use less space, draw less power and generate less heat. Today, a cell phone loaded with multimedia bells and whistles and a digital camera would use both NOR and NAND chips. In the future, a single chip could do the trick.

In fact, a recent announcement by AMD illustrated how companies will push the existing technology. "They've been able to double the density of the NOR Flash," said Joanne Feeney, a nanotechnology and nanoelectronics analyst with investment bank Punk Ziegel & Co. "The current technologies are going to be pushed as far as they can."

Indeed, history supports that thesis. Handy cites the example of the giant magneto-resistive, or GMR, head. Just when the computer industry was starting to fret about the limits of hard disk drives, the GMR head came along and dramatically expanded disk capacity.

That type of ongoing innovation within entrenched technologies "raises the barrier for entry for new technology," according to Feeney. Companies developing alternatives need to remember that the price-performance combination they must meet lies somewhere out in the future, already well beyond the capabilities of today's Flash. On the other hand, Feeney says, that also "gives them more time to get the technologies to mature."

In some cases, that means finding a niche market like military applications within which to grow. For others, it means targeting a related market like embedded memory where devices don't need to be non-volatile. For all would-be contenders, it means working hand-in-hand with major semiconductor foundries to make processes as efficient as possible and to prove that new materials won't contaminate processing machinery.

The road to the next Flash, says Feeney, will be paved by market drivers and price points. "The higher density they can achieve, the faster they can go and the more robust they can be. … That's what the market wants." Anything else is doomed to be merely a flash in the pan.

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