Paper Title: **Cost-Effective Data Placement in Edge Storage Systems With Erasure Code**

Paper Link: Cost-Effective Data Placement in Edge Storage Systems With Erasure Code

1 Summary

1.1 Motivation

Edge computing has emerged as a promising paradigm to provide low-latency, high-bandwidth services to users at the network edge. Edge storage systems (ESSs) play a crucial role in edge computing by storing popular data near users to minimize latency and improve user experience. However, the constrained storage capacity of edge servers poses a challenge for storing large amounts of data in ESSs. Replica-based storage approaches, which store multiple copies of data across different edge servers, can lead to significant storage overhead, especially for large-size data that does not require real-time access.

1.2 Contribution

This paper investigates the use of erasure coding in cost-effective data storage in ESSs. Erasure coding is a technique that divides data into multiple data blocks and parity blocks, such that any subset of data blocks of sufficient size can be used to reconstruct the original data. By utilizing erasure coding, the storage overhead of storing large-size data in ESSs can be significantly reduced. The paper proposes an optimal approach named EC-EDP-O and an approximation algorithm named EC-EDP-V for placing coded data blocks on edge servers in an ESS, aiming to minimize the storage cost while serving all users in the system.

1.3 Methodology

The proposed approach involves the following steps:

1. Modeling: Formulate the data placement problem as an integer linear programming (ILP) problem.
2. Optimal Approach (EC-EDP-O): Solve the ILP problem to determine the optimal data placement strategy.
3. Approximation Algorithm (EC-EDP-V): Develop a heuristic algorithm to provide an approximate solution for large-scale scenarios.

1.4 Conclusion

The experimental results demonstrate that the proposed approach can significantly reduce the storage cost compared to replica-based storage approaches. EC-EDP-O achieves an average of

68.58% storage cost reduction, and EC-EDP-V achieves an average of 64.44% storage cost reduction. These results highlight the effectiveness of erasure coding in cost-effective data placement in ESSs.

2 Limitations

2.1 First Limitation

The proposed approach assumes that the access pattern of users is known in advance. In practice, user access patterns may be dynamic and unpredictable, which could affect the performance of the proposed approach.

2.2 Second Limitation

The proposed approach does not consider the heterogeneity of edge servers in terms of storage capacity and processing power. This could lead to uneven distribution of data across edge servers and affect the overall performance of the ESS.

3 Synthesis

Erasure coding offers a promising approach to cost-effective data placement in ESSs. The proposed approach demonstrates the effectiveness of erasure coding in reducing storage overhead while ensuring data availability for users. Further research is needed to address the limitations of the proposed approach and develop adaptive data placement strategies for dynamic user access patterns and heterogeneous edge servers.