LightTx: A Lightweight Transactional Design in Flash-based SSDs to Support Flexible Transactions

Youyou Lu[1], Jiwu Shu[1], Jia Guo[1],
Shuai Li[1], Onur Mutlu[2]

[1]Tsinghua University
[2]Carnegie Mellon University

Carnegie Mellon

Data updated in a single operation should be performed atomically and durably , and this is called a transaction.

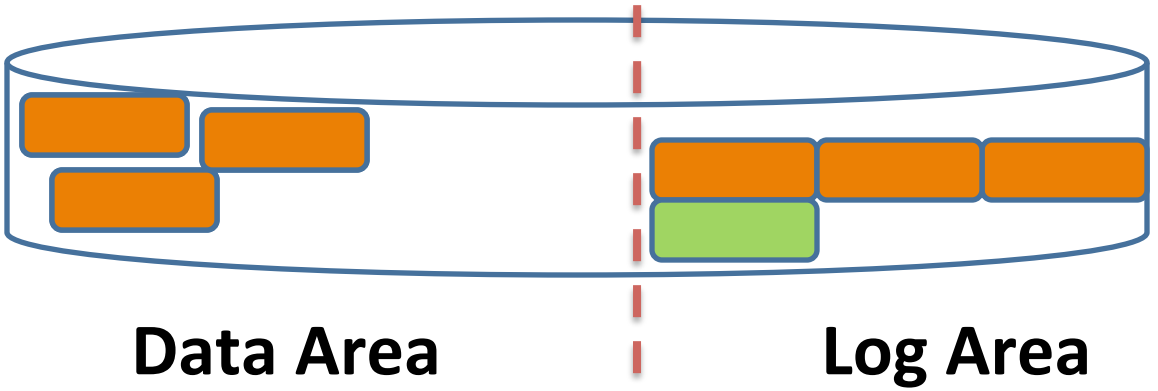
Software Transactions

High overhead:

- Duplicated writes
- Synchronization for ordering

Software

HDD

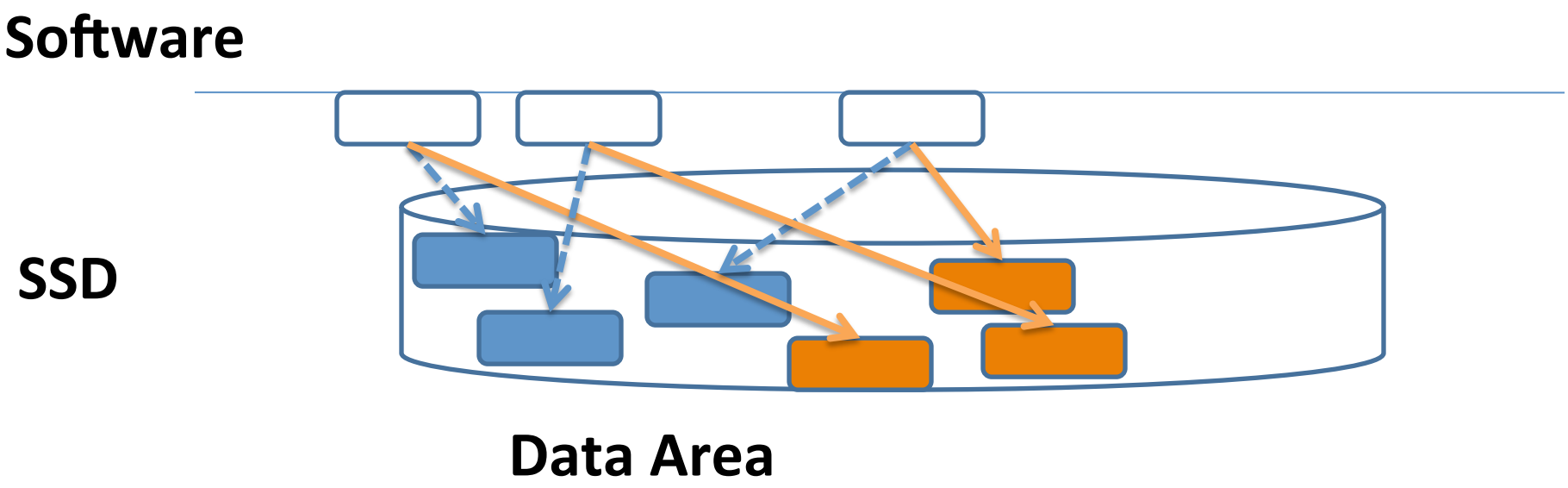


Flash pages are update in an out-of-place way, but this property is transparent from the software by the Flash Translation Layer (FTL) in SSDs.

Hardware Supported Transactions

Problem:

- ✓ How to support different isolations? (Flexible transaction requirement from software)
- ✓ How to cluster pages for each transaction? (Internal Parallelism of SSDs)



Design Issues:

Flexibility: support tx with flexible requirements

Lightweight: low overhead on the device

Observations and Key Ideas:

Simultaneous updates can be written to different physical pages, and the FTL mapping table determines the ordering

=> (Flexibility) make commit protocol page-independent

Transactions have birth and death, and the near-logged update way enables efficient tracking

=> (Lightweight) track recently updated flash blocks, and retire the dead transactions

Results:

20.6% throughput improvement (flexibility)

Stable garbage collection overhead

Fast recovery with negligible persistence overhead

Today 1:15pm

CSA-2: Memory Systems

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