Deferred Updates for Flash-based Storage

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Properties of Flash Memory

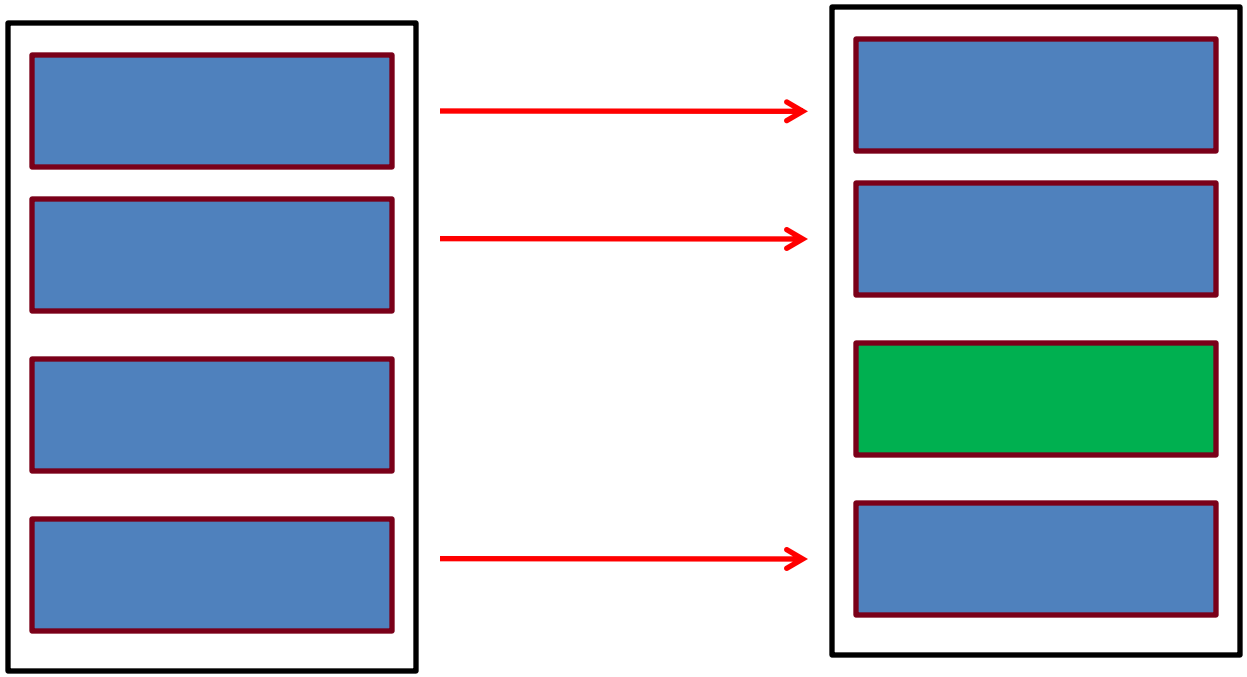
- Asymmetric Read and Write Behavior
- In-Place-Update Problem
  - To overwrite a sector (page), entire block needs to be erased
- Wear Out Problem
  - Frequent erases of blocks reduces the lifetime of flash memory

Problem Definition

- Given
  - Flash Memory Characteristics
  - Either DRAM is limited or data needs to flushed very frequently

- Design a new Update Processing Technique
  - Improve the update processing time and lifetime
  - For applications incurring lot of small random write operations

Over-Write in Flash Memory



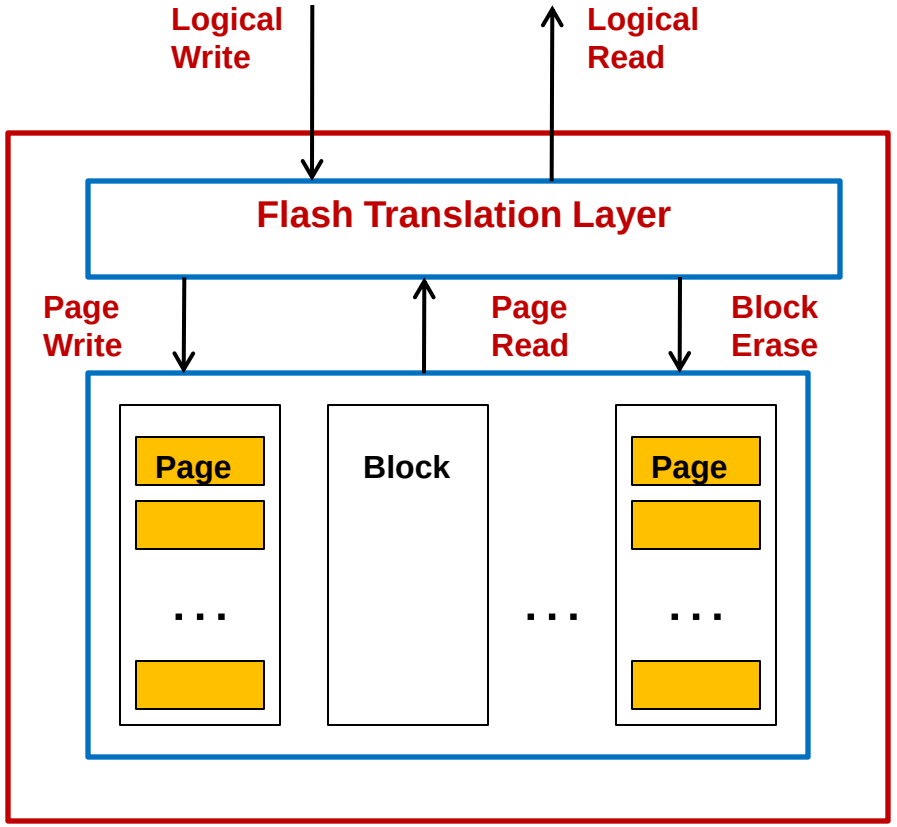
Solid State Disk (SSD)

