CS122A: Intermediate Embedded and Real Time Operating Systems

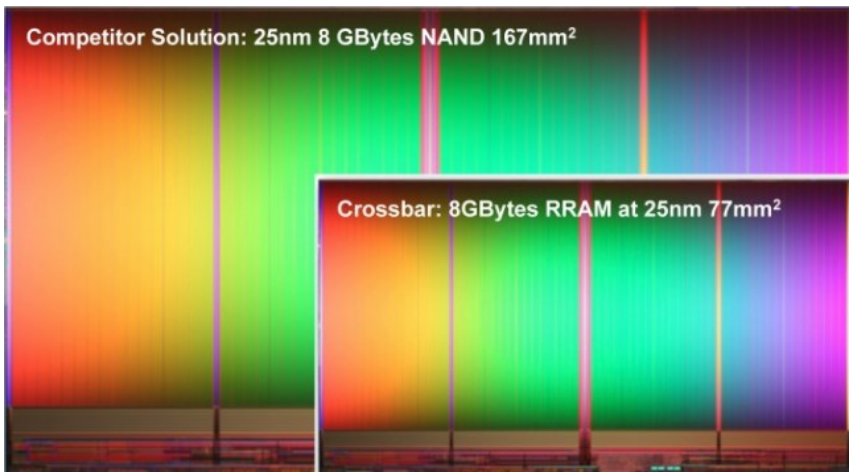
Jeffrey McDaniel

University of California, Riverside

Memory

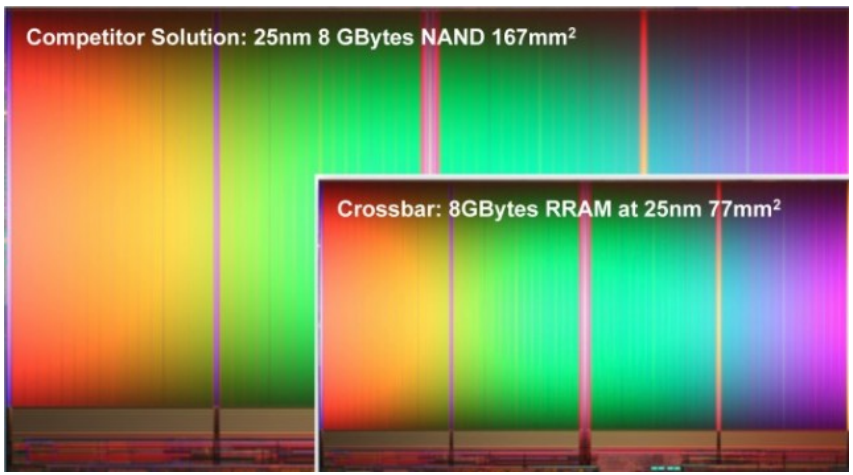
- Resistive RAM (RRAM)
- Magnetoresistive RAM (MRAM)
- Phase-change RAM (PRAM)
- Solid-State Drives (SSD)

Resistive RAM (RRAM)



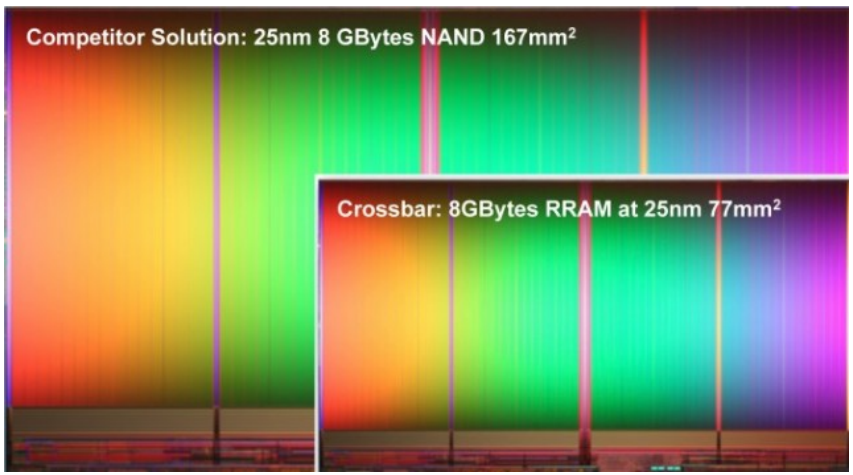
- Data stored by changing the resistance across a dielectric

Resistive RAM (RRAM)



