Accelerating Data Storage

MRAM as a Fast Storage Tier or Write Cache

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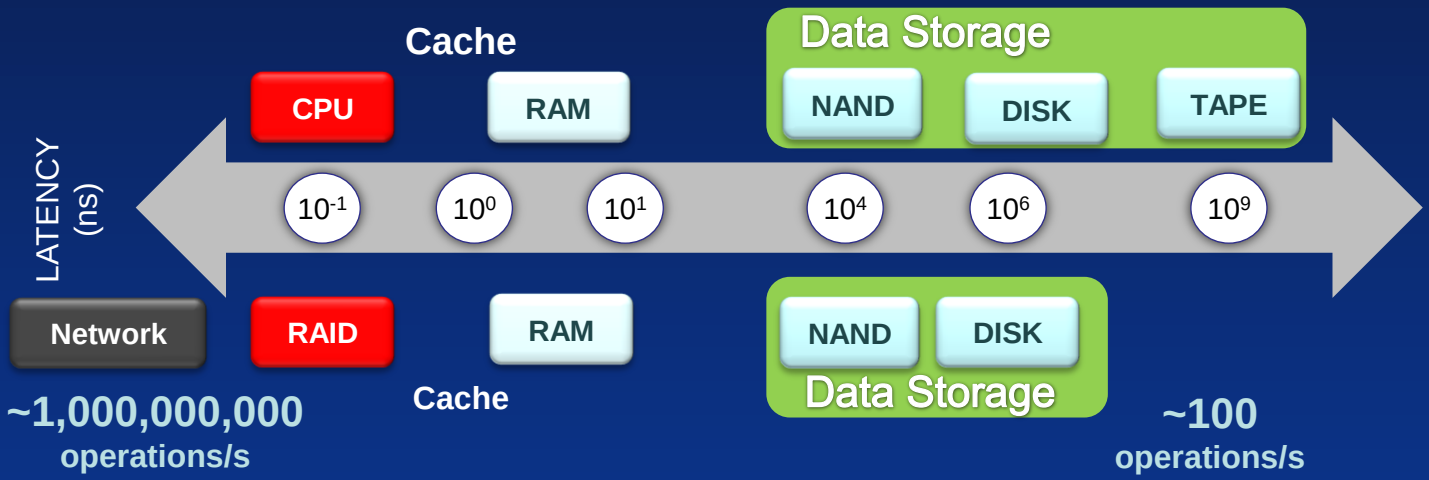
Storage Performance Gap

CPU – Storage gap increasing

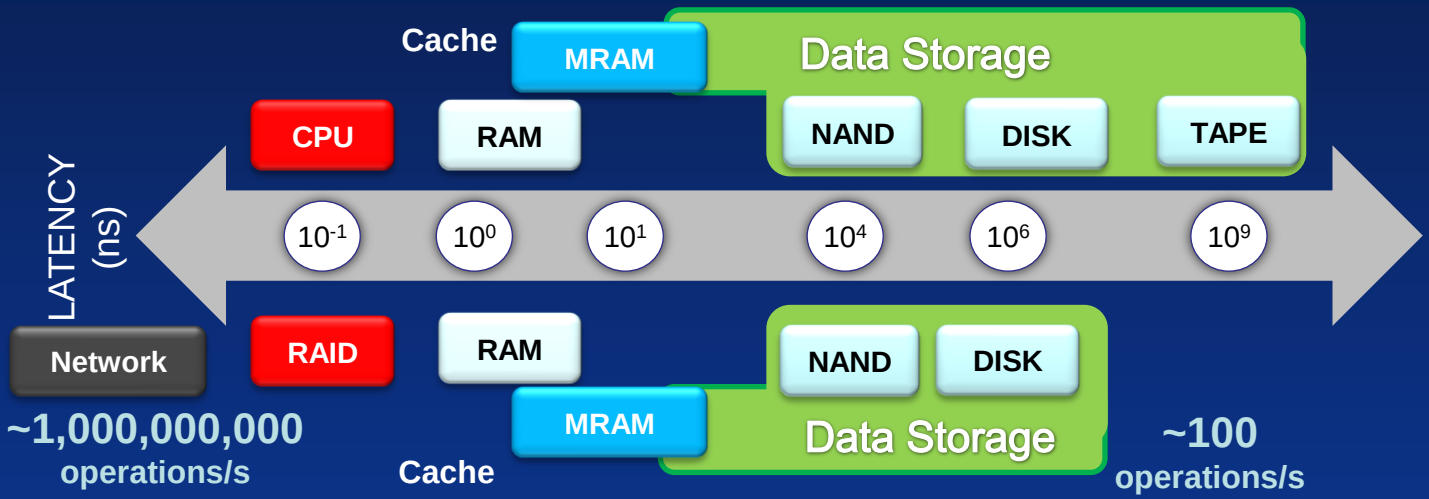


NAND introduces µs latency class for storage
Complexity, endurance and power-fail issues

Latency must be predictable & further improved

Storage Performance Gap

MRAM delivers ns latency class cache & storage



MRAM will complement existing storage technologies by adding a tier of persistent, high performance memory

