

## **New and Emerging Memory Technology Status/FMS 2024**

### **Status of New and Emerging Memories (Mark Webb, MKW Ventures Consulting LLC)**

We have a Future of Memory and Storage/Flash Memory Summit Paper that we are presenting showing how chipleths change the equation on adding different types of memory to products. It allows designers to trade off cost and performance characteristic with more knobs. MRAM, NOR, DRAM, all on the same chip in the desired proportion with different processes.

Our presentation is “Memory Technologies : How Chipleths Change Everything”

FMS OMEM-203-1 Heterogeneous Solutions for Performance Session - Wed Aug 7, 3:00pm - 4:05pm Ballroom C

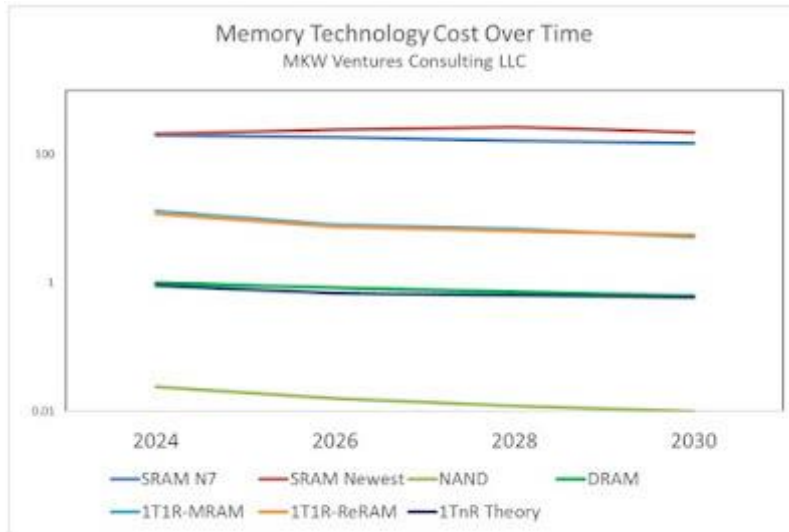
That said, we need to reiterate the opinion, backed by data, that emerging memories will not emerge to any material impact on the DRAM or NAND Market. Unlike some peoples predictions, the emerging memory market will not be \$30B or even \$3B in the next 5-10 years. It is well below \$300M today

#### **Emerging memories are possible in 3 areas:**

- Niche products (which we will show can be integrated in a chiplet product)
- Embedded In a foundry process from TSMC or Global or Intel
- High volume IF they require minimal (<10% of steps) changes to a NAND or DRAM flow.

Fourth Option: They stagnate due to technical issues and lack of demand.

## Costs for Memory Technologies



Note: SRAM is Modeled Cost in L2 Cache

### Quick Summary:

**MRAM (STT):** Available today. In embedded, replacement for E-flash if you need advanced process and embedded memory. Niche applications as discrete. Those applications will increase with chiplet use.

**RRAM:** Available today. May scale differently than MRAM and typically is slower. But has applications depending on cost scaling. Embedded, Chiplets, Niche applications. Some AI weighting use

**PCM (1T1R):** Available today. This is lower density (<1Gbyte). A technology that 50+ years old .... Typically used by companies who love PCM (ST, IBM, Micron) as they have decades of history of characterization.

**Crosspoint technologies (1TnR):** Optane fully developed the worlds best and most dense “faster than NAND, cheaper than DRAM” technology. The economics didn’t work and the demand was 10x lower than anticipated. Intel and Micron gave it a huge effort and we all appreciate the attempt. It’s not clear how to get these technologies to high volume IF they worked well.

**FeRAM (high density):** Was a potential future due to ability to integrate with DRAM flow. However all memory companies worked extensively on Hf based FeRAM products since 2020 and none were productized due to a variety of reasons.

**Other New Materials:** UltraRAM, New PCM materials, New RRAM materials/companies etc: These are possible but are 10 years from potential production. Unless implemented with 3D DRAM in 2028-2030, these are lower probability at this point. Our presentation on our website of “Memory technology Product Lifecycle” give detailed timeline of how new memories come to production

**Summary:** There is no universal memory coming. We have SRAM, DRAM, NAND, NOR, MRAM, RRAM, PCM available today. Lets focus on integrating those as embedded or in chiplets.

I will be in Santa Clara Aug 5-8. Call or text to set up meetings at FMS or by Zoom. We will host some Zoom sessions during the conference timeframe. I can address all of the technologies one by one with costs and applications

Lots More info on our website [www.mkwventures.com](http://www.mkwventures.com)

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