Closing Remarks –
Did we Accomplish What we Said We Would?

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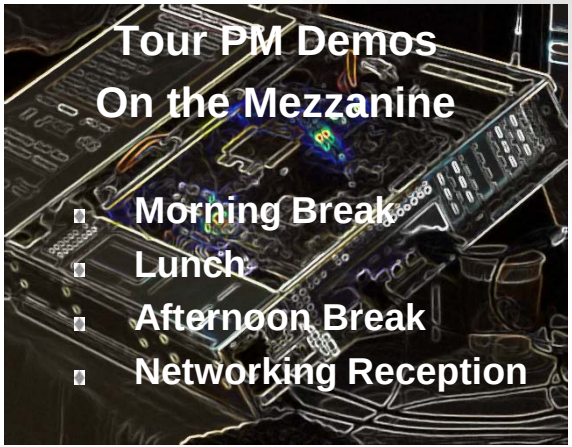
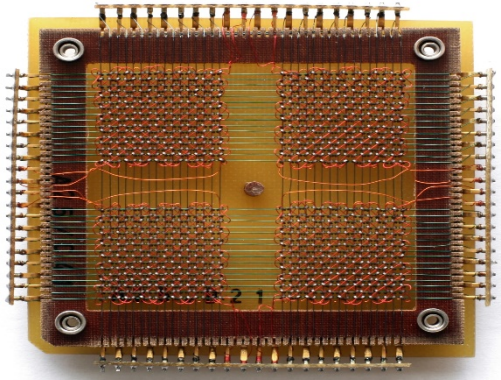


Today – Persistently Fun

- We had a metric boatload of great presentations/sessions!
  - PM Characteristics
  - The SNIA NVM Programming Model and its Impact
  - Enabling PM via Operating Systems
  - Enabling PM in Java
  - Cloud-native Apache Spark w/PM
  - Existing/New Uses for NVDIMMs (-N, -P)
  - PM and In-Memory Databases
  - New Interconnects for PM
  - PM Performance Benchmarking/Comparisons
  - Remote PM
  - PM Media Types
  - The Analyst View of PM
  - Recap
  - Beer o'Clock