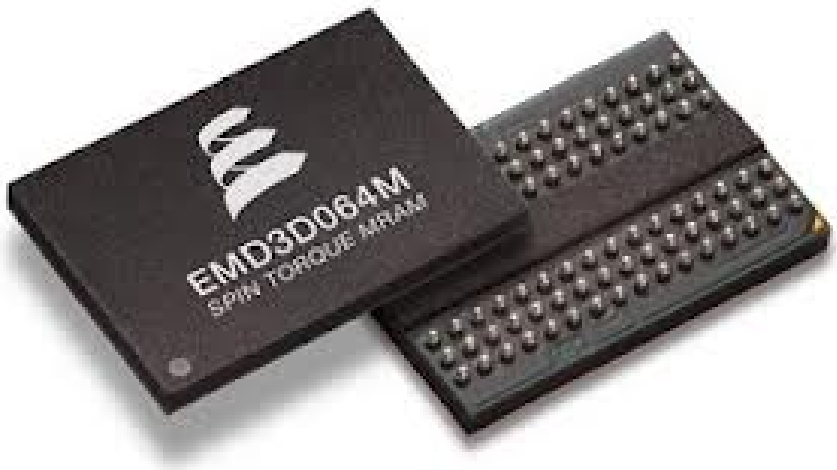
- Data stored by changing the resistance across a dielectric
- In 2013 Crossbar introduced a prototype chip

Resistive RAM (RRAM)



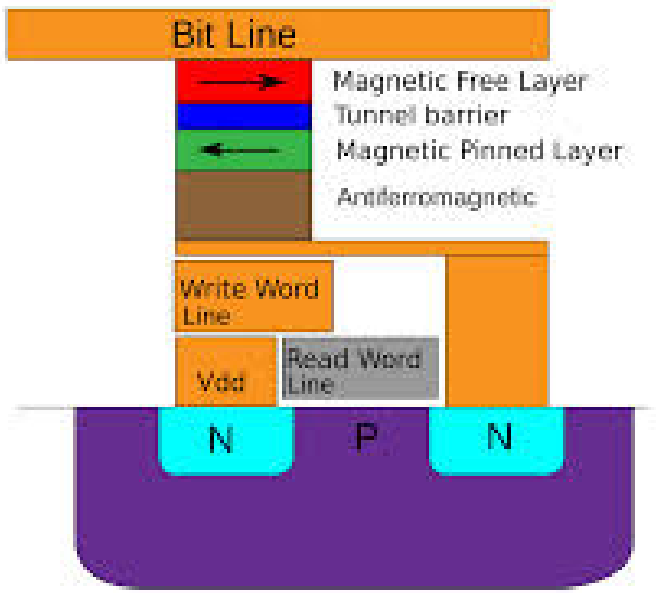
- Data stored by changing the resistance across a dielectric
- In 2013 Crossbar introduced a prototype chip
- The chip was the size of a postage stamp with 1 TB of data

Magnetoresistive RAM (MRAM)



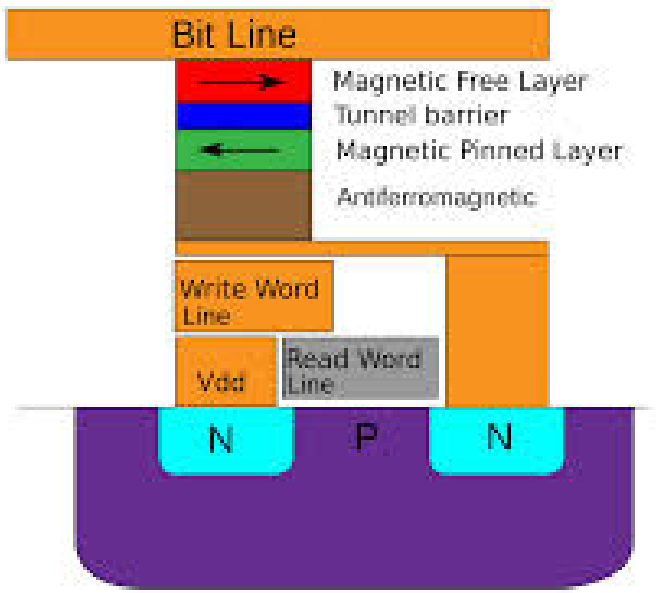
- Data stored using magnetic storage elements

Magnetoresistive RAM (MRAM)



