

DFTL Optimization Method

Prof. Dongkun Shin (dongkun@skku.edu)

TA – Junho Lee (crow6316@skku.edu)

TA – Somm Kim (sommkim@skku.edu)

Embedded Software Laboratory

Sungkyunkwan University

<http://nyx.skku.ac.kr>

Contents

- FTL Testing
 - With SATA interface
 - Windows: IOmeter
 - Linux: FIO
 - Without SATA interface
 - ftl_test (Emulation)
- DFTL Optimization Method
- Project 3: Custom DFTL

FTL Testing

FTL Testing: FIO

- Check the device.
 - *lsblk*
- Create a partition.
 - *fdisk /dev/sdh* (your device in /dev)
 - Run 'n' command and 'w' command
- Create a file system.
 - *mkfs -t ext4 /dev/sdh1* (your device partition in /dev)
- Mount the device.
 - *mount -t ext4 /dev/sdh1 /mnt*

FTL Testing: FIO

- Install the FIO.
 - *sudo apt-get install fio*
 - Verify the installation with the *fio* command.
- Write a FIO script.
 - *vim test.fio*
- Run the FIO.
 - *fio test.fio*

```
[global]
ioengine=libaio
directory=/mnt
rw=write
bs=32k
direct=1
size=1G
```

```
[job]
numjobs=1
```

FTL Testing: FIO

- Sample result

```
somnode@somnode-qemu:~$ sudo fio test4.fio
job: (g=0): rw=write, bs=32K-32K/32K-32K/32K-32K, ioengine=libaio, iodepth=1
fio-2.2.10
Starting 1 process
Jobs: 1 (f=1): [w(1)] [100.0% done] [0KB/52875KB/0KB /s] [0/1652/0 iops] [eta 00m:00s]
job: (groupid=0, jobs=1): err=0: pid=8348: Thu Nov 21 11:44:55 2019
write: io=1024.0MB, bw=46268KB/s, iops=1445, runt= 22663msec
slat (usec): min=19, max=534, avg=210.75, stdev=32.24
clat (usec): min=144, max=1668.2K, avg=476.22, stdev=16206.90
lat (usec): min=332, max=1668.2K, avg=687.89, stdev=16204.97
clat percentiles (usec):
| 1.00th=[ 169], 5.00th=[ 199], 10.00th=[ 221], 20.00th=[ 245],
| 30.00th=[ 251], 40.00th=[ 258], 50.00th=[ 306], 60.00th=[ 318],
| 70.00th=[ 338], 80.00th=[ 358], 90.00th=[ 382], 95.00th=[ 406],
| 99.00th=[ 438], 99.50th=[ 446], 99.90th=[ 470], 99.95th=[ 486],
| 99.99th=[1138688]
bw (KB /s): min= 2377, max=83264, per=100.00%, avg=56265.91, stdev=18850.44
lat (usec) : 250=25.55%, 500=74.40%, 750=0.02%, 1000=0.01%
lat (msec) : 2=0.01%, 2000=0.01%
cpu       : usr=1.14%, sys=30.89%, ctx=32861, majf=0, minf=13
IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
issued   : total=r=0/w=32768/d=0, short=r=0/w=0/d=0, drop=r=0/w=0/d=0
latency   : target=0, window=0, percentile=100.00%, depth=1

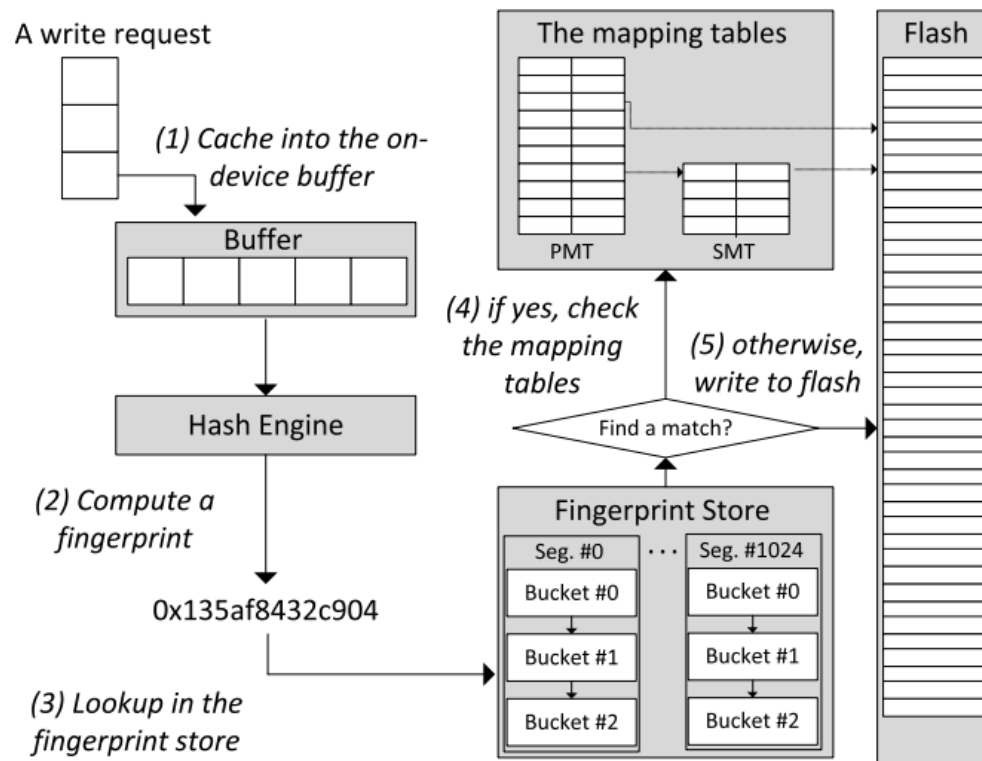
Run status group 0 (all jobs):
WRITE: io=1024.0MB, aggrbw=46268KB/s minbw=46268KB/s, maxbw=46268KB/s, mint=22663msec, maxt=22663msec

Disk stats (read/write):
sda: ios=0/32374, merge=0/109, ticks=0/26724, in_queue=0, util=0.00%
```

