



Universal dreaming?

By Russ Arensman,
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For years the semiconductor industry has searched in vain for a “universal” memory technology that can retain data without a constant power supply and is fast, cheap and dense enough to replace the multiple technologies such as DRAM, SRAM and Flash now supplying the nearly US\$50 billion (\$65 billion) memory market.

Without that unified capability, system designers are increasingly turning to elaborate, expensive multichip packages. Samsung’s latest offering, for instance, combines four kinds of Flash and DRAM in an eight-chip package that lets mobiles store more than 3.2 GBytes of data. “Look at how it takes four memory configurations to support a simple cell phone,” says Semico Research analyst Bob Merritt. “It means that the memory technologies we’ve developed so far are no longer adequate.”

Mark DeVoss, an iSuppli memory analyst, forecasts a US\$76 billion (\$100 billion) market by 2019 for any memory chip technology that can merge the best of multiple memory types. “The company that gets there first is going to make a ton of money,” he says.

Yet many industry experts, including those working on alternative memory technologies, doubt that a true universal memory will ever be developed.

“I really don’t see a unified memory as something that’s going to occur anytime soon,” says Greg Atwood, an Intel fellow working on phase-change memory (PCM), which may one day replace Flash. The problem, he notes, is that the market requires a wide range of memory chips that are either fast, cheap or nonvolatile. Unfortunately, he notes, “achieving all of those goals simultaneously will be very difficult.”

In fact, many qualities of an ideal universal memory appear to be mutually exclusive. Fast memory chips such as SRAM, for instance, require a fairly low energy barrier to change each bit of stored data. But a high energy barrier is better for long-term data retention. Thus, it’s difficult to combine fast operation with long-term data integrity.

Still, the industry is devoting more effort than ever to developing new memory technologies. Analyst Radu Andrei, of investment firm Kalydus Asset Advisors, says more than 70 companies are working on new memory technologies, although most are years from commercial production. “The money flowing into this area is growing faster than in any other part of the semiconductor industry,” he says.

Leading contenders include PCM, ferroelectric random-access memory (FRAM) and magnetoresistive random-access memory (MRAM). Nantero is developing another promising technology that stores data by using carbon nanotubes. But FRAM is the only one of those actually on the market. Ramtron International is selling about US\$30 million (\$40 million) in FRAM chips annually, and Fujitsu, which fabricates Ramtron’s chips, also sells an undisclosed amount.

Yet FRAM is unlikely ever to be dense and cheap enough to completely displace other memory technologies. The latest FRAM chips store just 256 kilobits, whereas Flash memory chips already hold 8 Gb, more than 3,000 times as much. And although Texas Instruments is working with

Ramtron on higher-capacity FRAM designs, most now see FRAM as specialty memory best suited for smart cards and other ultralow-power uses.

PCM, which is being pursued by Hynix, Infineon, Intel, Samsung, STMicroelectronics and others, has the potential for very small memory cells, which could make it cheaper than its rivals. It's relatively power-hungry, however, and may have manufacturing issues related to its temperature sensitivity.

Intel's Atwood sees it as a possible replacement for Flash memory but concedes that because of its limitations, "it's still not a true universal memory".

On the MRAM front, Freescale Semiconductor has been making customer samples of its prototype 4-Mbit chips for two years and plans to start commercial production next year. Other MRAM developers include Hewlett-Packard, Honeywell, IBM, Infineon (Arrow), Micron Technology, NEC, NVE, Renesas Technology and Samsung, although none of those have announced commercialisation plans.

Saied Tehrani, Freescale's director of MRAM technology, contends that MRAM is the best alternative memory candidate in terms of speed and durability.

But he doesn't expect it to be the "one memory that actually displaces everything we have today".

Nantero CEO Greg Schmergel calls nanotube memory "a technology with no fundamental physical limits" that could ultimately become a true one-size-fits-all memory chip.

But like other contenders, it's still far from proving that in the market.

Meanwhile the search continues, bringing us closer to the possibility that, someday, a true universal memory may actually exist.