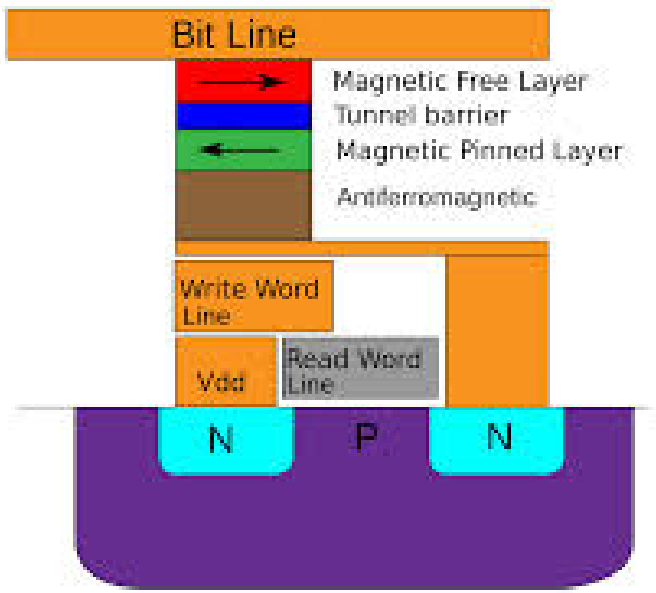
- Data stored using magnetic storage elements
- Two ferromagnetic plates each holding a magnetic field

Magnetoresistive RAM (MRAM)



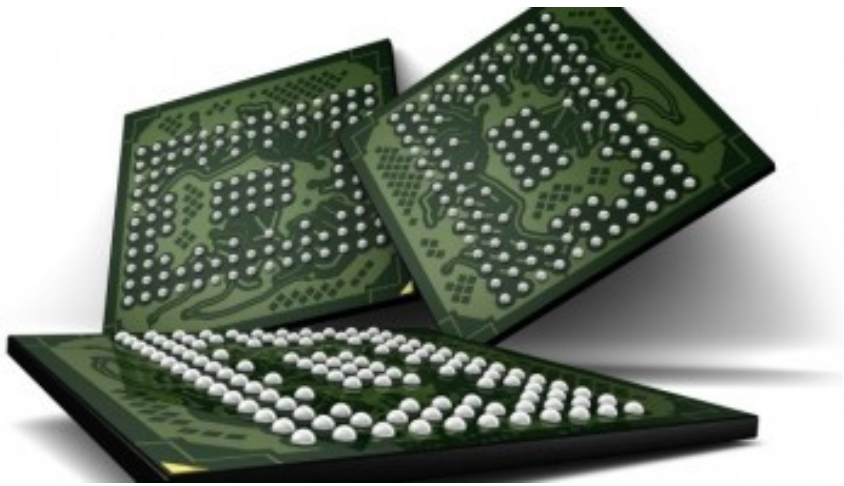
- Data stored using magnetic storage elements
- Two ferromagnetic plates each holding a magnetic field
- Data read by measuring electrical resistance of the cell

Magnetoresistive RAM (MRAM)



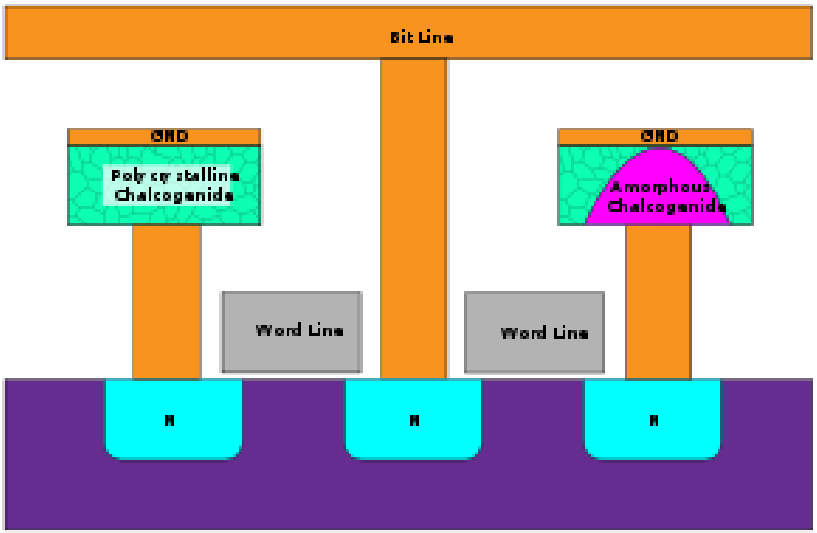
- Data stored using magnetic storage elements
- Two ferromagnetic plates each holding a magnetic field
- Data read by measuring electrical resistance of the cell
- Data written by inducing a magnetic field using a substantial current

