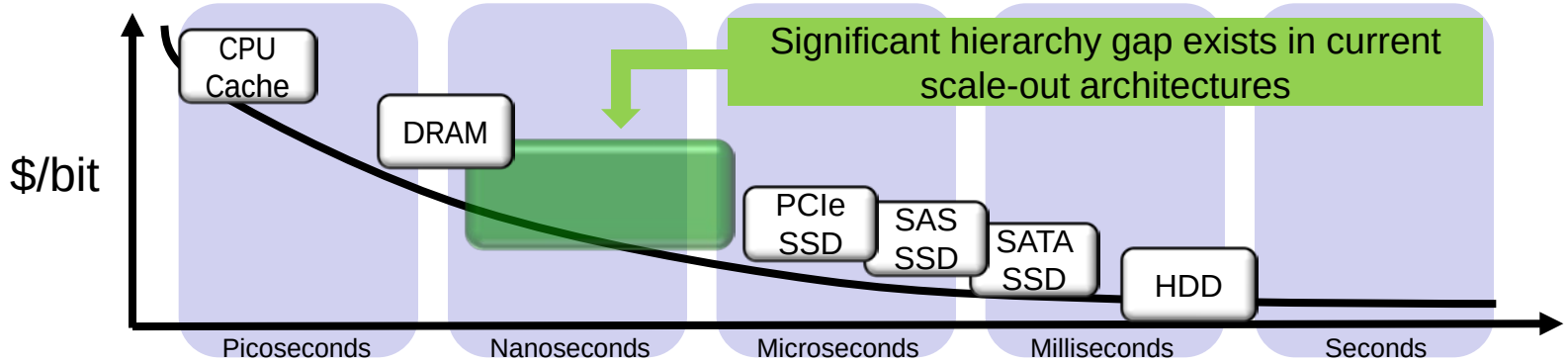
The Case for Composite DIMMs

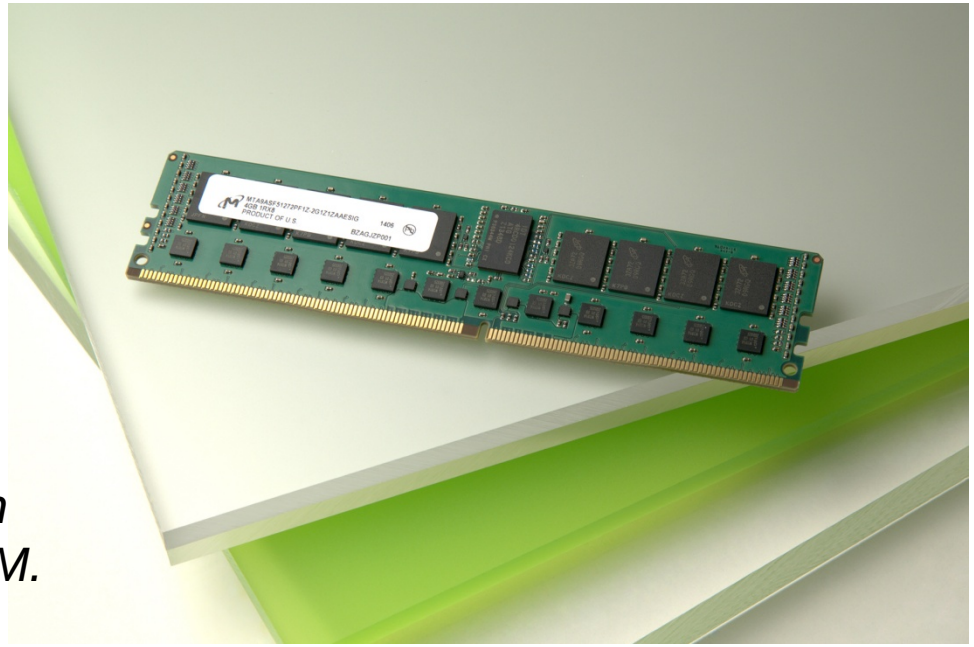


- Speed/performance driving large data sets to be stored in “warm” or “hot” locations (NVDIMM, PCIe SSDs).
- Enterprise applications need real-time processing to capture, analyze, and respond intelligently to changing events.
- Reliability/uptime is critical for enterprise IT resources.

