Designing Storage Architectures for Digital Preservation

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Henry Newman

Community Challenges

- ## Hardware
  - Performance growth slower than the growth of data
- ## Software
  - Limited by POSIX framework and per file and file system standards that have not changed and are not going to change
- ## Nomenclature failure
  - Preservation community (librarians and archivists) discuss preservation completely differently than IT people and/or vendors
    - Vendors use different "9" counts
    - Librarians use "data loss" or "no data loss"
- ## Technology Costs
  - The TCO of digital preservation is not well understood
  - Lots of hidden costs and impacts
    - New technology might be "cool" but generally higher costs for people to architect and deploy

Hardware Technology

- Cores increasing faster any other component
  - Per core memory bandwidth is dropping as core counts increase and checksums require memory bandwidth
- Memory bandwidth has not and is not expected to scale with CPU core counts
  - Both needed for data validation and checksums
    - DDR-3 memory performance has not scaled with CPU performance increases
- Reliability of technology is not improving
  - Hard error rates for datapath (CPU, memory, buses, storage …)
  - Undetectable error rates (error not detected in hardware)
    - Exception is T10 PI/DIX which adds a checksum byte to each SCSI packet

Instrumental
HIGH PERFORMANCE INNOVATION

- No standards for checksum management
  - Critical for digital presentation whether data is in a cloud or not
    - Nothing in POSIX and nothing planned

- No OS standards for long term preservation
  - No per file error correction
  - No standards for digital preservation data access
    - Every HSM is different and no real standards
  - No standards for migration either local or cloud
    - How do you migrate 100 PBs from vendor A to B

Instrumental

- No common areas of discussions between technology people and the library/archivist community
  - Expectation of data loss by technologists and no data loss by library/archivists
- No one can calculate the reliability of data in an archive with any accuracy given a significant amount of information is not published
  - Best we can do is an estimate of reliability
    - Too many factors to evaluate like what I call the sprinkler errors
- No vendor nor IT professional will ever provide 100% data reliability for even 1 PB data
  - But what is the number of 9s they will provide?
  - But what is the cost for adding 1 more 9?

Costs and Budgets

- Costs and therefore the budget requirements of digital preservation are not understood
  - Lots of hidden costs and impacts
- 100% data reliability is impossible at reasonable cost
  - And claims to the contrary should be ignored
    - Even if stored in something like Yucca Mountain
- What are the actual "9" counts as they relate to long term budgeting
  - It is not discussed and the community must know this