

Roundtable Discussion

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Changes in storage technology will occur and will change the model for data intensive computation

- Storage must make huge advances in power conservation to keep up with CPU technology
 - Flash is at 10⁴pJ/bit,
 - HDD at 10^8pJ/bit,
 - STTRAM at 0.1pJ/bit
- Differences in performance layers must be leveled to gain computational efficiency
 - HDDs access data in mS
 - NAND devices access data in uS
 - DRAM, STTRAM, and PCRAM access data in nS
- Storage efficiency will increase by orders of magnitude with 5 years
- Processing bottlenecks will be limited by data mobility rather than storage system performance

An Emerging Storage Tier is Needed Traditional Construct

AN EXAMPLE OF MEMORY HEIRARCHY



The Emerging Storage Tier's Placement Where The New Tier Will Reside

AN EXAMPLE OF MEMORY HEIRARCHY



Utilizing The Emerging Storage Tier Non-volatile Memory (NVM)

AN EXAMPLE OF MEMORY HEIRARCHY CPU REGISTERS HOLD WORDS RETRIEVED REGISTER FROM L1 CACHE SMALLER, FASTER, AND COSTLIER (PER BYTE) 61 ON-CHIP L1 CACHE LI CACHE HOLDS CACHE STORAGE DEVICES LINES RETRIEVED FROM THE L2 CACHE MEMORY L2 OFF-CHIP L2 CACHE L2 CACHE HOLDS CACHE LINES RETRIEVED FROM MAIN MEMORY L3 MAIN MEMORY LARGER, SLOWER, AND CHEAPER (PER BYTE) MAIN MEMORY HOLDS STORAGE DEVICES DISK BLOCKS RETRIEVED FROM LOCAL DISKS **NVM-BASED BUFFER CACHE** L5 LOCAL SECONDARY STORAGE LOCAL DISKS HOLD FILES RETRIEVED FROM DISKS ON REMOTE NETWORK SERVER **REMOTE SECONDARY STORAGE** LG

NVM-based Buffer / Cache

- File cache residing between DRAM & local disk
 - Performance
 - Capacity
 - Cost
- System managed resource
 - Shared PFS acceleration, pinned libraries, common datasets, etc.
- Application managed resource
 - Allocated on a per-job basis, dedicated to a specific job or application, etc.
 - Application "co-design"
- Accelerating parallel file system I/O
 - POSIX, MPI, etc.

Thank You

Questions?

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