State of Industry

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Where we are at

• Hardware
• System Software
• Applications
Hardware

- **CPU**
  - Hardware instructions for Advanced Encryption Standard (AES) and Secure Hash Algorithm (SHA) need to be in all CPUs or some equivalent
    - Applications need to take advantage of these features in CPUs that support them
- **Memory**
  - Memory hybrid cubes are just about here
  - As are non-volatile memory
  - And DDR-4 (double data rate fourth generation) which adds parity to reduce the potential for Silent Data Corruption (SDC)
- **Connectivity**
  - PCIe (Peripheral Component Interconnect Express) connectivity is the rage given flash performance needs
  - But what happens to the PCIe bus is in question
- **Storage**
  - Disks getting denser and faster less expensive
  - SSDs getting somewhat denser but not faster for writes
  - Tape getting denser but not faster
System Software

- Linux OS working to integrate objects
  - Still lacking management and resource control for objects
- Memory management framework needs to take into account non-volatile memory
  - Intel doing some work but more is needed
- Still no end to end standard for checksums or ECC (Error Correction Codes)/Erasure code/Forward error correction
  - It will not happen within POSIX (Portable Operating System Interface) framework for I/O but maybe the object world can solve this
    - There is hope on this front
Application Software

- Need application interfaces to:
  - Hardware offload (do things in hardware not software)
    - Example include security, networks and more to come
  - New storage frameworks
    - As Dave Anderson will be discussing

- Need interfaces for reliability end-to-end starting in the applications
  - Still nothing on the horizon
    - I have been asking since the 1st storage conference in ~2004

- Applications framework will never happen in POSIX as there are really no changes being done
  - I am hopeful that it will be done with objects
  - But we have 30 years of code that need to be ported to support object interface
Final Thoughts

• Needle has not moved much in a decade given the needs in the preservation world
  – Maybe it was just too hard to do in the frameworks we had
  – Maybe meeting the needs of the preservation world were too high cost for the rest industry
  – Maybe it is both and/or something else

• Challenges of the preservation world continue to grow and yet the industry as a whole is not taking action
  – Next 1.5 days we hear from people and understand where they are going and hopefully there is an intersection that meets everyone’s needs