Multi-Stream Write SSD

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- Intro. to other techniques to page-mapping FTLs
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Troubleshooting
Quiz

Lab2. Dummy FTL
- What is for ‘copy buffer’ of buffer region in DRAM?

Lab4. Greedy FTL
- Guess the reason why some data should be kept at SRAM
- What kinds of metadata are copied into NAND at which function?
- Is it resistive against power crashes? (SPO)
- What’s the disadvantage of GC-triggered condition in Dummy FTL?
Project #1: NAND Simulator

- Check your score at course homepage

- Notice
  - If you want to use C99 standard (e.g. for(int i=0; i< 1000; i++)), please add compile option (--std=c99) at Makefile
  - make tar

- NAND simulator is for helping you, not disturbing you
Project #2: Greedy PM FTL

- DO NOT customize nand.c and nand.h
  - In real world, it’s impossible
  - Might make score using my nand.c, not your nand.c
Other Page-Mapping FTLs
Problem in Greedy FTL

- WAF problem
  - Caused by GC
  - Once GC is triggered, WAF emerges
  - Is there a better algorithm?

- Motivation #1
  - Workload in real world is not fully random
    - Temporal locality
    - Spatial locality
  - Needs Locality-aware GC policy
Cost-Benefit Policy

- Selects a block with the maximum

\[
\frac{Benefit}{Cost} = \frac{(1 - u)}{2u} \times age
\]

- How to get age?
  - Each physical block has a last modification time
  - Logical time = the total number of writes
    
    \[= \text{# of host\_write} + \text{# of gc\_write}\]
Problem in Greedy FTL (cont’d)

- Motivation #2
  - Host controls a stream of I/O requests
  - Current I/O interface (read, write, trim) is too narrow
    - It can’t deliver additional information to and from underlying devices
  - If host directly manages SSD, it can do better!
    - Bjørling, Matias, Javier Gonzalez, and Philippe Bonnet. "LightNVM: The Linux Open-Channel SSD Subsystem.“ (FAST’ 17)
  - If we can give hints to device, it can do better!
    - Kim, Hyukjoong, et al. "SHRD: Improving Spatial Locality in Flash Storage Accesses by Sequentializing in Host and Randomizing in Device.“ (FAST’ 17)
Multi-Stream Write SSD

- Based on page-mapping FTL
  - Host issues additional “stream ID” to help GC
  - Before: <start lba, # of sectors, ..>
  - After: <stream ID, start lba, # of sectors, ..>

- FTL manages streams with different physical blocks

Changho Choi, Samsung Semiconductor, Inc., Flash Memory Summit 2016, Santa Clara, CA
Multi-Stream Write SSD (cont’d)

- Mapping data with different update frequency to different streams

Changho Choi, Samsung Semiconductor, Inc., Flash Memory Summit 2016, Santa Clara, CA
Any Questions?