Reducing Read Latency Fluctuations of Flash Storage Systems Using Preemptible Programs and Erases

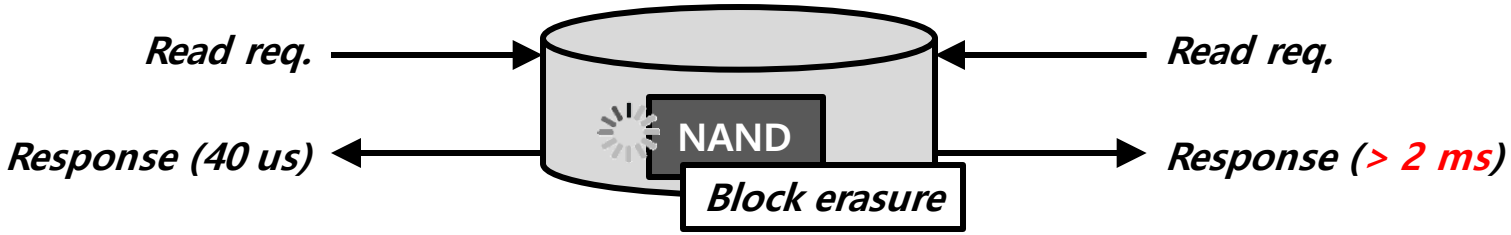
Jisung Park, Jaehoon Lee, Myungsuk Kim, Myungjun Chun and Jihong Kim

Department of Computer Science and Engineering, Seoul National University

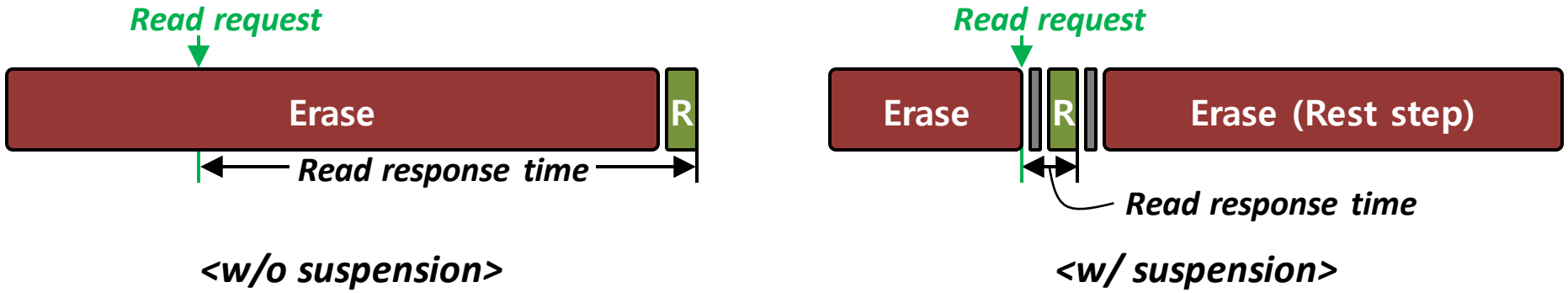
The 16th USENIX Conference on File and Storage Technologies (FAST'18)

Preemptible Programs and Erases

- **Read performance fluctuations**
  - Read latency can be increased by one or two orders of magnitudes for waiting the completion of on-going programs and erases.