The Distant Past: Persistent Memories in Distributed Architectures

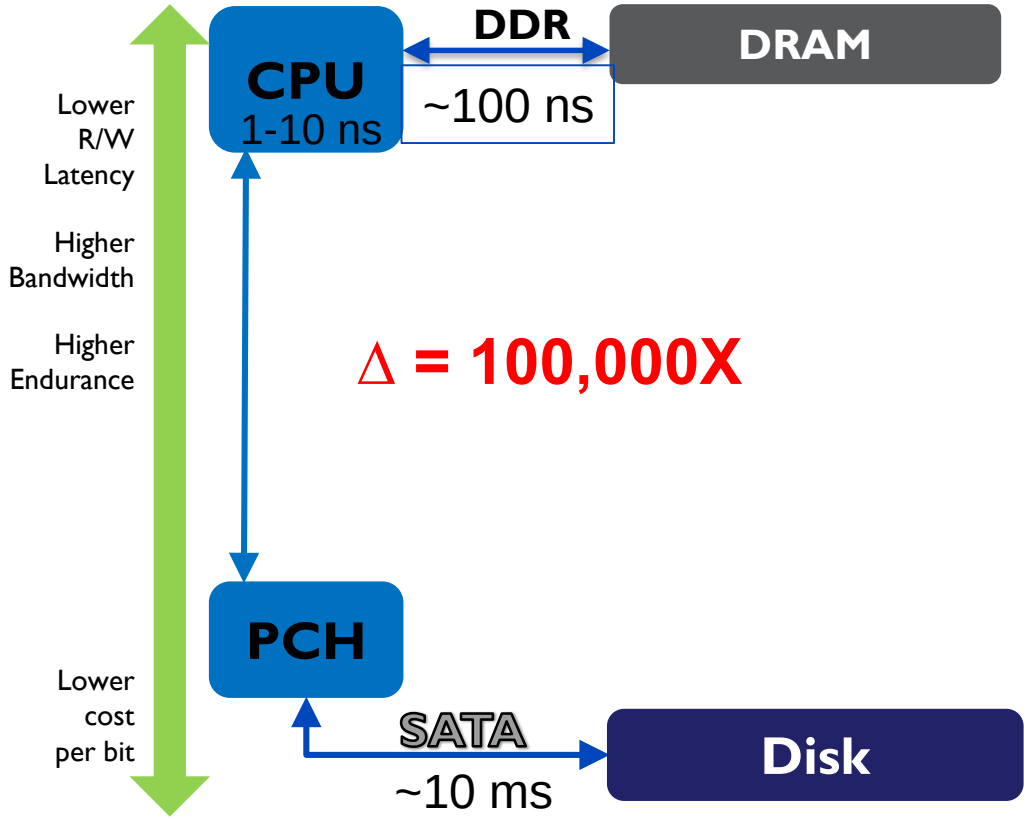


Courtesy Konstantin Lanzet

Courtesy CDC

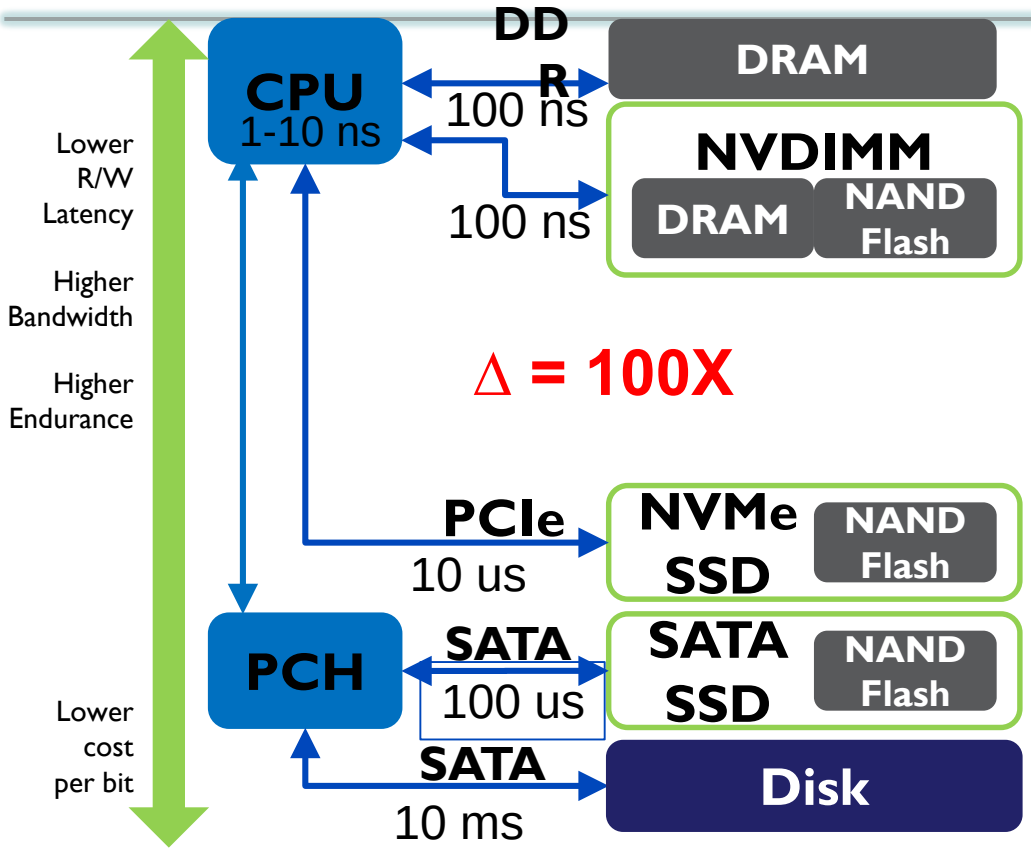
- Ferrite Core memory
- Module depicted holds 1,024 bits (32 x 32)
- Roughly a 25-year deployment lifetime (1955-1980)
- Machines like the CDC 6600 (depicted) used ferrite core as both local and shared memory
- CDC 7600 4-way distributed architecture – aka 'multi-mainframe'
- Single-writer/multiple-reader concept enforced in hardware (memory controllers)

