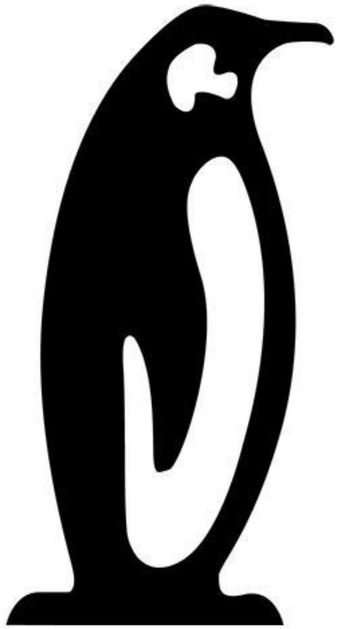


Linux Plumbers Conference

Dublin, Ireland September 12-14, 2022

Improving object caches using ZNS

Hans Holmberg, Western Digital Corporation

Use case

- Web services rely on caching at nearly every layer of the system architecture” [1]
- DRAM is expensive, SSDs offer a good alternative
- Large write amplification, especially for small objects [2]
- Writes need to be limited to limit wear
- Over provisioning used to mitigate WA
- Can we use ZNS to lower WA?

CacheLib

- A hybrid DRAM+Flash cache library
- Scales to billions of small objects
- Supports a wide range of use cases
- Separate large and small objects (<2k) storage
- Uses key hashes to map small objects to reduce DDR overhead

Challenges/opportunities

- Large objects
  - Written sequentially to big flash segments
  - Segments reclaimed round-robin
  - Great fit for ZNS!
- Small objects
  - Random block-sized writes, ouch!
  - Hard to optimize for, what can we do?

Proposed solution

- **Large objects** - easy
  - Map segments to zones
  - Do a zone reset before reuse
  - Works!
- **Small objects** - not easy
  - Idea : optimize garbage collection for caching
  - **Invalidate coldest blocks instead of relocation**

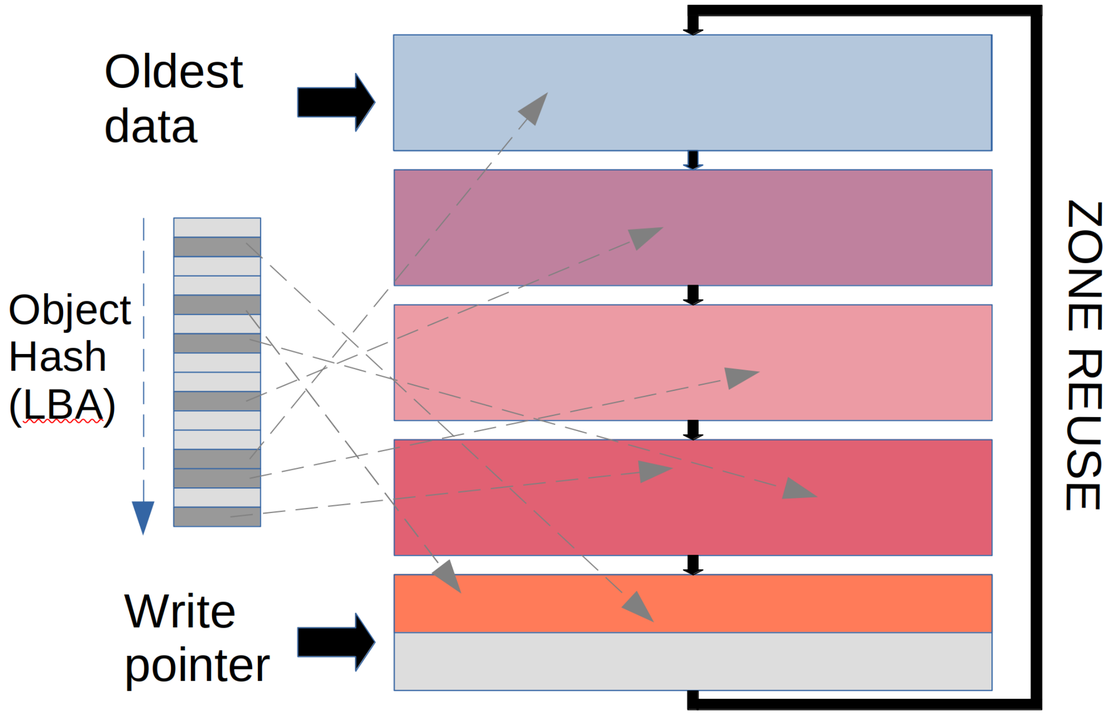
Implementation ideas

- Full ZNS-awareness in CacheLib

- Implement a separate cache-optimized FTL
  - As a user space library?
  - As an ublk block device?
  - In the kernel? (e.g. as a device mapper)

Cache FTL sketch

- Write user blocks round-robin
- Keep mapping table in DDR
- Throw away oldest data
  - Hit ratio decreases with time
  - Big objects are evicted this way
- Round robin zone reclaim – no garbage collection!
- Might work

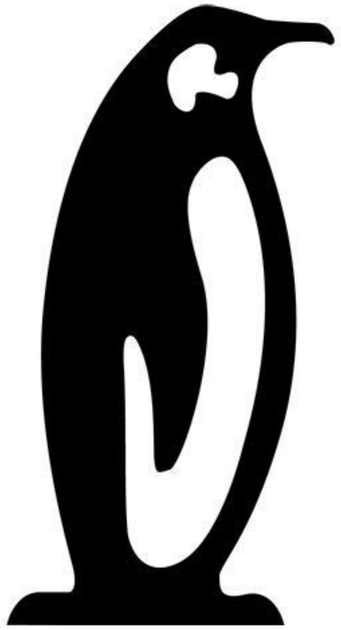


To discuss

- Who are interested in improving SSD caching?
- What type of workloads can we optimize for?

Links & further reading

- Cachelib
  - https://github.com/facebook/CacheLib
- Papers
  - [1] The CacheLib Caching Engine: Design and Experiences at Scale
  - [2] Kangaroo: Caching Billions of Tiny Objects on Flash



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