

# **Design and Evaluation of Fault-Tolerant Distributed Storage Systems for Big Data Applications**

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**Abstract:** *The proliferation of big data, characterized by its immense volume, high velocity, and diverse variety, has rendered traditional centralized storage architectures inadequate. This necessitates a fundamental shift towards distributed storage systems capable of managing vast datasets across numerous interconnected servers. A critical requirement for these systems, particularly in high-stakes big data applications, is robust fault tolerance, ensuring continuous operation and data integrity despite component failures. This paper provides an introductory overview of the design principles, mechanisms, and evaluation methodologies for fault-tolerant distributed storage systems. It delves into core architectural patterns, explores data redundancy techniques such as replication and erasure coding, and examines the implications of consistency models. Furthermore, it discusses key performance indicators, benchmarking frameworks, and advanced fault injection techniques for evaluation. The paper concludes by highlighting current challenges and identifying promising future research directions in this rapidly evolving domain, emphasizing the continuous need for resilient and efficient data management solutions.*

**Keywords:** *big data*

