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The Mojette Erasure Code for Distributed File Systems

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1 Data protection is expensive

In distributed storage systems, failures are the norm

Replication

- n copies
- $n - 1$ storage overhead
- ok for hot data



Figure 1: Data triplication (200% overhead)

Erasure Coding (EC)

- same protection
- only $\frac{n}{k} - 1$ overhead
- limited to cold data

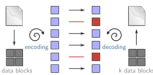


Figure 2: (6,4) Erasure coding (50% overhead)

Problem: implementations of Reed Solomon codes are computational bottlenecks for I/O-intensive applications
→ Galois field multiplication $GF(2^m)$ is expensive

Our goal: design fast ECs for Distributed File Systems
→ intense random access over small blocks (e.g. 4 kB)

2 The fast Mojette erasure code

The (n, k) non-systematic Mojette encoding

- k lines of the grid (i.e. data blocks)
- n projections (p, q) (i.e. parity blocks)
- based only on additions (XORs)
- reconstruction if $\sum |q_i| \geq k$
- $(1 + \epsilon)$ optimal

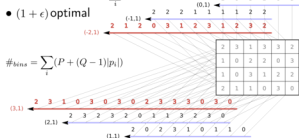


Figure 3: (6,4) Mojette encoding (mod 4) over a 6×4 discrete grid of data

The Mojette decoding

- decoding dependency graph
- deterministic path
- complexity is $\mathcal{O}(kPQ)$

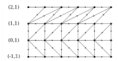


Figure 4: Mojette dependency graph

3 Performance comparison with Reed Solomon codes

Intel Xeon @3.10 GHz

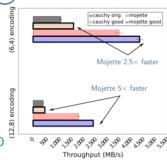
Criteria

- blocks of 4 kB
- input: 704 MB video
- output: desired protection

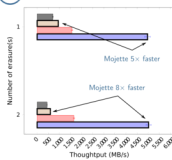
In competition

- cauchy RS (Jerasure 1.2)
- cauchy good: sparse matrix
- mojette (RozoFS)
- mojette good: optimized I/O

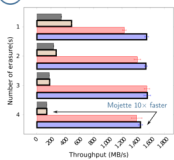
1 Encoding performance



2 (6,4) Decoding perf



3 (12,8) Decoding perf



4 Conclusion and future works

Conclusion: Mojette provides better performance, independently of the number of erasures

Future works:

- systematic Mojette for better performance
- repair problem

5 Acknowledgments

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Mojette code available at <http://github.com/rozofs/rozofs>

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