DFTL Optimization Method

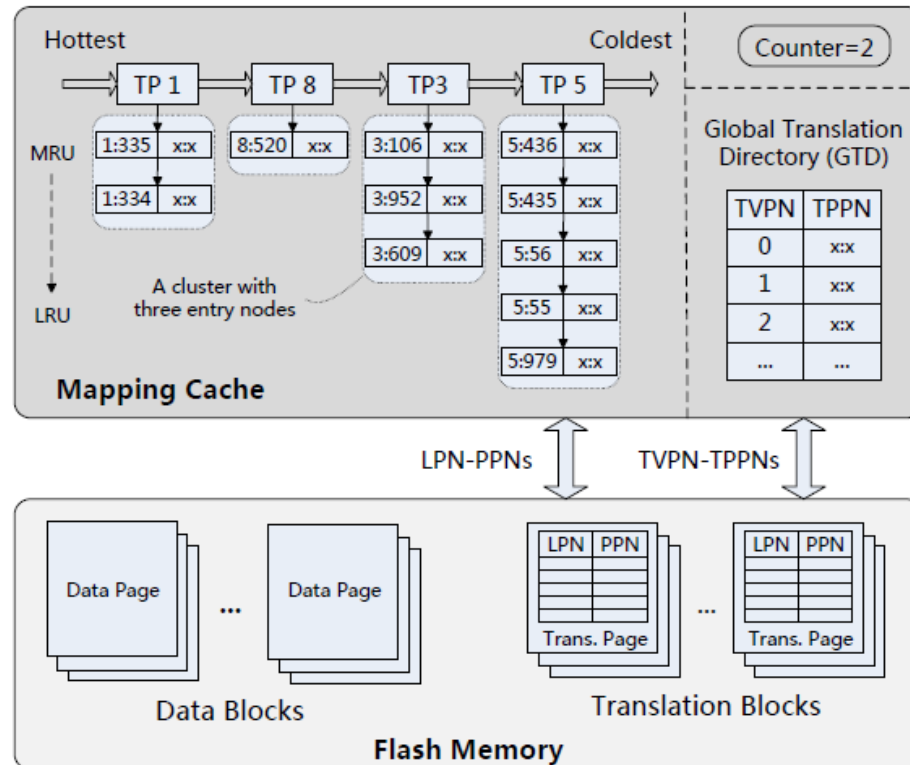
DFTL Optimization Method

- Example 1: CAFTL



DFTL Optimization Method

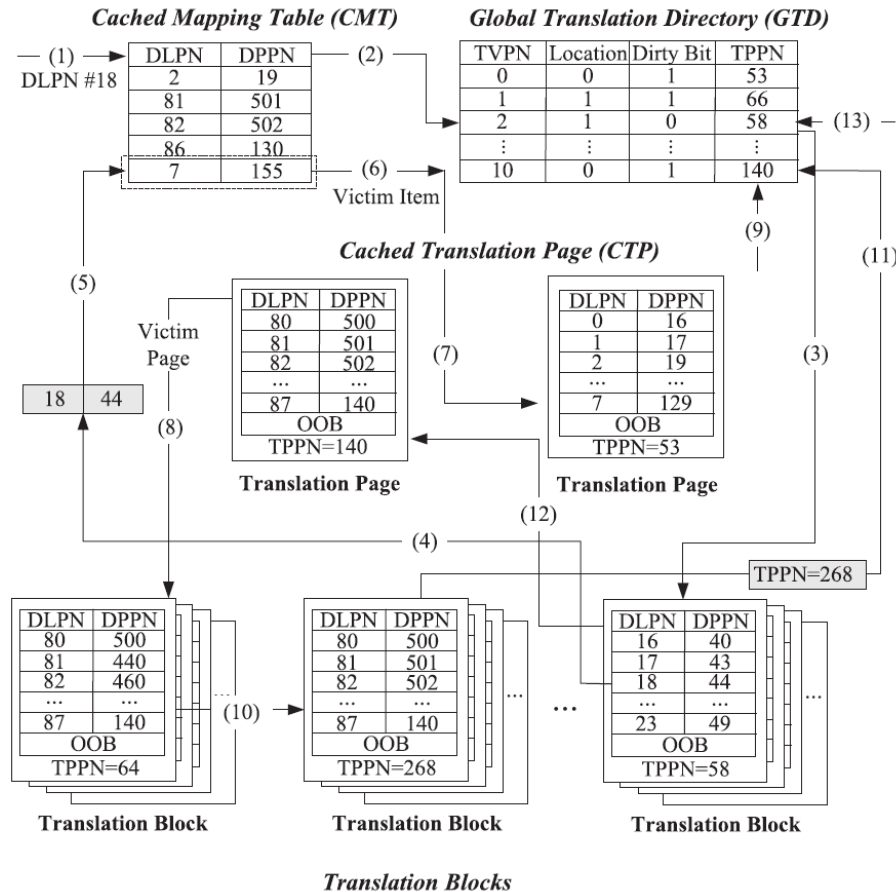
- Example 2: TPFTL



[2] [An efficient page-level FTL to optimize address translation in flash memory \(EuroSys'15\)](#)

DFTL Optimization Method

- Example 3: CDFTL



[3] [An Adaptive Demand-Based Caching Mechanism for NAND Flash Memory Storage Systems \(TODAES '16\)](#)

Project III

Custom DFTL

Project III : Custom DFTL

- Development a Custom DFTL (free topic)
 - Improve the performance
 - Performance improvement for specific workload is also OK.
 - Reduce the memory consumption
 - Implement additional functions
 - POR support (NPO or SPO)
 - Wear-leveling
 - Implement the idea of paper that has improved DFTL
 - ex) CAFTL, TPFTL, CDFTL, ...
 - Etc.

Miscellaneous

- Recommended environment : Windows, Linux
- Team Project
- You should submit a report
 - Describe your idea in detail
 - Motivation, Idea, Implementation, Evaluation
 - Idea
 - Evaluation
 - Describe the experimental environment and the workload in detail.
 - Capture and analyze the experimental result.
 - Compare the performance with original DFTL
- Submit to the icampus
 - Due: 12/08(Sun.) 23:59:59
 - File to submit: ftl_dftl (folder), report.pdf, presentation file
 - File name: team_ \$NUMBER.zip (ex. team_01.zip)

Any Questions?