



STORAGE INDUSTRY SUMMIT

The Future of Computing:
The Convergence of Memory
and Storage through
Non-Volatile Memory (NVM)

JANUARY 28, 2014, SAN JOSE, CA

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Trends in HW and SW

That Will Create Disruption

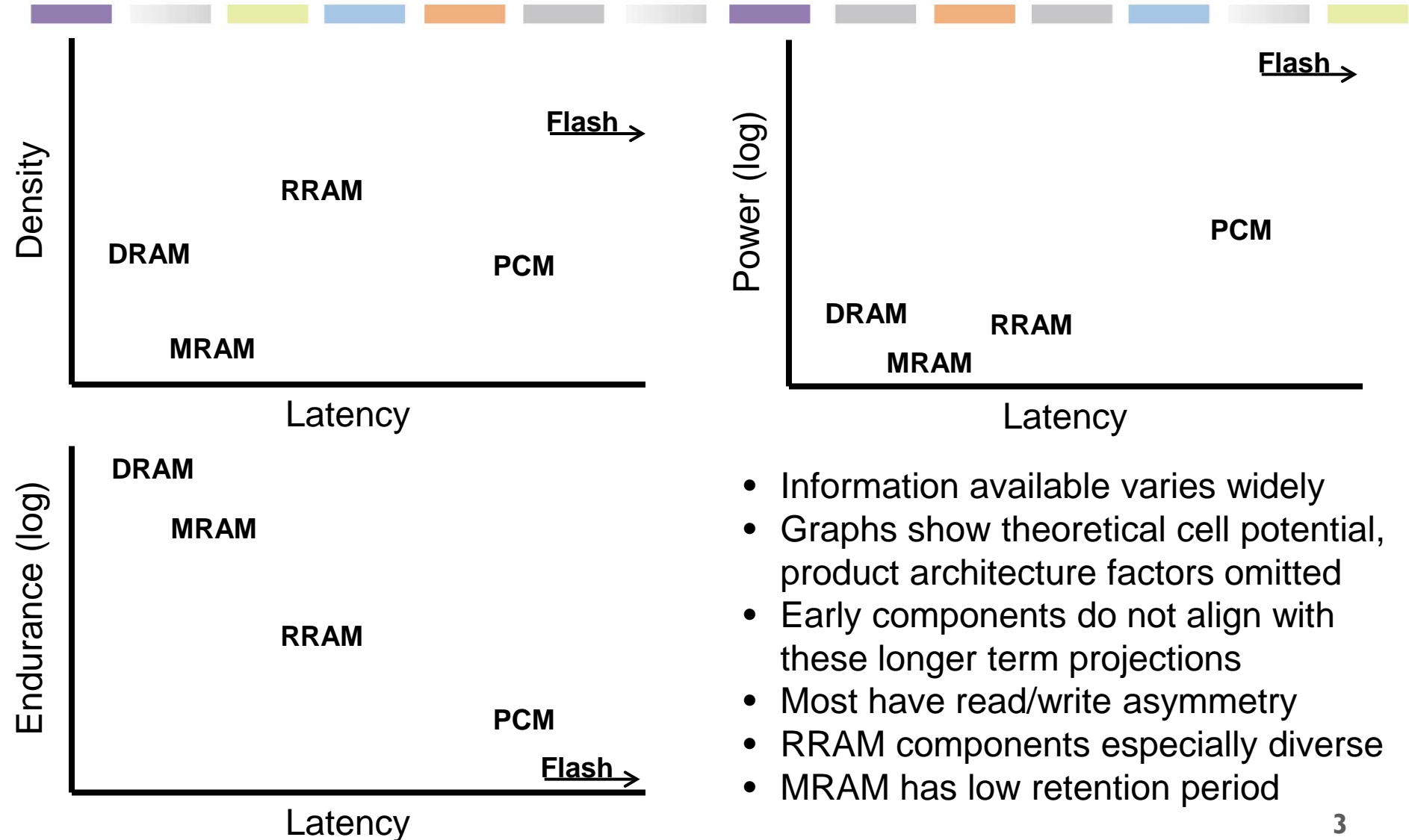
Beyond PCIe and Flash



Agenda

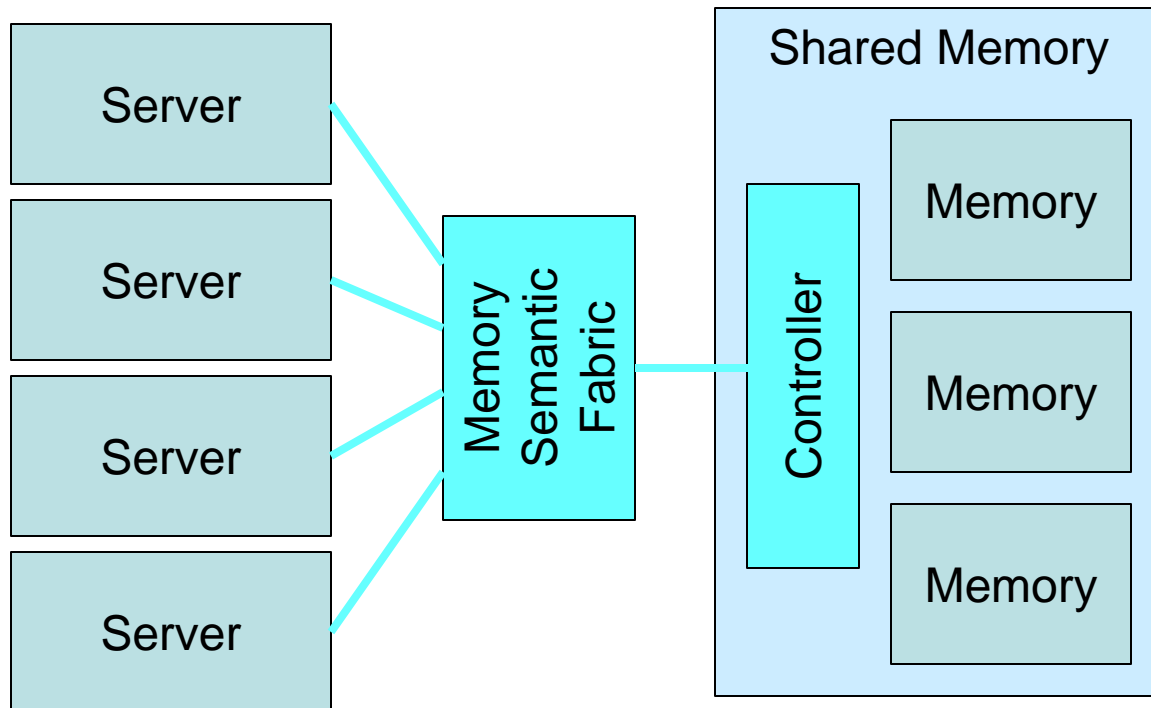
- Non-Volatile Memory Technologies Beyond Flash
- Memory Disaggregation
- Application View
 - ◆ IO Elimination
 - ◆ Memory Properties
 - ◆ Abstractions
- Navigating Chaos

