



Flash Memory Summit



NRAM Carbon Nanotube Memory

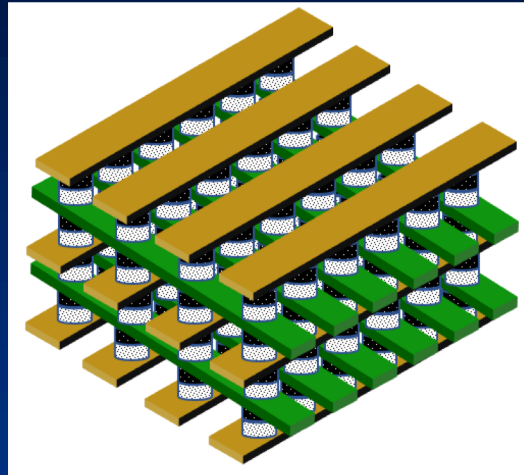
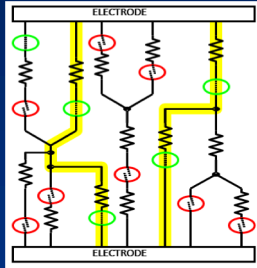
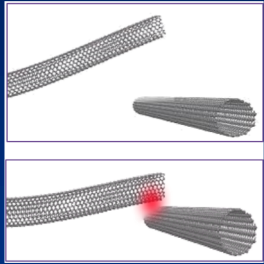
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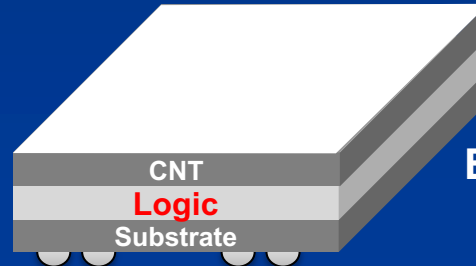


DDR4
DDR5



Nantero NRAM is a persistent memory using carbon nanotubes to build resistive arrays which can be arranged in a DRAM compatible device or deposited directly on circuits

