Low-Cost and Efficient Consistency with Adaptive Synchronization for Metadata Replication

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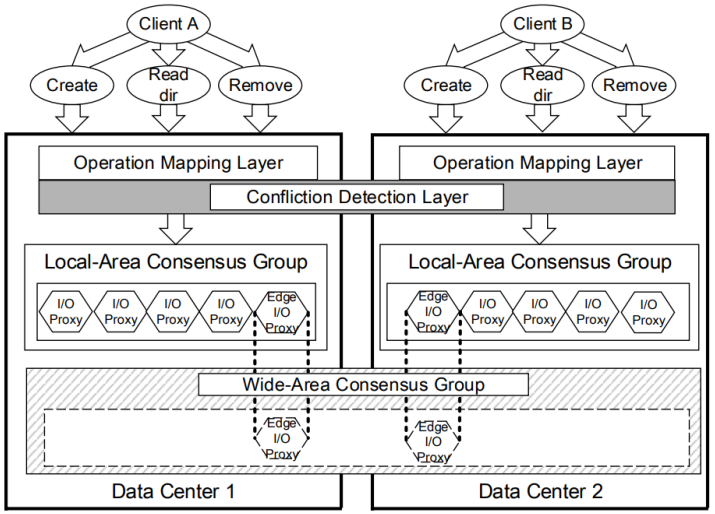
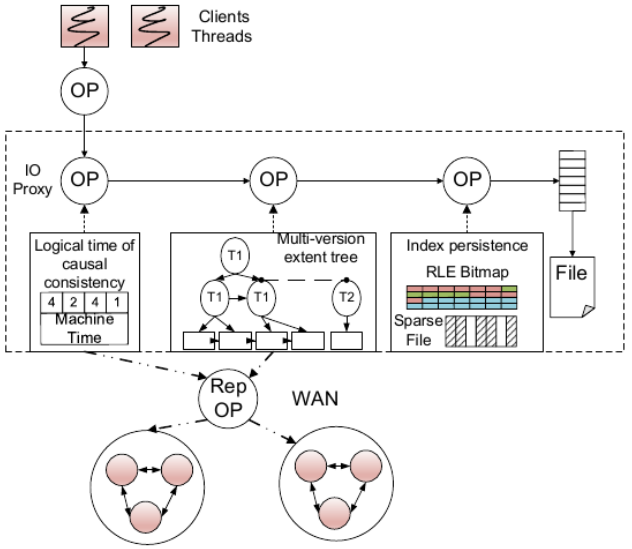
Frontiers of Computer Science, DOI: 10.1007/s11704-023-2772-y

Problems & Ideas

- Problems of existing metadata replication methods :
  - The strict consistency impedes I/O, resulting in a performance bottleneck.
  - Update conflicts will affect file system security, such as directory tree corruption, index corruption, normal operation of applications , etc.
- Ideas: a low-cost and efficient consistency framework with adaptive synchronization for metadata replication that ensures system performance without sacrificing metadata consistency.



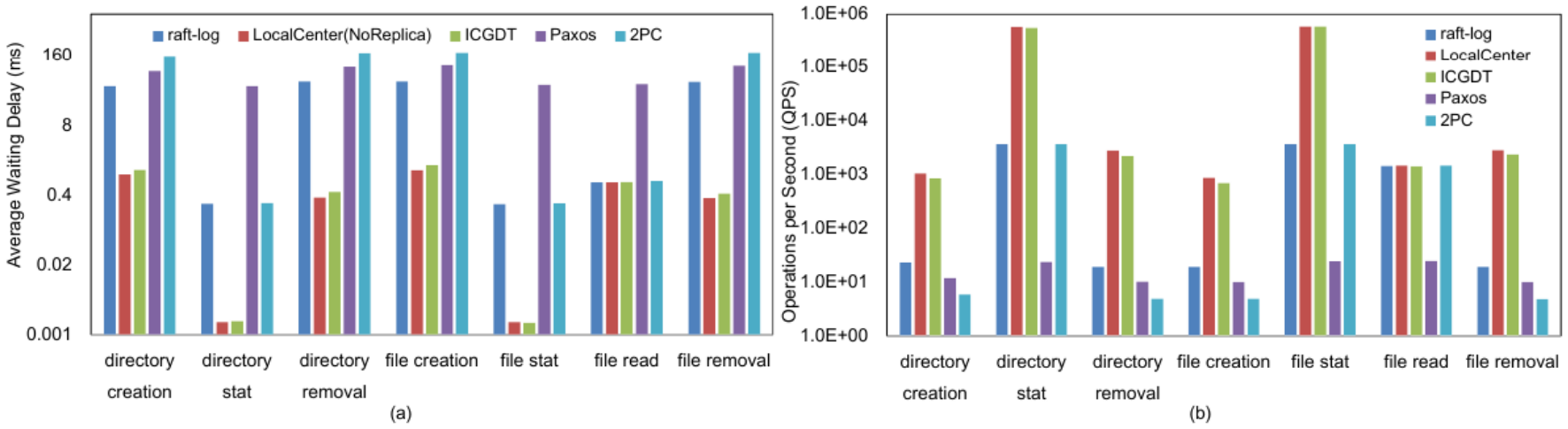
The directory tree replication architecture



Replica index Synchronization Architecture with Causal Consistency guarantees

Main Contributions

- Contributions:
  - An incremental consistency synchronization is proposed based on conflict detection to ensure metadata consistency with low latency;
  - A causal consistency guaranteed replica data index synchronization is designed based on request timestamps to guarantee the causal consistency of data access.
  - Through evaluation, the proposed methods can achieve low-cost and efficient consistency in metadata replications in wide-area file systems.



The directory operation performance result. (a) Directory tree operation delay of ICGDT, Raft-log and Local Center method in a single process; (b) Directory tree operation QPS of ICGDT, Raft-log and Local Center method in a single process.