Storage Solutions craving ST-MRAM

MRAM complements solid state & magnetic storage

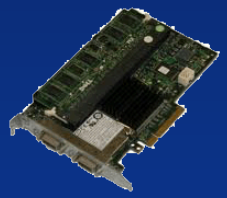
Improved response time due to low latency & high bandwidth



MRAM as Buffer Memory

MRAM instead of low density DRAM

Better performance & reliability




MRAM as I/O & Network Cache

MRAM instead of NV-DRAM

Better reliability & overall TCO


MRAM as Fast Storage-Tier

MRAM in addition to SSD/HDD

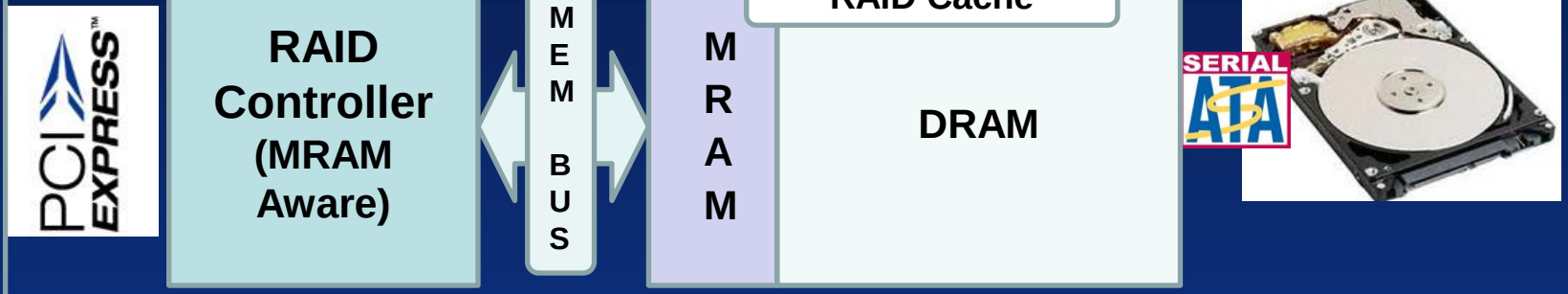
Better IOPS/$/W & reliability

Features to Support Effective Caching

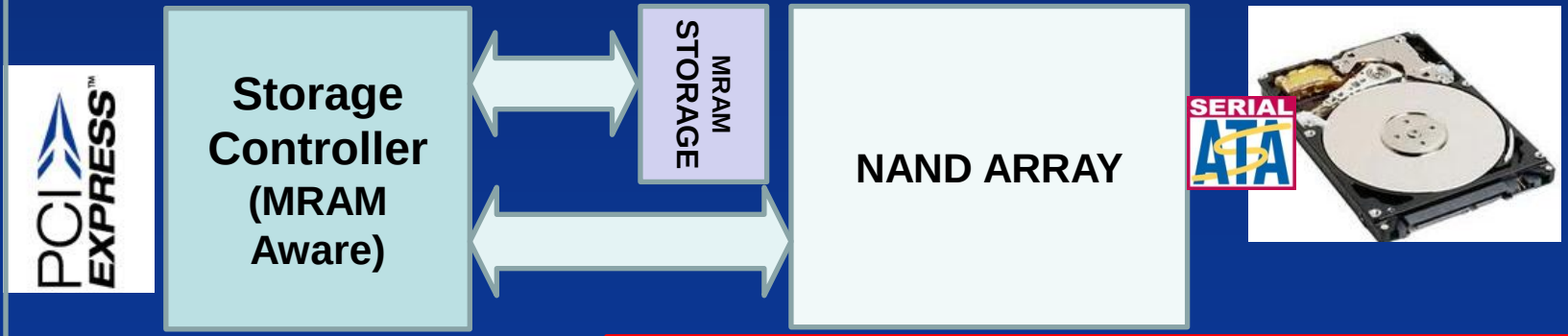
Feature	Metric	Everspin MRAM
Fast random access	SRAM/DRAM like speed	✓
Fast write time	Symmetric R/W	✓
High bandwidth	10.6 GB/s-12.8GB/s	✓
High endurance	10^{15} Write cycles	✓
Random Access	Bit/Byte addressable	✓
Power Loss Protection	Preserve in-flight data	✓
Controller Compatibility	Industry support	✓
Small Form Factor	Small BGA or DIMMs	✓
Power Fail Circuit	No SuperCaps/Batteries	✓

MRAM Write Cache or Fast Storage Tier

Write Cache



Fast Storage Tier



Building an Ecosystem

- **Memory Controller compatibility**
  - Cadence Denali Databahn memory controller
  - FPGA RTL
  - Working with many of the leading IP providers and EDA suppliers
- **Form Factor**
  - Industry standard component package and DIMMS
- **PCIe interface evaluation system**
  - Enabling ease of evaluation and adapted to the latest storage protocols
- **Architecture**
  - Enable hybrid Cache of MRAM+DRAM
  - Use MRAM for Write Cache to protect critical or in-flight data
  - MRAM only when Cache size allows (MRAM density increases over time)