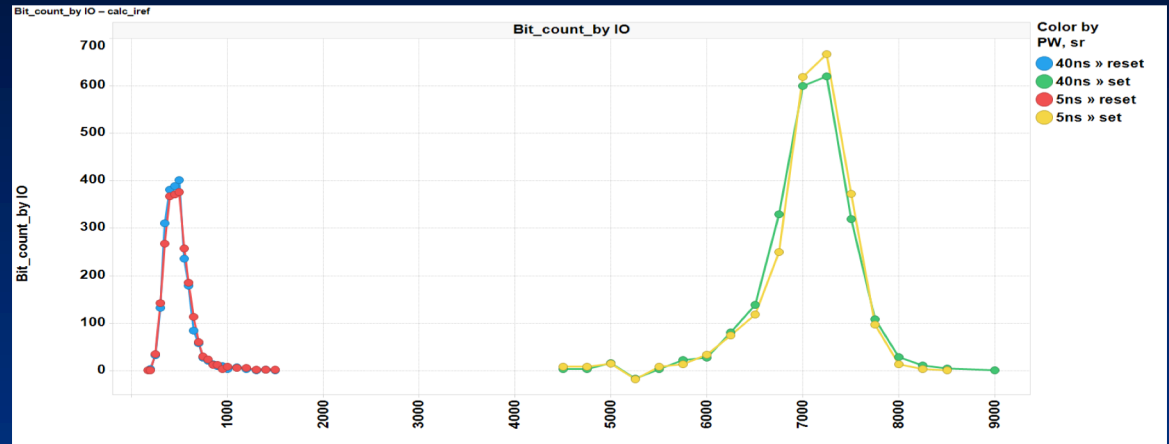
HBM



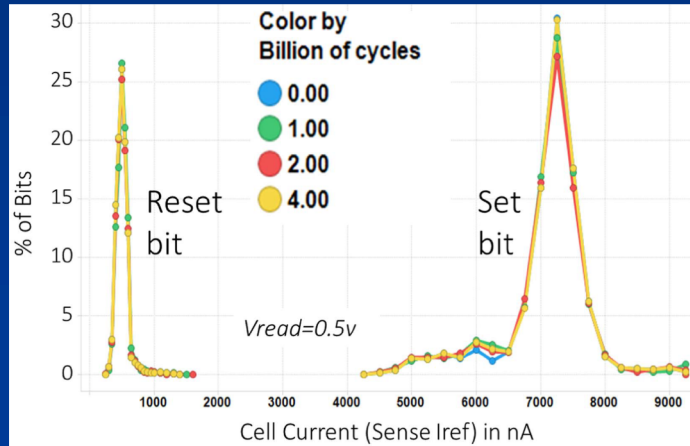
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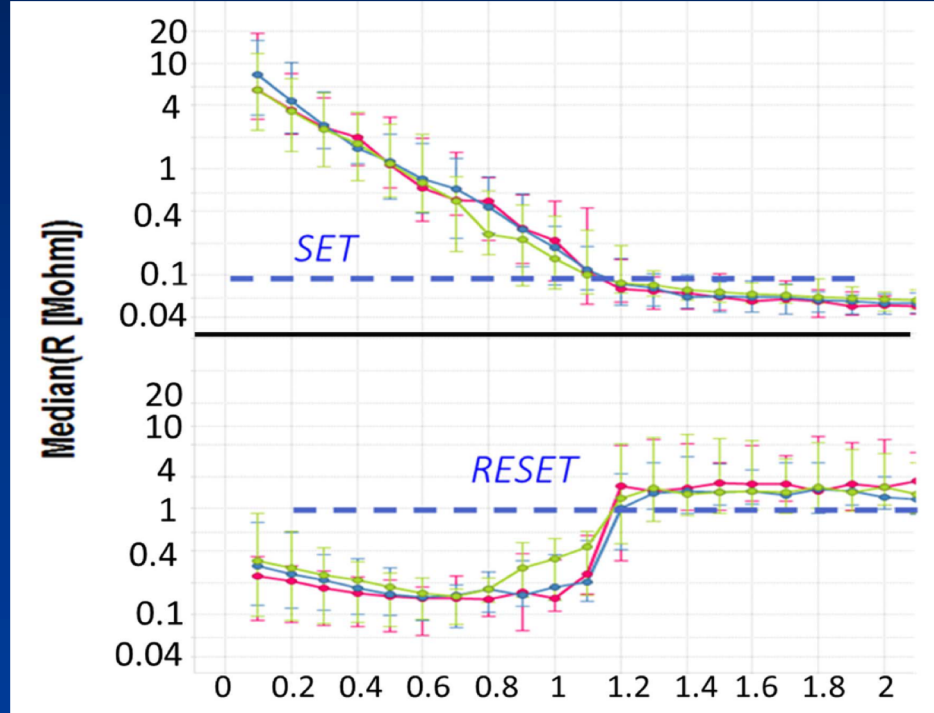
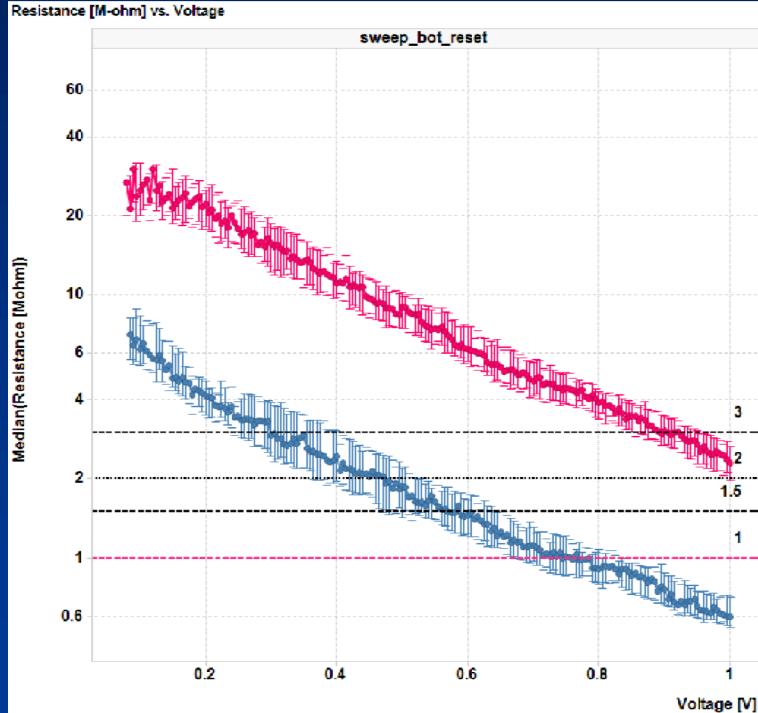
Consistent operation from 40 ns down to 5 ns read/write per cell



