Chapter 9
Synergizing Cloud Computing and Blockchain Architectures: Applications and Implications

Sheraz Maki Mohd Ahmed
https://orcid.org/0009-0004-0967-4455
International Islamic University Malaysia, Malaysia

Aisha Hassan Abdalla Hashim
International Islamic University Malaysia, Malaysia

Zainab Senan Attar
https://orcid.org/0000-0002-1452-8098
Kulliyya of Engineering, Malaysia

Othman Omran Khalifa
https://orcid.org/0000-0002-0847-6017
International Islamic University Malaysia, Malaysia

ABSTRACT

Blockchain is a decentralized and distributed digital ledger that records transactions across multiple computers. It consists of a continuously growing list of blocks, where each block contains a set of transactions and a reference to the previous block. The blockchain ensures the immutability and integrity of the recorded transactions by using cryptographic hashes and consensus mechanisms. Cloud computing is a service available over the network. Users can access and store data and applications remotely rather than on local servers or personal computers. Cloud computing offers resource pooling by letting users share the same physical resources dynamically

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according to their demands, often through virtualization. Cloud computing offers flexible, scalable resources, it can address blockchain's limitations in scalability and transaction speeds by act as a backup for blockchain data, enabling faster recovery and reduced latency. Synergy between cloud computing and blockchain offers significant potential for innovation across numerous sectors

1. INTRODUCTION

Blockchain is a decentralized and distributed ledger system designed to record transactions across a network of computers or nodes (Wright, 2008). Each transaction is grouped into blocks, which are cryptographically linked to preceding blocks, forming a chronological chain—hence the term blockchain. This structure utilizes cryptographic hashes and consensus protocols to maintain data security and ensure immutability. However, as participation and transaction volume increases, the consensus mechanism can slow down, potentially introducing latency and limiting the system's scalability and responsiveness in real time.

Cloud computing, on the other hand, delivers services over a network, enabling users to access and manage applications and data remotely rather than relying on local infrastructure. It supports dynamic resource sharing through virtualization, allowing multiple users to efficiently utilize shared physical resources based on real-time demands (Al-Hamad et al., 2024).

The scalability and flexibility offered by cloud computing can help address some of blockchain's inherent limitations, particularly in terms of transaction throughput and data latency. Acting as a backup layer for blockchain data, cloud infrastructure can enhance recovery speed and reduce processing delays.

The convergence of cloud computing and blockchain technologies represents a major shift for industries aiming to improve efficiency, transparency, and data security (Ahmadi, 2024). Cloud platforms provide on-demand resources, while blockchain ensures trust, decentralization, and immutability. Together, these technologies can reinforce data integrity, optimize workflows, and support the creation of innovative business models.

Services such as Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) can be used to host blockchain components like nodes and smart contracts. Application Programming Interfaces (APIs) facilitate interaction between blockchain systems and cloud platforms. Hybrid solutions that integrate public and private clouds with blockchain networks allow organizations to make data privacy levels, while also supporting consortium blockchains managed collaboratively by multiple stakeholders.