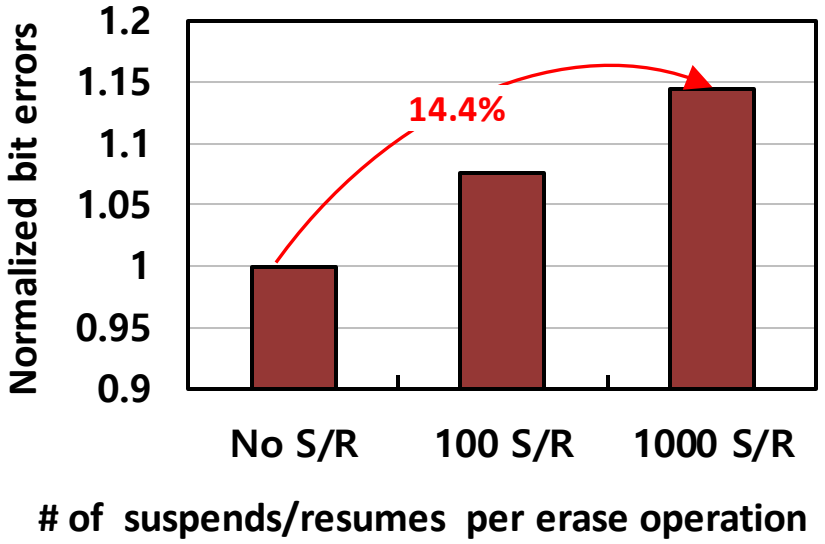


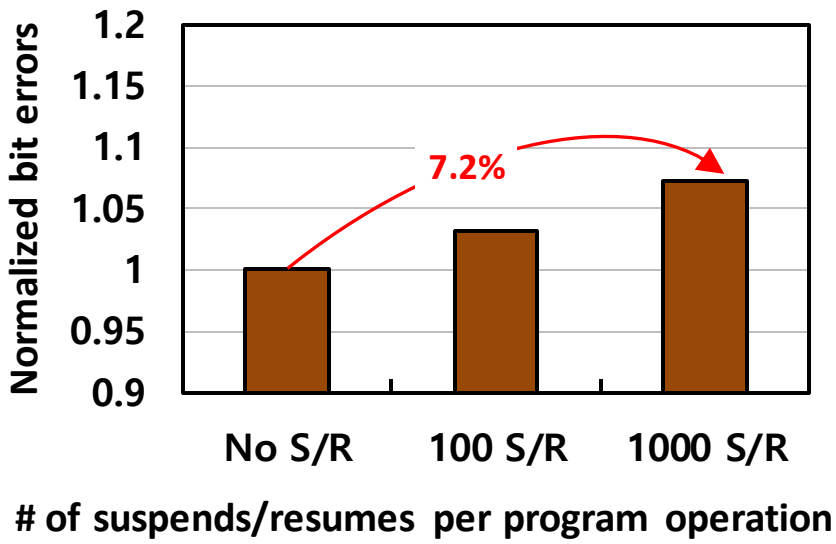
- **Program and erase suspension technique (Wu *et al.* @ FAST'12)**
  - Prevents read requests from being blocked by program/erase operations
  - Makes the read latency more deterministic



Impact of PES on NAND Reliability

- **Over-program and over-erasure issues**
  - Frequent suspensions can degrade the data reliability in modern NAND flash memory (e.g., 1X-nm TLC NAND devices).

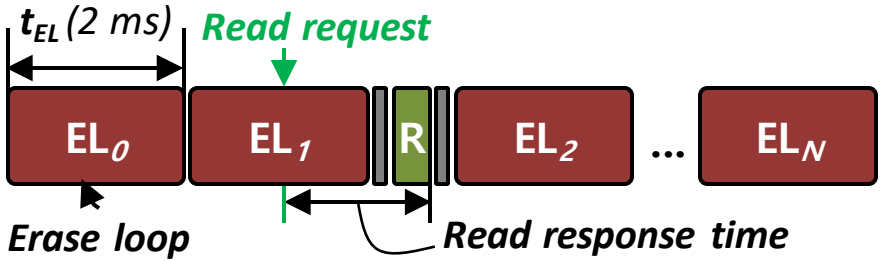


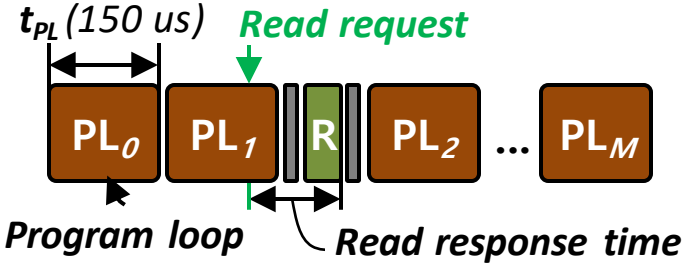


<Normalized Bit Errors After 1K P/E Cycles>
(Measured from over 1200 Blocks out of 80 NAND Chips)

