Accelerating Data Deduplication by Exploiting Pipelining and Parallelism with Multicore or Manycore Processors

Wen Xia, Hong Jiang, Dan Feng, Lei Tian

Background and Challenges

• Data deduplication
  - Reduce storage space requirement by eliminating duplicate data
  - Minimize the transmission of redundant data in storage systems

• Deduplication computation overheads
  - Contend—Defined Chunking (Rabin)
  - Fingerprinting (SHA1 or SHA256)

• Increasing compute resource with multicore or manycore

![Graph showing throughput vs. cores for CDC-based and FSC-based deduplication]

Observation and Motivations

• Minimize the deduplication compute overheads

  • Serial Dedupe
    \[ X_{\text{put}} = \frac{1}{T_c + T_f + T_w/D} \]
  
  • Pipelining
    \[ X_{\text{put}} = \frac{1}{\max(T_c, T_f, T_w/D)} \]
  
  • Parallelism
    \[ X_{\text{put}} = \frac{1}{\max\left(T_c, T_f, \frac{1}{N}, T_w/D\right)} \]

P-Dedupe Approaches

• Data deduplication process can be organized as:
  - Data units (such as chunks and files)
  - Functional units (i.e., chunking, hashing, indexing, and writing)
  - They are independent of one another

• Full exploitation of parallelism on data deduplication
  - Pipelining of CDC based deduplication processes
  - Paralleling fingerprinting and chunking

![Diagram of P-Dedupe system architecture]

Real world data deduplication

![Bar chart showing throughput for different data sets]

Preliminary Results

• Evaluate P-Dedupe on an Intel quad-core and eight-thread CPU

  ![Graph showing performance of P-Dedupe vs. traditional deduplication methods]

  • Deduplication based writing throughput

• Write efficiency among Serial, Pipeline, and P-Dedupe

Ongoing Work

• Boost the performance with increasing numbers of cores
  - Memory and cache management
  - Choices of section size and chunk size
  - Asynchronization or synchronization of parallelism
  - Deduplicated file fragments issue

![Diagram showing write efficiency with and without deduplication]

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