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ADAPTIVE MULTI-REGION DATA REPLICATION WITH ML-DRIVEN LATENCY PREDICTION MODELS

Suket Gakhar[1] & Lagan Goel[2]

[1]Kurukshetra University, Kurukshetra, India

[2]Director, AKG International, Kandela Industrial Estate, Shamli, U.P., India

ABSTRACT

In modern distributed systems, ensuring efficient data replication across multiple regions is critical to achieve low latency, high availability, and fault tolerance. This paper presents an innovative approach to adaptive multi-region data replication using machine learning (ML)-driven latency prediction models. The proposed framework dynamically adjusts replication strategies based on real-time latency predictions, which are learned from historical network performance data. By employing advanced ML techniques, such as regression models and time-series forecasting, the system can predict network latency and adjust replication decisions to minimize response time and reduce operational costs. The adaptability of this model allows it to react to changes in network conditions, traffic load, and regional failures, ensuring optimal data distribution and redundancy. This adaptive model is integrated into a multi-region architecture, where data is replicated intelligently across geographically dispersed data centers to balance consistency, availability, and partition tolerance. The paper also explores how the prediction model can enhance decision-making regarding data placement, allowing for smarter resource allocation and reduced overheads in cloud infrastructures. Through extensive experiments, the effectiveness of the proposed approach is demonstrated, showing significant improvements in system performance and user experience compared to traditional replication strategies. The proposed adaptive framework can be leveraged across various applications, including cloud storage, content delivery networks, and global e-commerce platforms, to improve data access speeds and ensure seamless user experiences globally.

KEYWORDS: *Adaptive Data Replication, Multi-Region Architecture, Machine Learning, Latency Prediction, Dynamic Replication Strategies, Network Performance, Time-Series Forecasting, Data Consistency, Cloud Infrastructure, Fault Tolerance, Resource Allocation, Content Delivery, Distributed Systems.*

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