Chapter 3
Enhancing Cloud Security and Privacy With Blockchain Technology

Parth Khandelwal
https://orcid.org/0009-0002-3645-8542
Christ University, India

Lata Yadav
https://orcid.org/0009-0009-9925-0731
Christ University, India

Vandana Sharma
https://orcid.org/0000-0002-8636-2365
Christ University, India

ABSTRACT

This chapter explores blockchain's potential to address cloud computing security challenges. Despite cloud computing's scalability and cost efficiency, it faces risks like data breaches and regulatory non-compliance, as seen in the 2019 Capital One AWS breach. Blockchain's decentralized ledger, cryptographic hashing, smart contracts, and consensus mechanisms (e.g., PoW, PoS) enhance security through decentralized access control, secure storage, and intrusion detection. Privacy techniques like homomorphic encryption and zero-knowledge proofs protect data. Case studies, including IBM Food Trust and MedRec, show practical applications. However, scalability, interoperability, regulatory conflicts (e.g., GDPR), and high costs pose barriers. Solutions like sharding and layer-2 protocols aim to overcome

DOI: 10.4018/979-8-3373-1832-5.ch003

these. Future research focuses on scalability, privacy, hybrid cloud integration, and AI-driven security. Blockchain strengthens cloud security but requires innovation to achieve widespread adoption.

1. INTRODUCTION

Imagine losing millions in seconds — that is the harsh reality of modern cloud breaches. In 2023, organizations faced an average of $4.45 million in damages per incident, with over 2,200 cyberattacks occurring daily, many of them targeting cloud platforms. (IBM Security, 2023)

Today, businesses, government organizations and individuals use cloud computing to handle information more flexibly and efficiently. Microsoft Azure, Amazon Web Services (AWS) and Google Cloud Platform (GCP) are among the leading providers that provide affordable and on-demand computing services. (Bhatte et al., 2022) Moving to cloud infrastructure instead from physical data centres helps organizations save money and work more efficiently. (Bhole, 2025)

Despite these benefits, cloud computing introduces significant security and privacy challenges. (Mathew, 2024) Traditional cloud infrastructures are centralized, making them vulnerable to cyberattacks, unauthorized access, and insider threats. Cloud systems must also comply with regional and global data protection laws, including the General Data Protection Regulation (GDPR), the Health Insurance Portability and Accountability Act (HIPAA), and India's Digital Personal Data Protection Act (DPDP Act, 2023). (Folorunso et al., 2024) Ensuring data confidentiality, integrity, and availability is a growing concern for both businesses and policymakers.

Blockchain technology, originally developed for cryptocurrencies, has emerged as a promising tool to improve cloud security and privacy. (Karunakaran et al., 2024) Its decentralized and immutable ledger reduces risks associated with centralized data storage. Through features such as cryptographic hashing, smart contracts, and decentralized identity management, blockchain supports secure data storage, transparent access control, and improved intrusion detection.

This chapter provides an in-depth analysis of how blockchain strengthens cloud security mechanisms. It begins by outlining the core security challenges in cloud computing, followed by blockchain-based solutions including decentralized identity, secure access control, privacy-preserving techniques, and real-world case studies. It also explores challenges such as scalability, interoperability, and regulatory compliance, while identifying future research opportunities for integrating blockchain into cloud security frameworks. (Karunakaran et al., 2024)

A Model-Driven Approach for the Design and Implementation of Software Development Methods

Mario Cervera, Manoli Albert, Victoria Torresand Vicente Pelechano (2012).
International Journal of Information System Modeling and Design (pp. 86-103).
www.irma-international.org/article/model-driven-approach-design-implementation/70927