- Solid State Disks
  - Acts like a virtual HDD
  - NAND Flash-based
  - Faster read performance
  - Good sequential write performance

- Read/write in **page** units
- Erase in block units
- Must erase a **block** before write
- Typical **block** = **128K**; **page** = **2K**

- **Read** latency **25** microseconds
- **Write** latency **200** microseconds
- **Erase** latency **1500** microseconds

- Limited number of erases per block



NAND Flash-based SSD

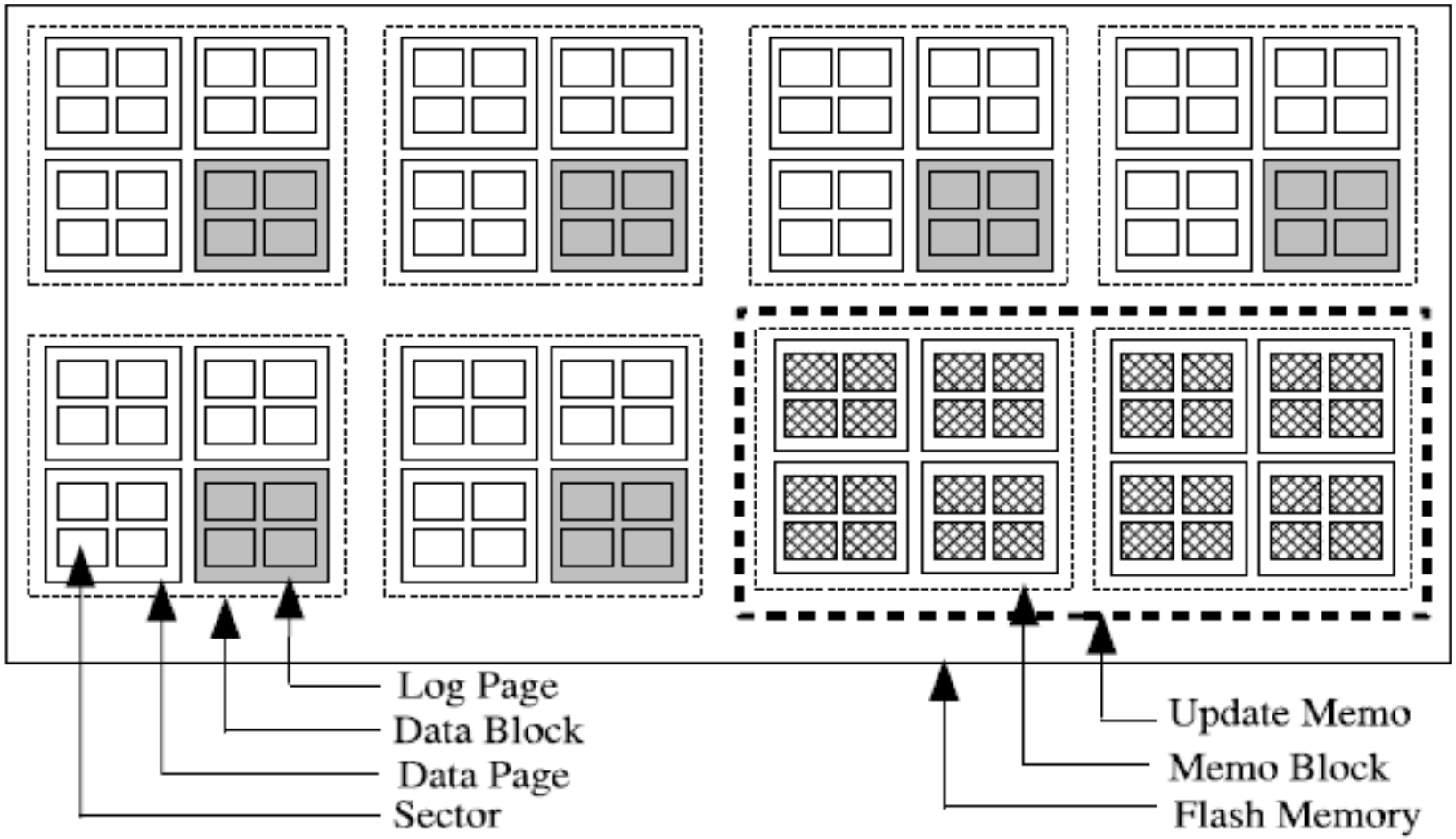
Scope of This Work

- Flash-based devices having no FTL
  - Sensor motes
  - Windows Mobile OS
- Customized FTL
  - FPGA-based Reconfigurable FTL
  - Useful for the super-computing environment

