What is persistent memory?

- Persistent
- Byte addressable
- Load/store
- Behaves like DRAM

Persistent Memory

Persistent Storage

1994 eNVy
2004 MRAMFS
2009 Better I/O
2009 OS Support
2011 Consistent and Durable
2011 Mnemosyne
2013 Atlas
2014 SOFORT (SCM)
2016 NOVA
2017 5 Level Page Tables
2018 NVStream
2019 Intel Optane DC Persistent Memory Released
2019 SplitFS

Brief History of Persistent Memory Research (1994-2020)

DRAM v PMEM Performance

Locality Matters!

Demand Paging: Not Compelling for PMEM

- PMEM Density much larger
- Time to transfer 1TB from storage: 32 seconds @ max bus speed
- Time to switch 6TB PMEM from storage: 6.4 minutes
- Conclusion: certainly not at 4KB, probably not at all.

Future PMEM Technologies

What does a PMEM based system design look like?

Data (Memory) Intensive
- Flat addressing/no paging
- Critical spacial locality
- CPU caches less effective

Persistence Focused
- Flat addressing (fix pointer issue)
- Efficient load/store usage
- Recovery: PMEM doesn’t forget

Judicious flush/fence usage