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SYSTEM-LEVEL IMPLICATIONS OF NON-VOLATILE, RANDOM-ACCESS MEMORY

Level-Setting

- Intel Labs
  - → No conclusions on future roadmap possible
  - → No disclosure of research details
- Electrical engineer
  - → No new computer architecture concepts
  - → No low-level material science
- System-level implications
  - → No direct link to Barrelfish

Can Barrelfish provide a
better environment for experimentation?

Emerging Memory Technologies (1)

- "Computer memory innovation is nearly irresistible" (R&D Magazine, Oct. 11)
  - Charge-based memories (DRAM, Flash) face severe scalability problems
  - Industry-focus on resistance as information carrier
- Implicit non-volatile storage ➔ NVRAM
- Opportunity for universal memory (working memory and storage)

Emerging Memory Technologies (2)

- ◉ Current prototypes
  - PCM   Phase-Change Memory
  - STTRAM   Spin-Torque Transfer RAM
  - ReRAM   Resistive RAM

Technology	DRAM	PCM	STTRAM	ReRAM
Density	0	+	-	++
Latency (ns)	10/10	20/50	6/12	10/10
Energy (pJ/b)	2	100	3	2
Endurance	n/a	10e8	10e15	10e12

Taciano Perez, Cesar A.F. De Rose:
Non-Volatile Memory: Emerging Technologies And Their Impacts on Memory Systems

System Implications

- DRAM → NVRAM
  - But volatile memory in cache hierarchy
  - SW-transparent vs. SW-managed
- Virtual memory
  - Huge physical address space
  - Protection of storage-class data
- Persistent memory
  - Orthogonal persistence
  - Data security

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