Phase-change RAM (PRAM)



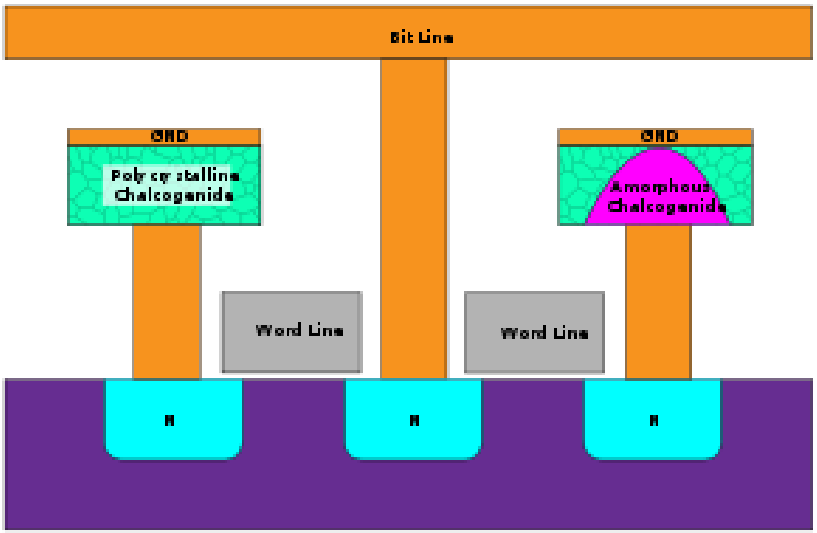
- Data is stored using chalcogenide glasses

Phase-change RAM (PRAM)



- Data is stored using chalcogenide glasses
- An amorphous state represents a 0, and crystalline state a 1

Phase-change RAM (PRAM)



- Data is stored using chalcogenide glasses
- An amorphous state represents a 0, and crystalline state a 1
- Able to hold multiple dates due to intermediary states

Solid-State Drives (SSD)

- Data stored using IC assemblies as memory

Solid-State Drives (SSD)

- Data stored using IC assemblies as memory
- Uses traditional I/O compatible with HDD

Solid-State Drives (SSD)

- Data stored using IC assemblies as memory
- Uses traditional I/O compatible with HDD
- SSDs have no moving parts

Solid-State Drives (SSD)

- Data stored using IC assemblies as memory
- Uses traditional I/O compatible with HDD
- SSDs have no moving parts
- Generally NAND-based flash memory

Solid-State Drives (SSD)

Intel® SSD Product Comparison

Product Name	Capacity (GB)	Sequential Read/Write (up to MB/s)	Random 4KB Read/Write (up to IOPS)	Form Factor	Interface
Data Center Products					
Intel® SSD DC P3700 Series	400 / 800 / 1.6 TB / 2.0 TB	2,800 / 2,000	460,000 / 175,000	2.5-inch and HHHL AIC	PCI Express* Gen 3
Intel SSD DC P3600 Series	400 / 800 / 1.2 TB / 1.6 TB / 2.0 TB	2,600 / 1,700	450,000 / 56,000	2.5-inch and HHHL AIC	PCI Express Gen 3
Intel SSD DC S3700 Series	100 / 200 / 400 / 800	500 / 460	75,000 / 36,000	2.5 and 1.8-inch	SATA 6 Gb/s
Intel SSD DC S3500 Series	80 / 120 / 160 / 240 / 300 / 400 / 480 / 600 / 800	500 / 450	75,000 / 11,500	2.5 and 1.8-inch	SATA 6 Gb/s
Professional Products					
Intel® SSD Pro 2500 Series	120 / 180 / 240 / 360 / 480	540 / 490	48,000 / 80,000	2.5-inch M.2	SATA 6 Gb/s
Intel SSD Pro 1500 Series	120 / 180 / 240 / 360 / 480	540 / 490	48,000 / 80,000	2.5-inch M.2	SATA 6 Gb/s
Consumer Products					
Intel® SSD 730 Series	240 / 480	550 / 470	89,000 / 74,000	2.5-inch	SATA 6 Gb/s
Intel SSD 530 Series	80 / 120 / 180 / 240 / 360 / 480	540 / 490	41,000 / 80,000	2.5-inch mSATA M.2	SATA 6 Gb/s
Intel SSD 525 Series	30 / 60	550 / 520	50,000 / 80,000	mSATA (1/8 the size of 2.5-inch)	SATA 6 Gb/s