

A Next-Generation Blockchain-Based Data Platform: Leveraging Decentralized Storage and Layer 2 Scaling for Secure Data Management

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Abstract : The rapid growth of data-driven decision-making across various industries necessitates advanced solutions to ensure data integrity, scalability, and security. This study introduces a decentralized data platform built on blockchain technology to improve data management processes in high-volume environments such as healthcare and financial services. The platform integrates blockchain networks using Cosmos SDK and Polkadot Substrate alongside decentralized storage solutions like IPFS and Filecoin, and coupled with decentralized computing infrastructure built on top of Avalanche. By leveraging advanced consensus mechanisms, we create a scalable, tamper-proof architecture that supports both structured and unstructured data. Key features include secure data ingestion, cryptographic hashing for robust data lineage, and Zero-Knowledge Proof mechanisms that enhance privacy while ensuring compliance with regulatory standards. Additionally, we implement performance optimizations through Layer 2 scaling solutions, including ZK-Rollups, which provide low-latency data access and trustless data verification across a distributed ledger. The findings from this exercise demonstrate significant improvements in data accessibility, reduced operational costs, and enhanced data integrity when tested in real-world scenarios. This platform reference architecture offers a decentralized alternative to traditional centralized data storage models, providing scalability, security, and operational efficiency.

Keywords : blockchain, cosmos SDK, decentralized data platform, IPFS, ZK-Rollups

Conference Title : ICBDC 2024 : International Conference on Big Data Computing

Conference Location : Lisbon, Portugal

Conference Dates : October 28-29, 2024