The Past: Nonvolatile Storage in Server Architectures



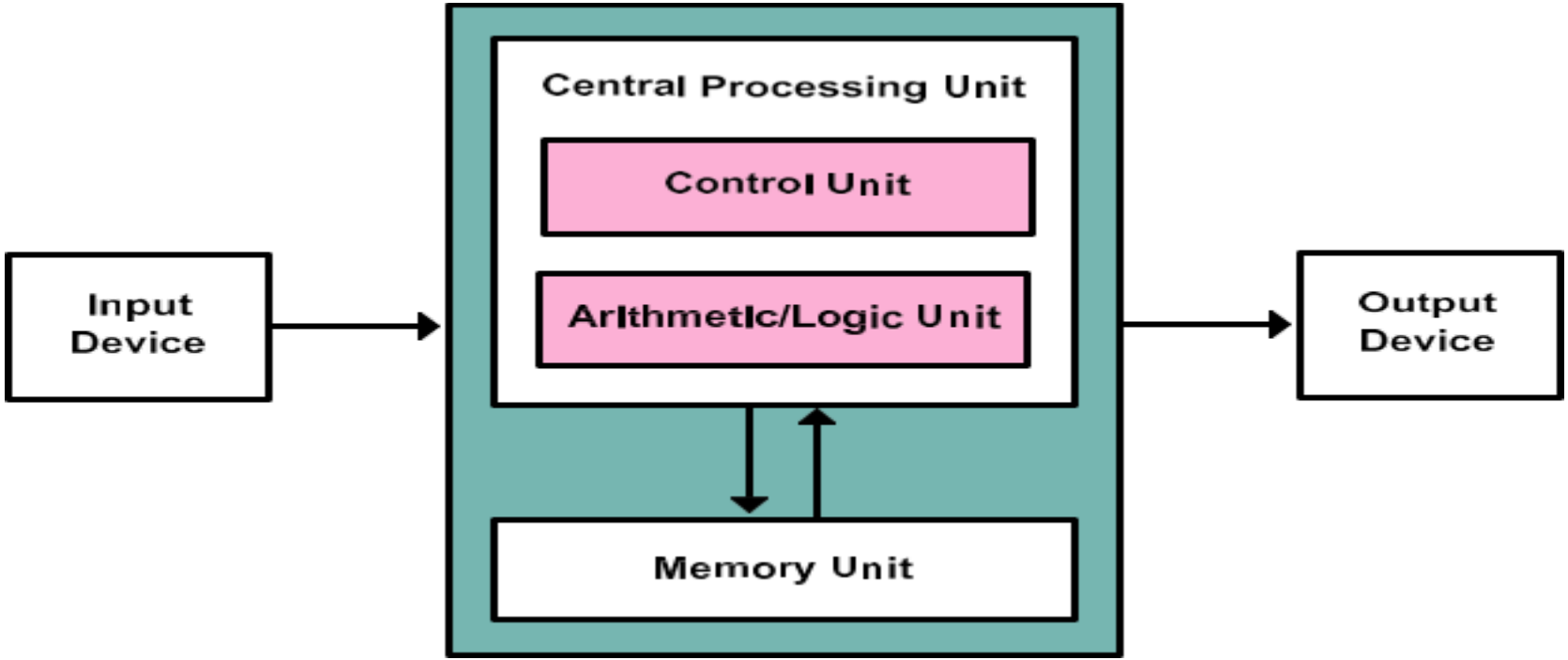
- For decades we've had two primary types of memories in computers: DRAM and Hard Disk Drive (HDD)
- DRAM was fast and volatile and HDDs were slower, but nonvolatile (aka persistent)
- Data moves from the HDD to DRAM over a bus where it is the fed to the processor
- The processor writes the result in DRAM and then it is stored back to disk to remain for future use
- HDD is 100,000 times slower than DRAM (!)

