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New Breakthroughs in NAND?

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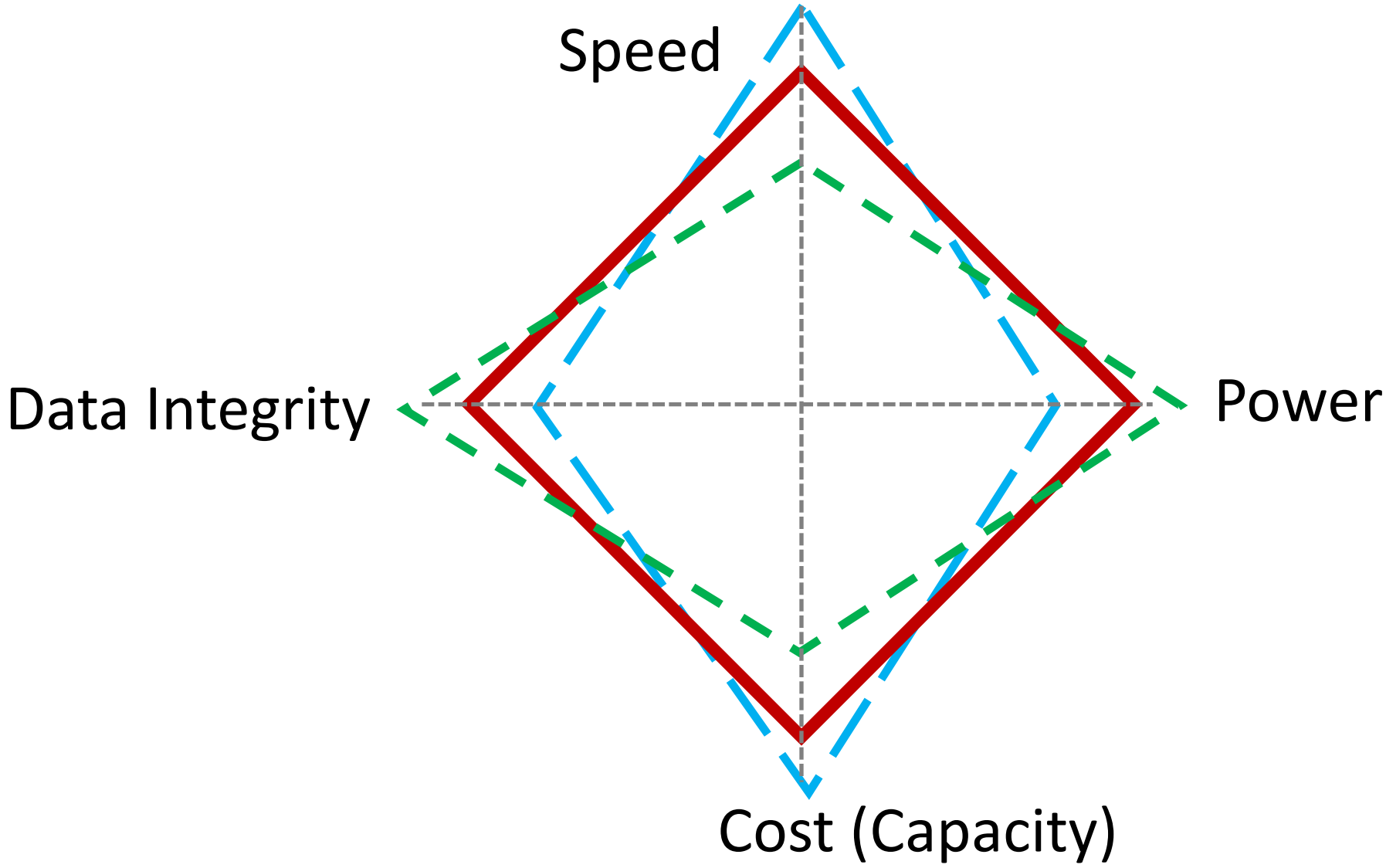
What Kind of Breakthroughs




Speed

Speed Improvement

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- Read Latency.
  - SLC ~ 30µs. (Compare with DRAM : 50ns)
- Write Latency.
  - SLC ~ 1ms
- Throughput
  - ONFI4 800MBps transfers. (Compare with 2GBps DDR, 40GbE, 100GbE)

Most Potential for Breakthrough : Read Latency → **Sub µs**

How Lower Latencies Impact Controller Design

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- NVMe
  - Is NVMe still relevant?
  - Current controller architectures rely heavily on firmware to interpret NVMe commands and translate from logical to physical addresses.
- Error Correction Coding
  - BCH codes can be fast, but lack in ECC performance achievable by LDPC.
  - LDPC codes and other large block codes require an entire codeword to be transferred to the controller prior to start of decoding.
  - Most new media undergo a period where data integrity is gradually improved until they become compatible with contemporary standards.
- Data Transfer
  - A 6µs transfer time quickly becomes a system bottleneck when Tread approaches 1µs

What Lower Latencies Mean to NVM Industry

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- Enable newer horizons
  - Neural networks and deep learning machines
- Higher levels of storage virtualization
  - Finer-grain definitions between hot and cold data on tiered storage networks
  - Improved QOS for HyperScale storage
- DRAM Replacement
  - A full replacement is unlikely, but the continued refinement of a tiered memory structure is very possible.

Unexpected Considerations

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- Asymmetric access times
- Power
  - Power loss protection
  - Sleep Power
- Write amplification
- Garbage collection
- RAID

THANK YOU

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