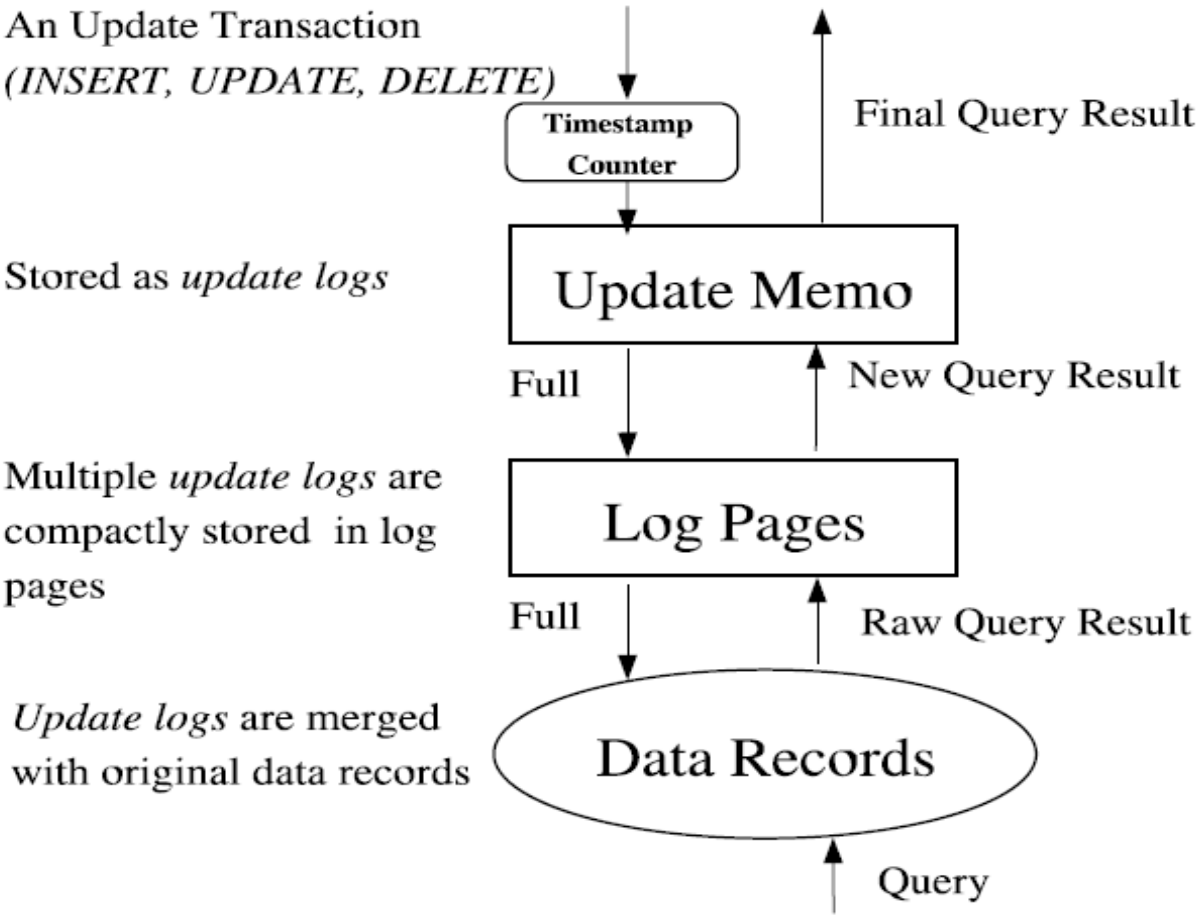
Main Idea

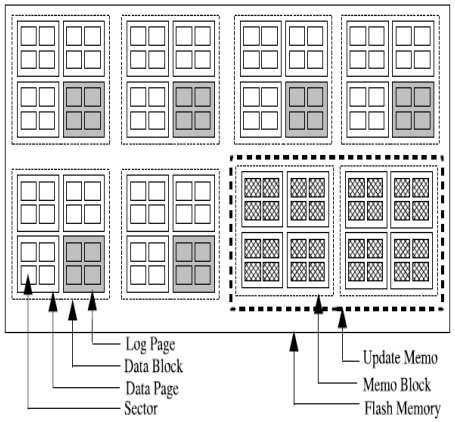
- Reduce the total number of expensive erase operations
- Defer the changes due to update operations as logs
  - A buffer-space is used to temporarily hold the logs
  - Apply multiple updates logs at once
- Part of flash memory is used as buffer-space
  - Buffer-space consists of ***update memo*** *and* ***log page(s)***

System Overview



Deferred Update Methodology





Thank You!

Comments / Questions?