

# Multi-Stream Write SSD

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# Contents

- Intro. to other techniques to page-mapping FTLs
  - Cost-benefit policy (in GC)
  - Multi-Stream Write SSD


# 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
    - = # of host\_write + # of gc\_write

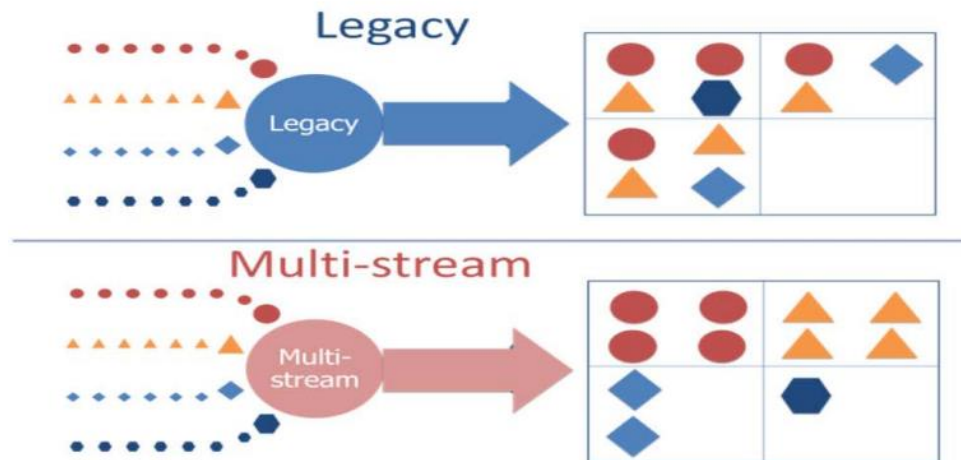
# Problem in Greedy FTL (cont'd)

- 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)
  - Kang, Jeong-Uk, et al. "The Multi-streamed Solid-State Drive." *HotStorage*. 2014.

# Multi-Stream Write SSD

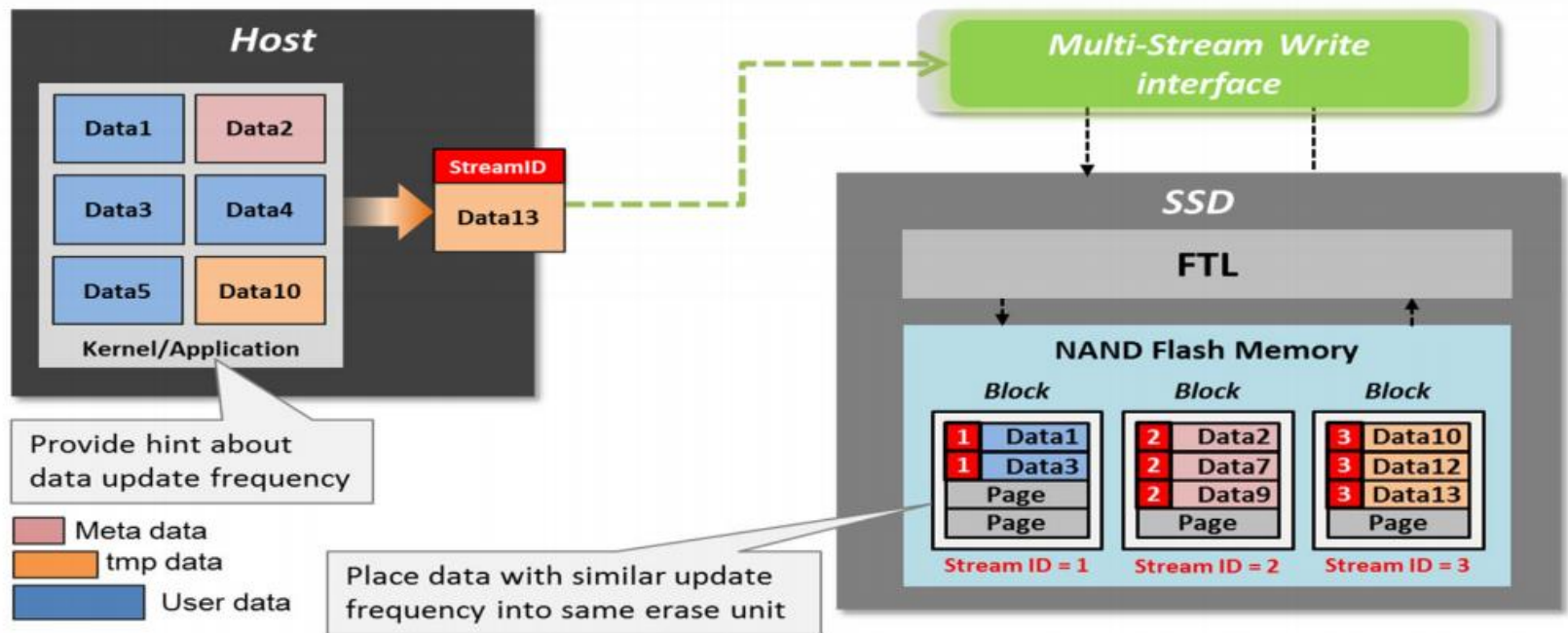
- Based on page-mapping FTL
  - Host issues additional “stream ID” to help GC
  - Before : <start lba, # of sectors, ..>
  - After : <stream ID, start lba, # of sectors, ..>
- FTL manages streams with different physical blocks



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?**