



SI-TM: Reducing Transactional Memory Abort Rates through Snapshot Isolation

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Problem Statement

- Existing TMs exhibit high abort rates
- Pessimistic conflict detection
- Limits concurrency and performance

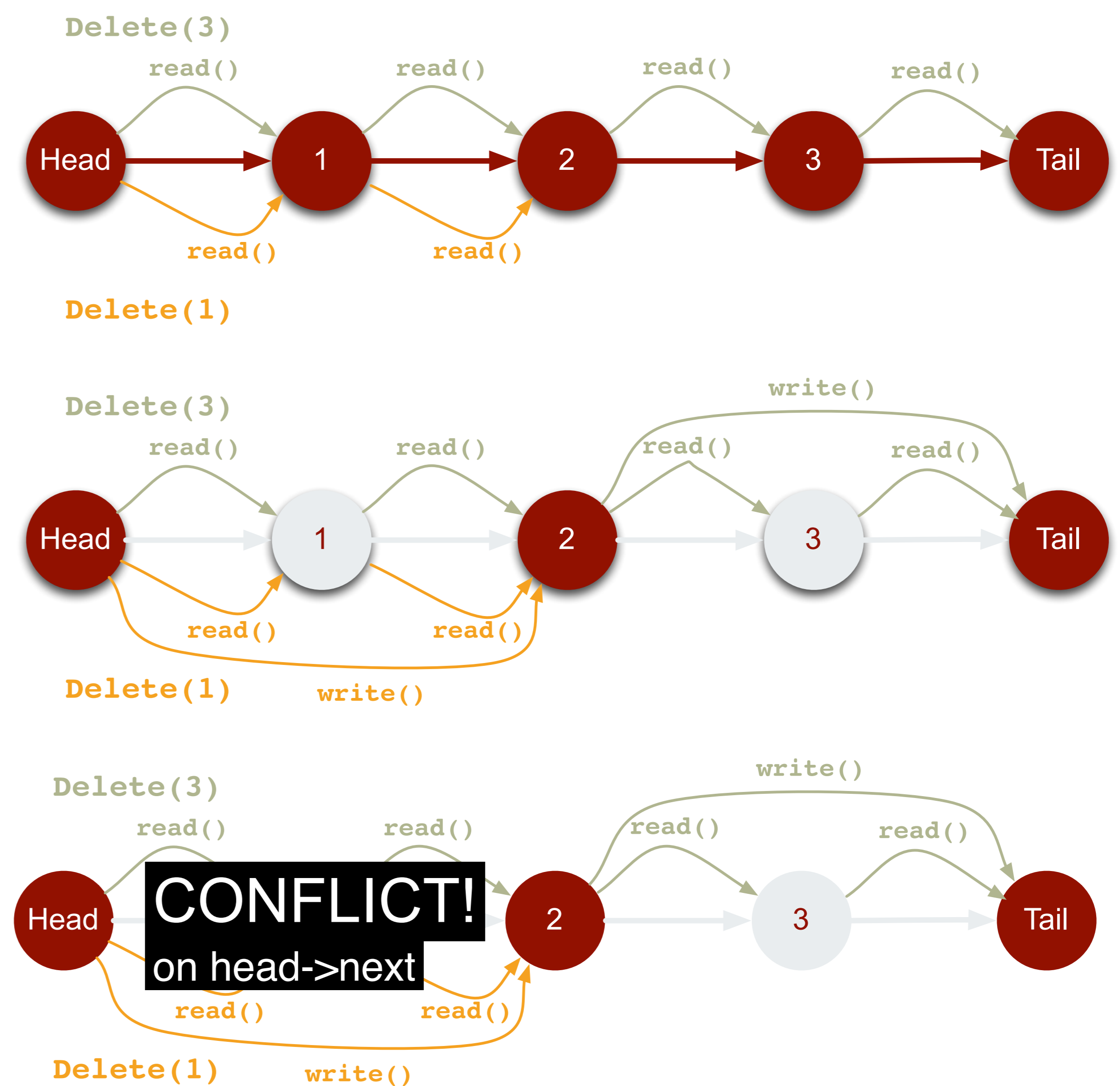
Snapshot Isolation (SI)

- Transactions obtain a memory snapshot at TX_START
- All reads target the consistent snapshot
- Writes are buffered until TX_COMMIT
- Validation only checks for write-write conflicts