Maintaining QoS while supporting increasingly demanding enterprise workloads are driving need for higher memory performance and capacity.

NVDIMM

- Write Cache
- Metadata Storage
- Tiered Storage
- In-Memory Database



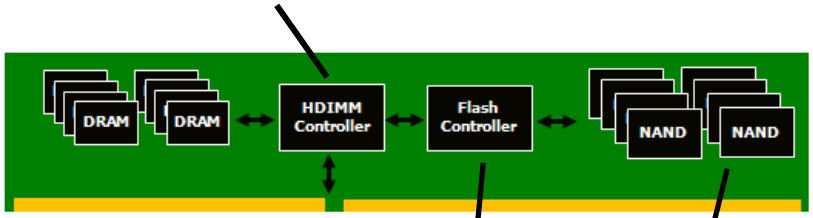
All require DRAM performance with persistance and/or endurance of NVM.

System Integration -- a maturing ecosystem

Components	*Platforms*	*Applications*
• BIOS/FW • Chipset • OS/Software	• OEM/ODM • MB vendors • Application Dev.	• Server • Storage • HPC

Evolution: Composite DIMM

Controller
Primary interface to system; accounts for latency differences between DRAM and NAND



Flash Controller
Updated as Flash requirements change

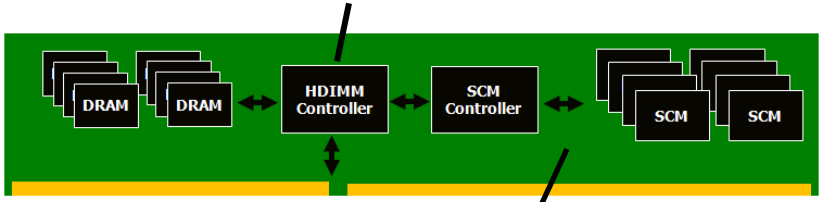
Onboard DRAM & NAND
DRAM performance with non-volatility

Enables high capacity, application storage space on the DDR bus

- Large application storage with large DRAM cache
- NAND used as fast, local swap space for DRAM memory
- Raw flash block storage with DRAM memory
- Requires significant software/ecosystem enablement to leverage full capabilities
- More transactions to NAND flash require significant NAND management

Evolution: Emerging Tech.

Controller
Primary interface to system; accounts for performance differences between DRAM and SCM



SCM and SCM Controller
As required by application

Incorporates key EM benefits without significant changes to system interfaces

- Enables faster time to market for new memory technologies
- Likely requires software/ecosystem enablement to leverage full capabilities

Attribute	Emerging Memories		NAND
	DRAM-Like	SCM	
Non-Volatile	Yes	Yes	Yes
Access Granularity	Small/Byte	Small/Byte	Large
Erase	No	No	Yes
Management	Easy	Easy	Hard
Power	High	Medium	Low
Write BW (x8)	~3200 MB/s	~400 MB/s	~10 MB/s
Read Latency	~25 ns	~100 ns	~10,000 ns
Endurance	Unlimited	10^{6+}	10^{4-5}
Cost Per Bit	DRAM	<DRAM>NAND	NAND

Summary

- Memory/storage hierarchy gap exists in current scale-out architectures.
- Evolving workload demands are driving new memory requirements.
- Evolutionary path toward new system capabilities.
- Composite DIMMs using emerging memory variants can extend capabilities of DRAM-based memory.
- Abstracting management of memory affords best potential for higher system performance and greater flexibility and intro for emerging tech.