



The Changing Face Of Non-Volatile Storage

The Flash Memory Summit was host to a range of new technology, from LSI's SandForce flash memory controllers utilizing a multi-level low-density parity check (LDPC) to the Hybrid Memory Cube. The need for storage is insatiable. Three additional technologies look to address the issue: Samsung's 3D flash architecture, Crossbar's resistive RAM, and Diablo Technologies' TerraDIMM.

3D VERTICAL FLASH

Samsung's 3D V-NAND flash architecture increases capacity by layering 24 cells on top of each other (see the figure). The technology improves reliability by a factor of two to 10 while delivering twice the write performance of conventional 10-nm-class floating-gate NAND flash memory.

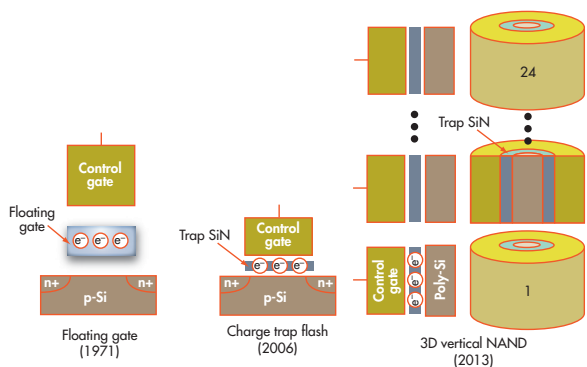
Samsung is delivering 128 Gbits in a single chip using V-NAND's 3D charge trap flash (CTF). The CTF architecture temporarily stores an electric charge in a non-conductive layer composed of silicon nitride (SiN) instead of a more conventional floating gate like most NAND technologies. A floating gate has more interference between cells as smaller geometries bring cells closer together.

Samsung uses a special etching technology to create the multilayer system. It punches holes through from the highest to the lowest layer of the chip. This is very difficult, but Samsung can now deliver chips on a regular basis.

RESISTIVE RAM IS NON-VOLATILE

Crossbar delivers non-volatile storage using a new resistive RAM (RRAM) technology that is compatible with existing CMOS technology. It beats NAND flash with performance increased by a factor of 20. It also cuts power requirements by a factor of 20. It has an efficient 4F2 cell layout as well. RRAM is comparable in performance and endurance with other non-volatile technologies like MRAM (see "Magnetic DRAM Arrives" at electronicdesign.com) and PCM (phase change memory), but with a lower power requirement.

Crossbar's announcement was about the technology versus chip delivery. It should scale well and even supports 3D stacking, but MRAM and PCM have yet to make a dent in flash except in niche markets. All three could give NAND flash a lot more competition in the future.




Samsung's 3D flash technology improves storage density by packing 24 layers of MLC storage cells on top of each other. It also improves reliability by a factor of two to 10.

DIMM FLASH

Diablo Technologies takes advantage of conventional MLC NAND flash but packs it onto a standard dual-inline memory module (DIMM). The TerraDIMM also includes the company's secret sauce in the form of a memory controller that handles the NAND flash and the DDR3 protocol.

A system can have a single TerraDIMM or multiple TerraDIMMs, and that's key to its performance edge. The TerraDIMM already has an edge by using the fastest interface to the processor, the memory controller. High-end processors sport multiple controllers, and multichip processor clusters share memory from all the controllers.

The TerraDIMM differs from Viking Technology's non-volatile DRAM, the ArxCis-NV. The ArxCis-NV mirrors conventional double-data-rate (DDR) memory in NAND flash between power cycles. The TerraDIMM works like conventional flash, so device drivers make this NAND look like a solid-state disk (SSD) to the operating system. The system can do more, but that requires operating-system changes. These changes may show up in the near future, offering interesting application advantages. 

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