The Near Past: 2D Hybrid Persistent Memories in Server Architectures

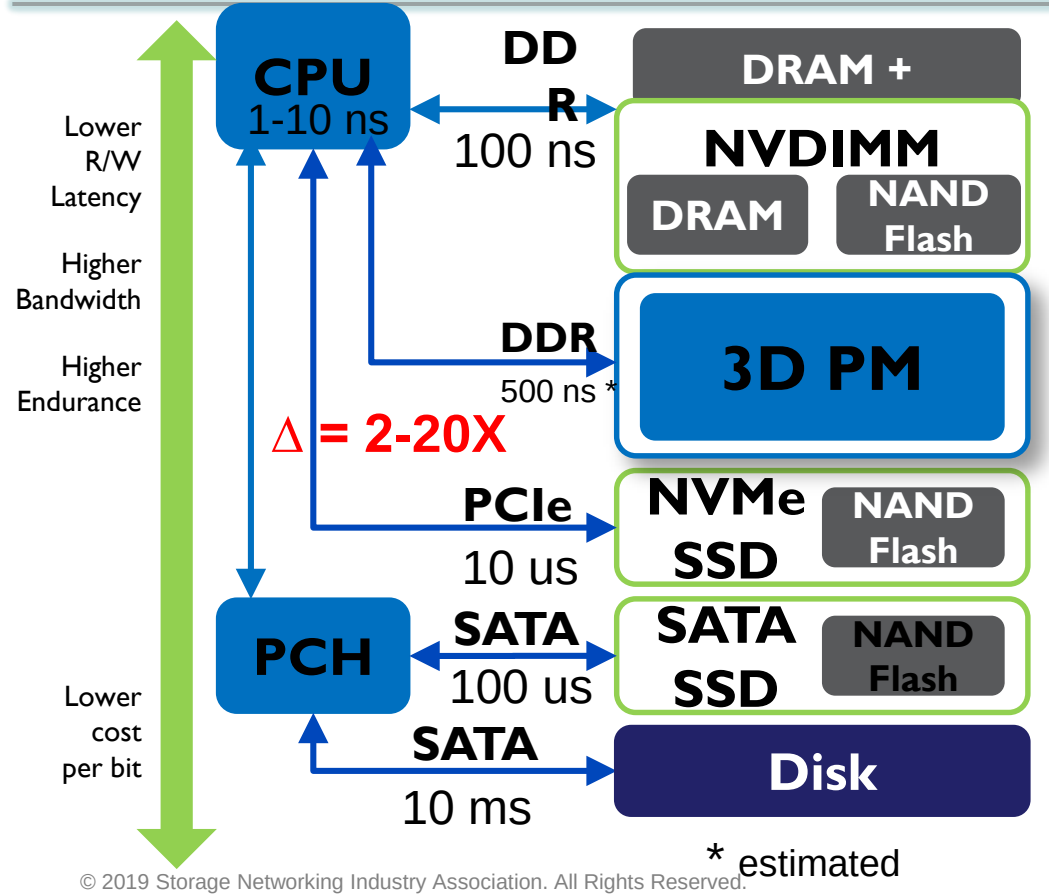


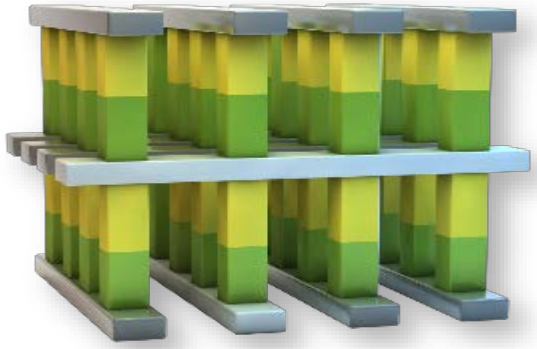
- System performance increased as the speed of both the interface and the memory accesses improved
- NAND Flash considerably improved the nonvolatile response time
- NVMe and PCIe made further optimizations to the storage transport and interface
- NVDIMM provides super-capacitor-backed DRAM, operating at DRAM speeds and retains data when power is removed (-N)

