Storage Performance Development Kit (SPDK) Flash Translation Layer Library for Zoned Namespace SSDs

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Agenda

• Storage Performance Development Kit (SPDK) Flash Translation Layer (FTL) library current state
• FTL core components overview
• Moving to Zoned namespace
Why do we Need FTL?

- Standard SSD provides Flash Translation Layer inside firmware
- Storage Performance Development Kit (SDPK) FTL provides block device access on top of non block SSD device implementing Open Channel/Zoned Namespace interface
- FTL logic should be moved from SSD firmware to the host
Storage Performance Development Kit (SPDK) FTL Library

SPDK 18.07  SPDK 19.01  SPDK 19.07
Bdev cache – block device with with metadata read/write API

Bdev layer

FTL bdev
FTL library
Bdev cache 1

FTL bdev
FTL library
Bdev cache 2

Bdev cache 1  Bdev cache 2  NVMe bdev

NVMe* driver
Open Channel API

Open Channel NVMe SSD

NVMe API

Intel® Optane™ SSD

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SSD Geometry

- GROUP
- PU – parallel unit
- CHUNK
- LOGICAL BLOCK
Band

- **CHUNK -> ZONE**
- Band - collection of zones, each belongs to a different parallel unit
- FTL write pointer iterates over the zones in the band to achieve maximum write parallelism
- Band could be in open, close or free state
We need to store metadata in each band for device restoring and defragmentation process.

When band is opening, head metadata is written and when band becomes full, we write tail metadata.

Head metadata contains: device UUID, sequence number, version etc.

Tail metadata contains LBA map for its band and its validity.
Write Buffer

• Optimal write size unit for ZNS SSD is greater than 4K block size e.g. 128K
• Write buffer collects writes before they can be submitted onto disk
• To provide power fail safety at 4K level we need persistent write buffer.
Relocation Module

- Manages band’s defragmentation process
- Each band has its own merit based on its age, write count and validity
Moving to Zoned Namespaces

- Extend existing BDEV interface to support zoned device
  - spdk_zdev_get_info()
    - zone_size
    - max_open_zones
    - optimal_open_zones
  - spdk_zdev_zone_info
    - start_lba
    - write_pointer:
    - capacity
    - state
- ZONE_MANAGMENT
  - Close
  - Finish
  - Open
  - Reset

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Summary

- Host FTL provides more control to applications
- Extra control can be used to provide
  - WAF reduction
  - Better isolation
  - Better QoS

Start using FTL with SPDK today: https://spdk.io/doc/ftl.html