And very repeatable

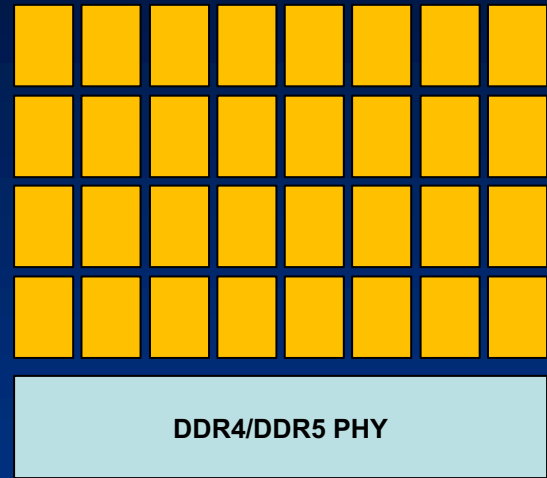


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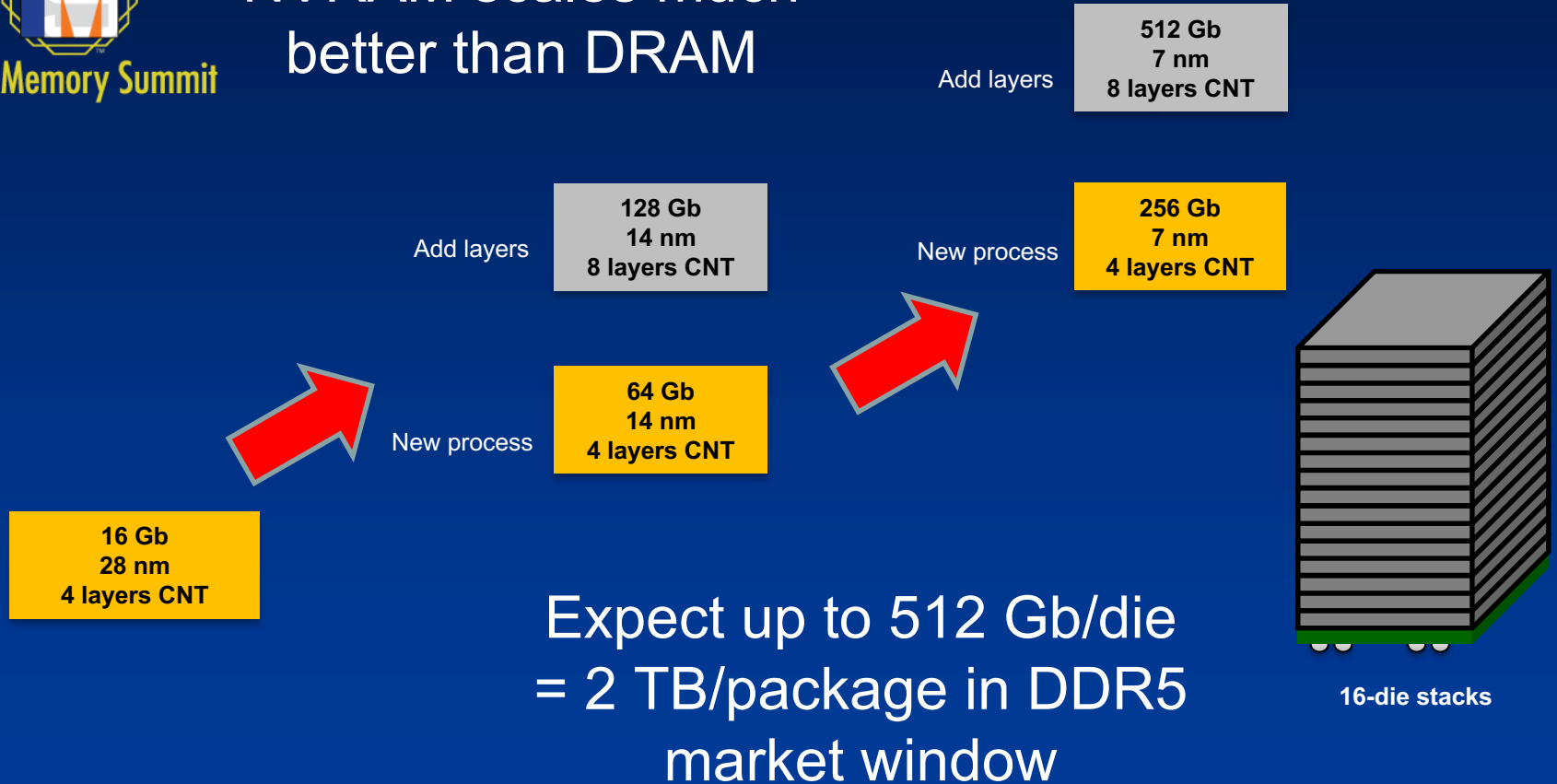


NRAM crosspoint tiles
fit into the DDR protocol
at full DRAM speed

No isolation selector
diode/transistor needed



NVRAM scales much better than DRAM





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JEDEC STANDARD

**Addendum No. 1 to JESD79-5,
DDR5 Non-Volatile RAM (NVRAM)**

JESD79-5-1

JC-42 Item #1856.10

September 2018

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION



New specification in process

Addendum to DDR5 SDRAM

Describes differences

Full presentation at Storage
Developer's Conference



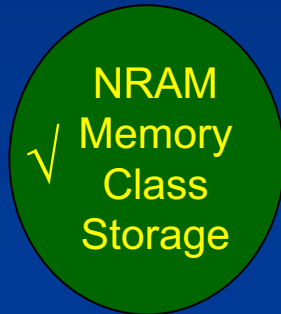
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One step closer to the Holy Grail
of end to end...

Data Persistence

Registers

Cache



✓ NVDIMM
Optane

✓ SSD

✓ Mag
Tape

✓ NVMe

✓ Hard Drive



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With **MC** Memory Class Storage, Some Systems May Eliminate Storage



CPU \$

Memory Control

- Memory Class Storage
- Memory Class Storage
- Memory Class Storage
- Memory Class Storage
- Memory Class Storage
- Memory Class Storage



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Thank you

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