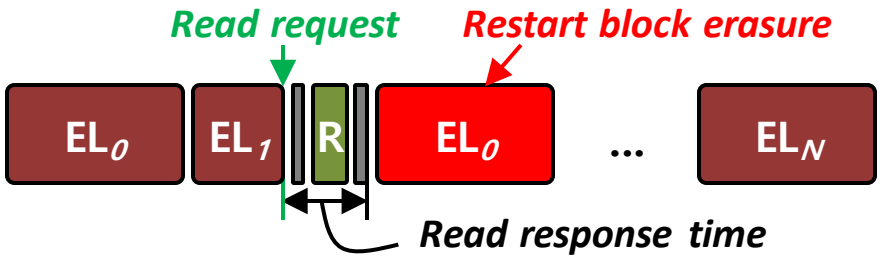
Our Approaches

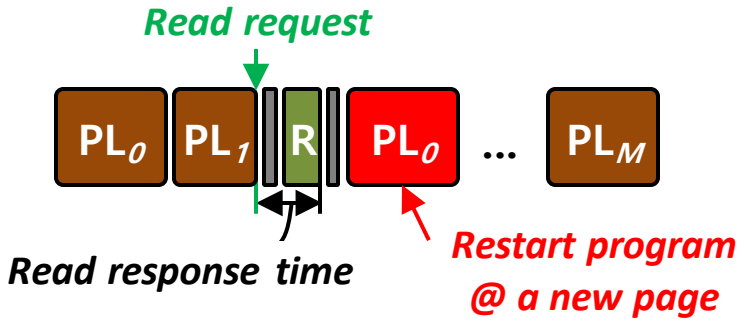
- **Loop-based program and erase suspension**
  - Delays suspensions until finishing an atomic inner loop
  - Limits the maximum number of suspensions per operation





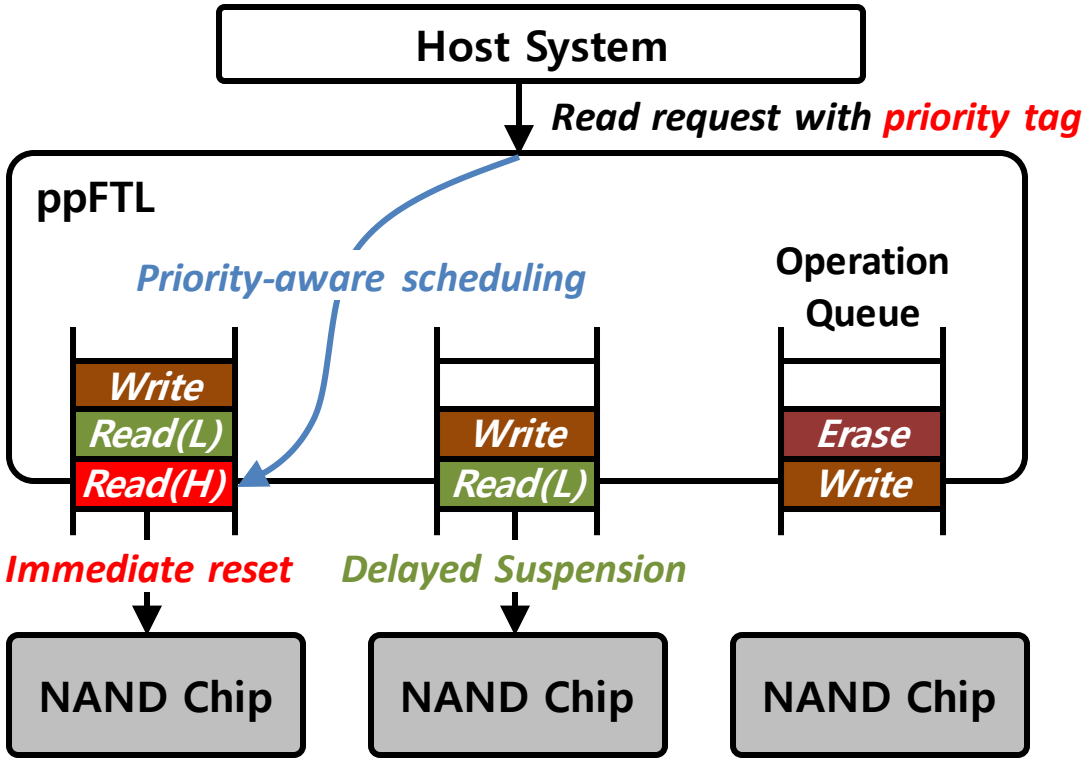
- **Immediate reset**
  - Immediately stops the on-going operation and starts it again from the beggining
  - Reflects the reliability degradation by over-programs and over-erasures





