Partially-Decompressible Dictionary Based Compression Format for All Flash Array

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All Flash Array

- **All flash array** (AFA) provides high-bandwidth, low latency data management
  - Upper limit of writing times of SSD shorten lifespan of the memory cells
  - We need a smart compression technique to solve this lifetime problem
“Partially-Decompressible Format”? 

- Bulk compression possibly improve compression ratio from individual compression
  - Several blocks are compressed in bulk

- How can we effectively decompress one block only with fraction of compressed data?

```
Block 0  Block 1  Block 2  Block 3

Compressed Bulk

Compression

Partial-Decompression

Block 1
```
Proposal

- We modified LZ4[1], a fast LZ77-like compression format

- The sliding window is the intersection of
  - Unlimited length of sliding window, and
  - Masks of the heading block and present block
Proposal (cont.)

- Compression function returns offsets of compressed blocks as well as compressed bulk.

- Each block can be decompressed only with compressed heading block and compressed desired block.
Evaluation

- **Hardware**
  - Intel Xeon E5-2697 @ 2.7 GHz

- **Dataset**
  - Eight CentOS 7.2 images with various applications are combined
  - Blocks are deduplicated in advance, consequently the data size is reduced from 4 GB to 770 MB

```
emacs  vim  ...  git
centos-1.vdi  centos-2.vdi  centos-8.vdi
```

Dataset (770 MB after deduplicated)
Evaluation
1. Compressed Size

- The averaged compressed size of 8 KB blocks was 3.73 KB when four blocks are combined.
- Which is 0.88x of individually compressed size, 4.25 KB.

![Graph showing average compressed block size vs. number of blocks](image-url)
2. Decompression Speed

The average decompression speed of one block in four blocks group is 0.85x of the individual case.
Future work

- Detect and cluster “similar” blocks to improve compression ratio
- Evaluate compression/decompression speed and compression ratio in real AFA
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