Minimizing the Cost of Periodically Replicated Systems via Model and Quantitative Analysis

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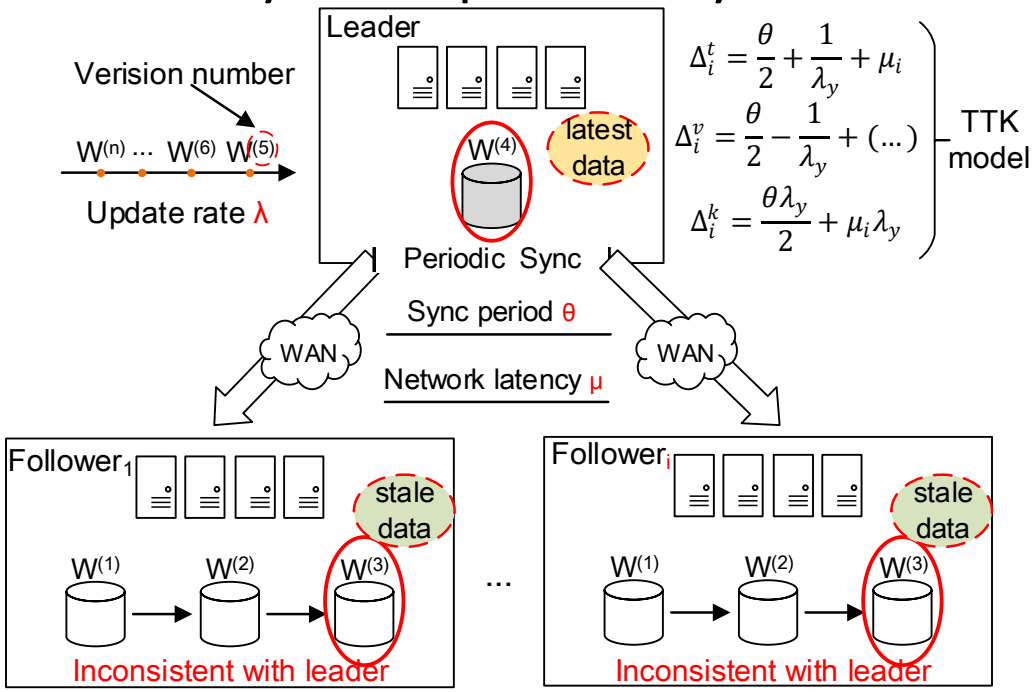
Problems & Ideas

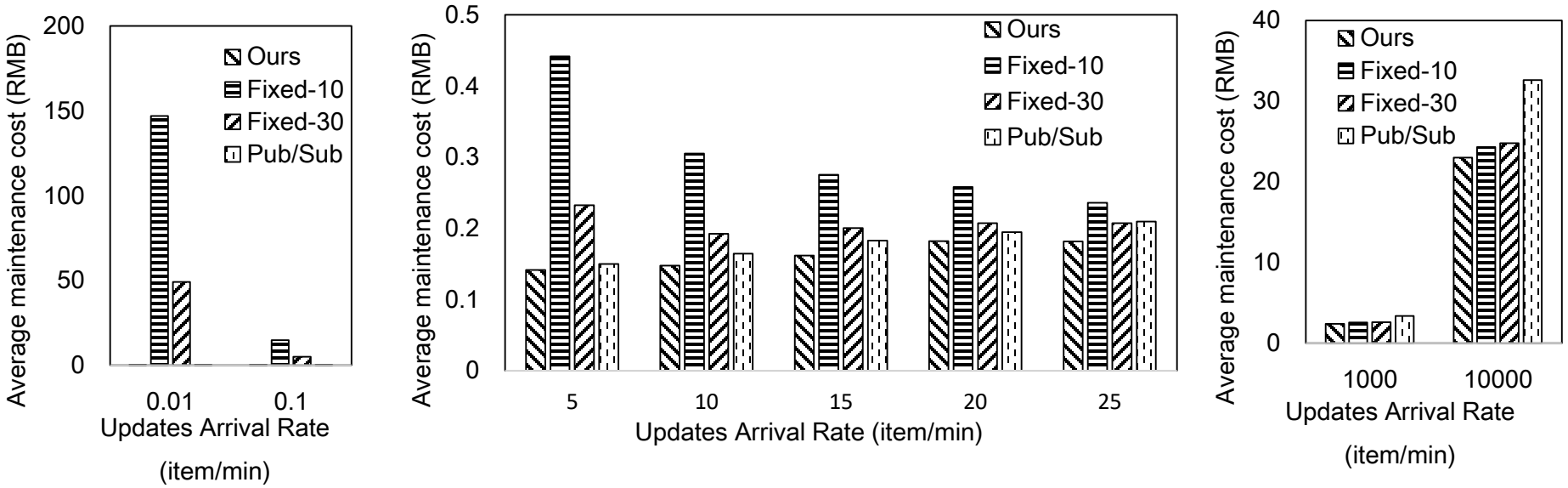
- Problems with the periodic replication approaches:
  - The static periodic replication cannot accommodate different workloads, resulting in additional costs.
  - The dynamic periodic replication strategy lacks quantitative analysis model, which leads to the sub-optimal cost.
- Ideas: A quantitative analysis model is established to find the cost-optimal synchronization period under different workloads, so a dynamic periodic synchronization strategy can be designed.



The synchronization process of periodically replicated systems: followers are unable to receive the leader's update request during the synchronization period delay, resulting in stale data. The staleness of data can be quantified by our TTK model.

Main Contributions

- Contributions:
  - A consistency quantitative analysis model is proposed, which explores the average staleness of the data retrieved by a read request using the T-Freshness, T-Visibility, and K-Staleness metrics.
  - A synchronization cost model is proposed, which models the tradeoff between consistency and synchronization cost, and derives the cost-optimal synchronization period;
  - A dynamic periodic synchronization method is proposed to reduce synchronization cost.



The synchronization cost of each method under different workloads. Left: lower workload; , a regular workload; Right, higher workload