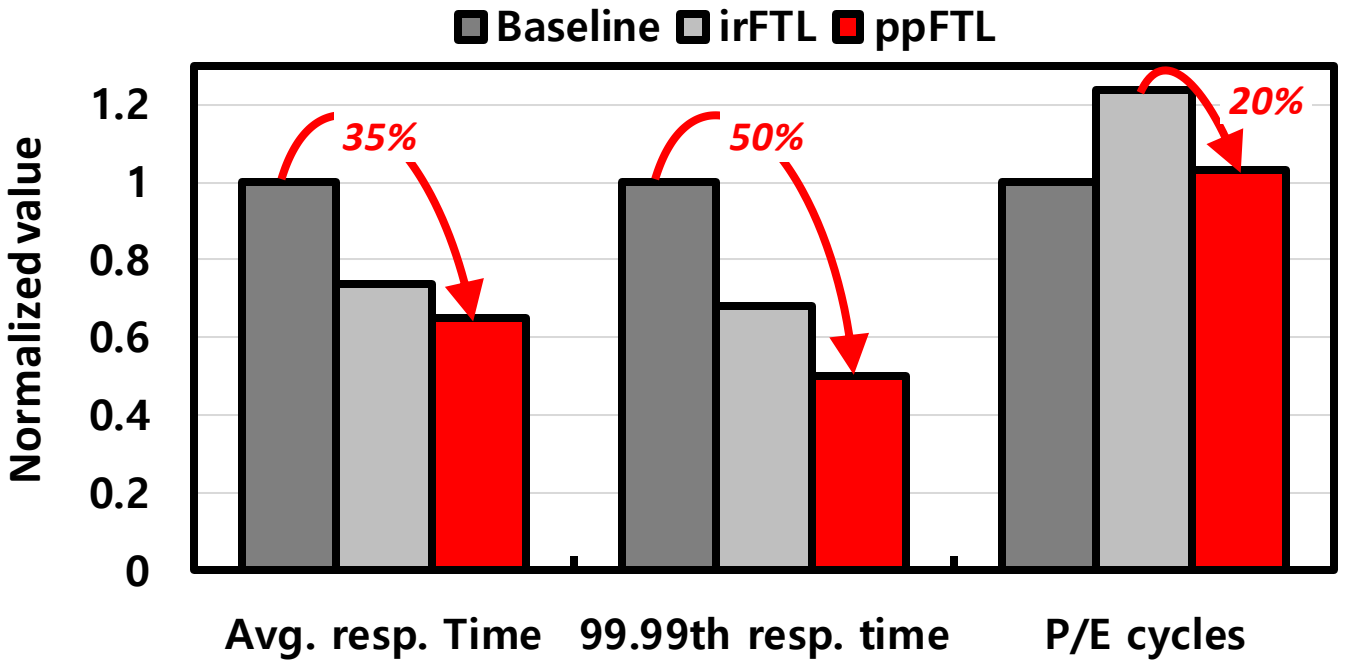
ppFTL: Priority-Aware Preemption

- **Hybrid approach based on reset and suspension**
  - Applies the immediate reset *only for* reads demanding the short latency



<An Overview of ppFTL)>

Preliminary Experimental Results



<Comparisons of three different FTLs>
(Baseline: No Preemption, irFTL: unconditional reset)

50% improvement over baseline w/ negligible overheads

Thank you!

Questions?

Reducing Read Latency Fluctuations of Flash Storage Systems Using Preemptible Programs and Erases (Work-in-Progress)

The 16th USENIX Conference on File and Storage Technologies (FAST'18)