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Startup Crossbar pits RRAM against DRAM and flash storage

Crossbar claims its new type of memory is smaller, faster, and more power efficient than flash storage

By Agam Shah | IDG News Service

Startup Crossbar emerged from stealth mode Monday to announce its version of RRAM (resistive random-access memory), a new type of memory that could be a successor to flash storage and DRAM.

The company, founded in 2010, will make and license its RRAM, a nonvolatile memory, which will be smaller, faster and more power-efficient than NAND flash and RAM, said George Minassian, CEO of Crossbar.

"It is higher density ... and the current is much lower," Minassian said, adding that the memory's physical and power attributes make it a suitable replacement for storage in smartphones, tablets, PCs and servers.

Crossbar is claiming RRAM will deliver 20 times faster write performance, 20 times less power consumption and 10 times more durability than NAND flash. The memory chips will be stacked, and a 1TB module will be roughly half the size of a NAND flash module with similar storage, Minassian said.

He could not estimate the price of a 1TB RRAM module, but said it will cheaper than NAND flash partly because RRAM is less expensive to manufacture.

Crossbar will also license the technology to third parties. It could be two or three years before the memory shows up in products, but that depends on demand for the product, Minassian said.

"It's a matter of what company appears at what time," Minassian said.

RRAM differs from the way NAND flash and RAM operate. Unlike NAND flash, Crossbar's technology does not use transistors or trap a charge. Instead it uses a layered approach to store data. An RRAM cell has three layers, with a switch in the middle that helps determines whether the cell is storing a 1 or a 0. The top layer has a metallic electrode, while the lower layer has a nonmetallic electrode. The top layer passes metal ions into the switching media and into the lower layer, which creates a filament to keep the electrodes connected, what Minassian called a "short wire." Applying a negative charge breaks the wire and leaves a gap between the electrodes, which leaves no resistance, changing the status of the memory cell.

"This is not a gate you use in standard NAND and NOR. This is resistive, which is where RRAM comes from," Minassian said.

RRAM uses existing material and can be made in factories. Prototypes are being made in factories of TSMC (Taiwan Semiconductor Manufacturing Co.), Minassian said.

Crossbar's RRAM doesn't contain transistors, so it is easy to make as chips become smaller, Minassian said.

Crossbar's technology is very interesting and could be useful as manufacturing technologies improve and chips get smaller, said Jim Handy, principal analyst at Objective Analysis, in an email.

"It's generally accepted that something is going to replace NAND and DRAM someday, since these technologies have scaling issues. When that will occur is unclear," Handy said.

It is becoming more complex to make NAND and DRAM as manufacturing technology improves at a rapid rate, Handy said. Intel, which has the world's most advanced chip factories, will soon move to the 14-nanometer process to make its chips. Manufacturing smaller chips with more features requires more attention to detail, and chips could be vulnerable to a wider class of defects.

"With that in mind, and with the advent of 3D NAND as a successor to today's planar NAND, there may be another five process generations, or even more, before alternative memory technologies have a shot at replacing NAND flash. The story's probably the same for DRAM," Handy said.

Once a scaling limit has indeed been reached, technologies like Crossbar's RRAM will rapidly take away market share from the entrenched players, Handy said.

Other RRAM designs are being **researched** by academics and research institutions. Alternative forms of memory to NAND and DRAM also include Everspin's MRAM (magnetoresistive RAM) and PCM (phase-change memory), a memory type being pursued by **Micron** and Samsung Semiconductor. Hewlett-Packard is making a memory type called memristor.