The Classic Von Neumann Machine

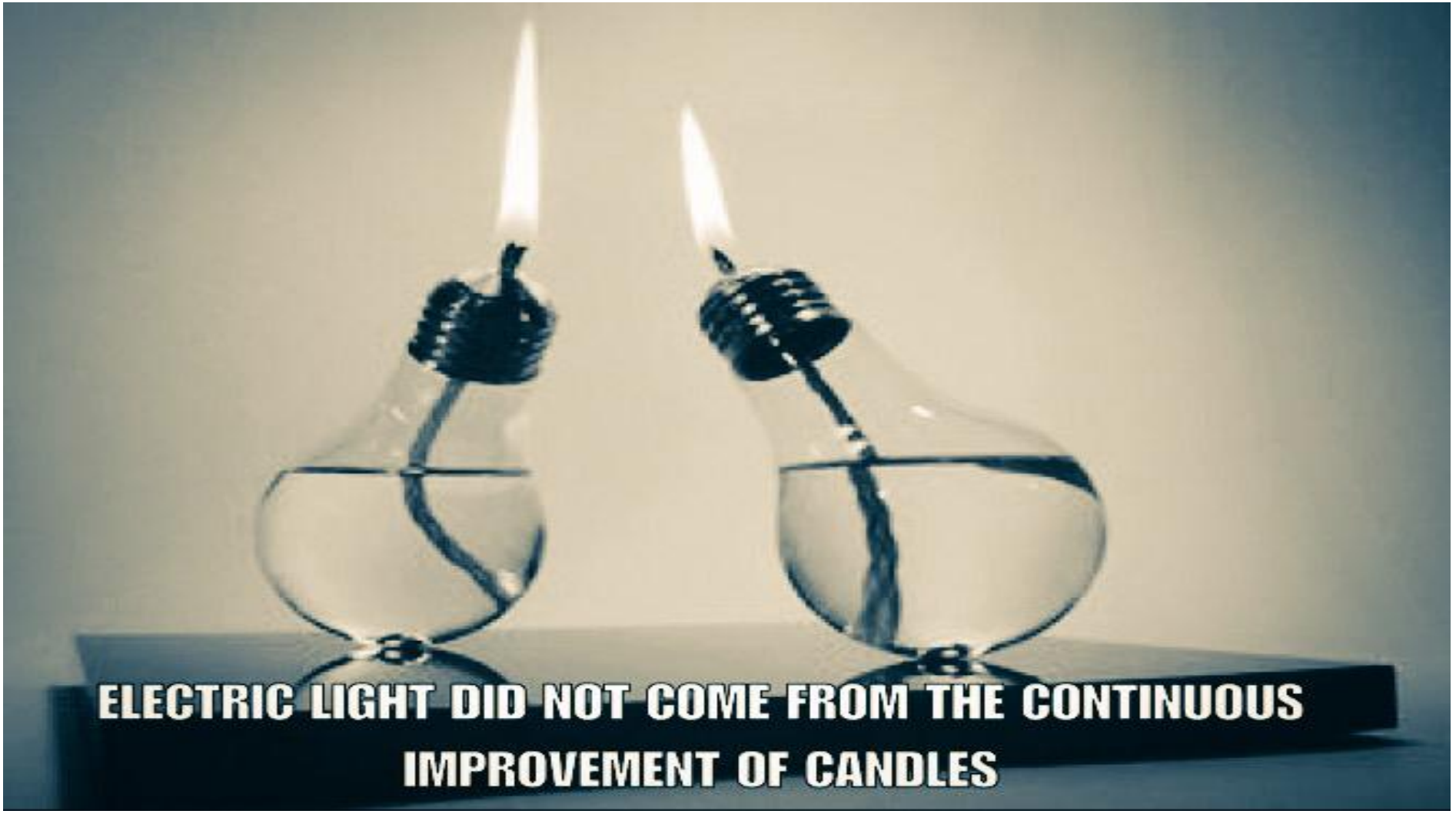


The Present:
3D Persistent Memory in Server Architectures





- PM technology provides the benefit "in the middle"
- It has considerably lower latency than NAND Flash
- Performance realized on DDR bus and/or future bus designs
- Lower cost per bit than DRAM while being considerably more dense


ELECTRIC LIGHT DID NOT COME FROM THE CONTINUOUS
IMPROVEMENT OF CANDLES

How Was The Summit for You?

- How was it?
- What could be better?
- What did we do well?

THANK YOU !!!