Chapter 3
Blockchain Beyond Cryptocurrency:
A Decentralized Approach to Urban Security

Yahaya Saidu
https://orcid.org/0009-0000-8909-8806
Universiti Teknologi PETRONAS, Malaysia & Taraba State University, Jalingo, Nigeria

Shuaibu Yau
https://orcid.org/0000-0002-0001-3536
Federal University Birnin Kebbi, Nigeria

Daniel Tonye Oyefidein
https://orcid.org/0009-0002-2232-3727
Universiti Teknologi PETRONAS, Malaysia

Aliyu Garba
Universiti Teknologi PETRONAS, Malaysia

Dahiru Adamu Aliyu
https://orcid.org/0009-0009-9803-3604
Universiti Teknologi PETRONAS, Malaysia

ABSTRACT

As cities become more digitally governed, centralized infrastructures face growing risks across identity, safety, and data domains. This chapter reframes blockchain as a foundational trust protocol for urban resilience, emphasizing its core features: immutability, decentralization, transparency, and consensus, as tools to address

DOI: 10.4018/979-8-3373-4455-3.ch003

systemic privacy and security challenges. It explores blockchain's role in securing digital identities, logging infrastructure events, and enabling auditable governance. Real-world deployments in land registries, voting, procurement, and incident response, especially in Asia and Europe are analyzed. Privacy-preserving techniques like zero-knowledge proofs and decentralized identity are also examined. The chapter highlights integration hurdles such as interoperability, regulatory gaps, and ethical tensions, while outlining emerging trends like Blockchain 4.0, quantum-safe cryptography, and DAO-led civic participation. It offers a roadmap for decentralized citizen-centric governance in smart cities.

1. INTRODUCTION: RETHINKING TRUST IN THE SMART CITY ERA

The 21st-century city is no longer defined solely by physical infrastructure but increasingly by a digital backbone composed of interconnected sensors, platforms, algorithms, and cloud-based services. From mobile-based citizen feedback apps in Seoul to biometric transit systems in Singapore, contemporary urban systems are characterized by data-intensive, algorithmically mediated processes that promise greater efficiency, real-time responsiveness, and citizen-centric design. Yet this digital transformation has not come without cost. Growing dependencies on opaque platforms, centralized service providers, and vulnerable infrastructures have triggered a global reckoning around the question of trust in urban governance.

Incidents such as the compromise of India's Aadhaar identity system, the use of facial recognition technologies without consent in London and Detroit, and opaque algorithmic decisions in welfare delivery in the Netherlands have spotlighted the fragility of digital trust models. Citizens increasingly demand clarity on how data is collected, how decisions are made, and who holds accountability when systems fail. These concerns are magnified in the smart city context, where governance, identity, and cybersecurity converge and where trust functions not only as a social or political asset but also as a technical requirement for system sustainability (Kundu, 2019). In response to these challenges, blockchain has emerged as a powerful conceptual and practical alternative, not merely as a financial innovation but as a protocol for decentralized trust in public systems. By distributing verification processes, ensuring data integrity, and enabling transparent automation through smart contracts, blockchain reconfigures the foundations of how cities can build, maintain, and share trust among residents, institutions, and machines (Kaushal et al., 2021; Saidu, Shuhidan, Aziz, Adamu, et al., 2025).

The evolution of trust in smart urban ecosystems demonstrates the appeal of blockchain as a response to deficits exacerbated by digital transformation. The