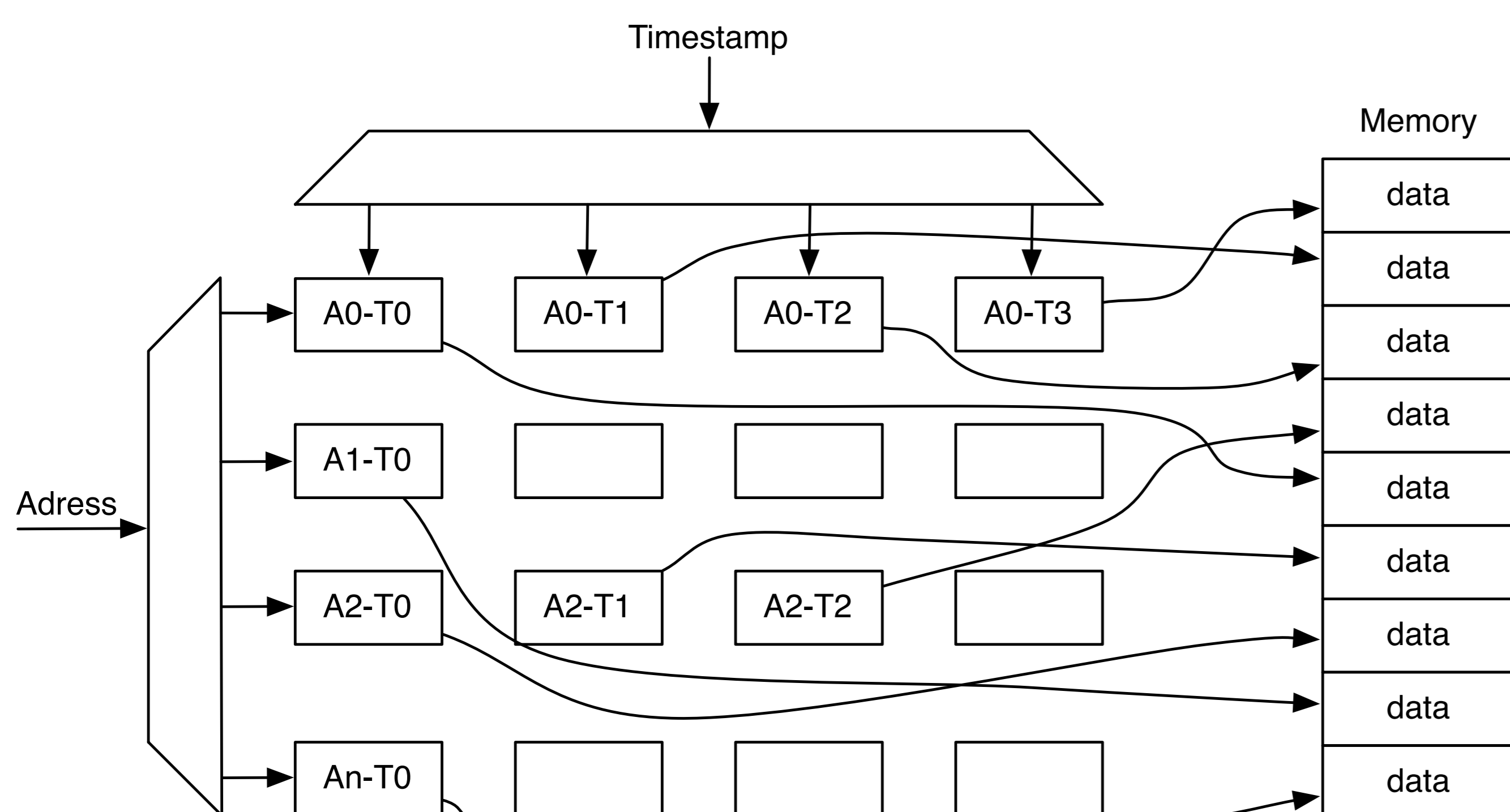
Properties of SI

- SI transactions do not abort on read-write conflicts
- Read only transactions always commit
- Requires multiversion concurrency control

SI-TM Avoids Read-Write Conflicts



Indirection Layer



SI-TM Challenges

- How to generate snapshots efficiently?
- How to address the write skew anomaly?

Multiversion Memory (MVM)

- Immutability - Data is never updated in place
- Instead, updates are supported through copy-on-write
- Multiple versions can coexist in the same memory space
- Disambiguate versions through timestamps
- Utilize indirection layer to map addresses to data versions

Methodology

- Cycle accurate simulator (Zsim)
- Detailed functional, timing models
- 2-phase locking baseline
- Conflict serializability baseline

Evaluation

- 3 Microbenchmarks
- STAMP suite
- 8 - 32 threads
- Up to 300x fewer aborts
- Up to 20x higher performance

Abort Rate Reduction