Technology Comparison Beyond 2015



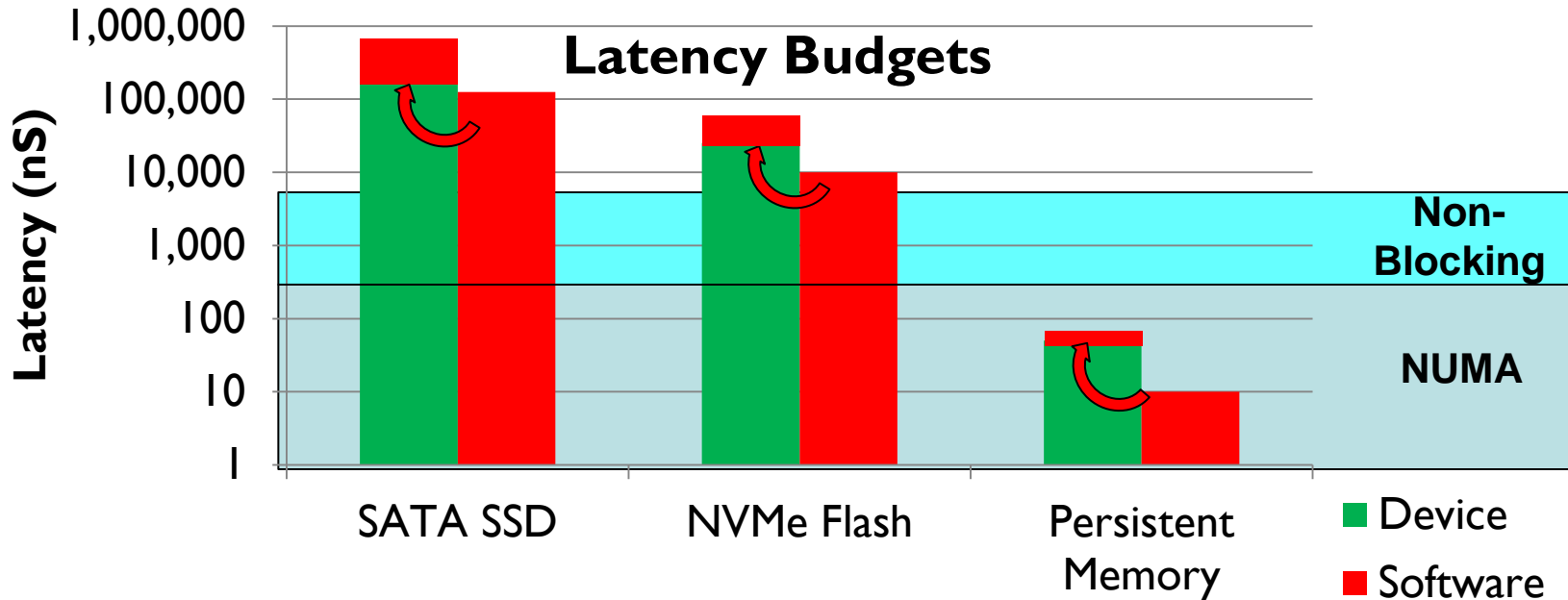
- Information available varies widely
- Graphs show theoretical cell potential, product architecture factors omitted
- Early components do not align with these longer term projections
- Most have read/write asymmetry
- RRAM components especially diverse
- MRAM has low retention period

Memory Disaggregation



Increased flexibility to provision memory from a shared pool
Pass data or VM's between servers without moving bits
Enabled at rack scale using silicon photonics

Application View of IO Elimination



Software overheads are being driven to keep pace with devices
NUMA latencies up to 200 nS have historically been tolerated
Anything above 2-3 μ S will probably need to context switch
Latencies below these thresholds cause disruption

Durability

- Applications should know which memory is persistent.

NUMA

- What part of the system manages proximity of processing to memory?
 - How much unpredictability is tolerable?

Multi-processing

- SMP boundaries implied by distance and fault domains

Abstractions need to account for...



Resource Diversity

- ▶ Choosing the right memory resources in real time

System Scalability

- ▶ Programming model accounts for wide scale

Transactions

- ▶ Accelerate recoverability to memory speed

Thriving in Chaos

- Make sure hierarchy levels earn their places
- Think dual stack
- Make middleware take up the slack
- Mind the fault lines



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