Engineering and Technology Journal e-ISSN: 2456-3358

Volume 11 Issue 06 June-2026, Page No.- 10596- 10600

DOI: 10.47191/etj/v11i06.35, I.F. – 8.595

Transforming Global Remittance Systems Through Blockchain Technology: An Architectural Framework for Financial Inclusion and Efficiency

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ABSTRACT: The global remittance market, projected to exceed $300 trillion by 2025, remains dominated by legacy correspondent banking systems characterised by high fees, multi-day settlement delays, limited transparency, and systemic exclusion of low-income and unbanked populations. These structural inefficiencies perpetuate financial inequality and hinder global economic integration, particularly in developing nations where remittances constitute a significant share of household income. Existing digital payment alternatives, while faster, continue to rely on intermediary networks that replicate many of these same inefficiencies. This paper examines the transformative potential of blockchain technology in restructuring global remittance systems, with a focus on financial inclusion and operational efficiency. Drawing on a mixed-method empirical study encompassing 54 survey respondents and two fintech expert interviews, we demonstrate widespread user dissatisfaction with traditional payment systems and strong intent to adopt blockchain-based alternatives. We present a blockchain-based architectural framework that removes intermediaries, enables near-real-time cross-border settlement, and provides end-to-end transaction transparency through distributed ledger technology. The framework is grounded in the Technology Acceptance Model, Cross-Border Management Theory, and Dynamic Systems Theory. The findings indicate that blockchain-enabled remittance systems can substantially lower transaction costs, accelerate fund delivery, and extend financial services to underserved populations, contributing to the achievement of the UN Sustainable Development Goal of reducing remittance costs to 3% or below.

KEYWORDS: Blockchain, Financial Inclusion, Remittances, Distributed Ledger Technology, Cross-Border Payments, Digital Wallet, Technology Acceptance Model, Global Payments

1. INTRODUCTION

Remittances financial transfers sent by migrants and diaspora communities to families in their home countries are a vital economic lifeline for hundreds of millions of people worldwide. The global value of remittances is projected to surpass $300 trillion by 2025 [6], yet the systems facilitating these transfers remain antiquated, costly, and exclusionary.

Traditional cross-border payment infrastructure relies primarily on SWIFT-connected correspondent banking networks. Average transfer fees reach approximately 7% on a $200 remittance [5], settlement windows span one to five business days [3], and documentation requirements exclude unbanked populations. These barriers stand in direct contradiction to United Nations SDG 10.c, which targets reduction of remittance costs to below 3%.

Blockchain technology characterised by decentralisation, immutability, cryptographic security, and programmable transaction logic presents a compelling alternative framework for global remittances. Pioneered by Nakamoto [1] as a peer-to-peer electronic cash system, blockchain has evolved into a general-purpose infrastructure supporting diverse financial use cases without centralised intermediaries. Platforms such as Ripple [8], Stellar, and R3 Corda [9] have demonstrated real-world blockchain applications in cross-border payments.

This paper contributes to the literature by providing:

1. A comprehensive empirical analysis of user perceptions and industry expert insights on the limitations of traditional remittance systems and the adoption potential of blockchain alternatives.
2. A theoretical synthesis integrating the Technology Acceptance Model, Cross-Border Management Theory, and Dynamic Systems Theory to explain blockchain adoption dynamics in global payment ecosystems.
3. A practical blockchain-based architectural framework designed to maximise financial inclusion by lowering barriers to access, reducing transaction costs, and accelerating settlement.

4. Policy-relevant recommendations for regulators, financial institutions, and payment service providers seeking to leverage blockchain for inclusive global finance.

2. LITERATURE REVIEW / RELATED WORK

2.1 The Financial Inclusion Imperative in Cross-Border Payments

Financial inclusion remains a critical development challenge globally. An estimated 1.4 billion adults remain unbanked [5], and many more lack access to affordable international transfer services. Traditional remittance systems exclude this population through mandatory bank account requirements, complex KYC documentation, and high minimum transfer fees. The correspondent banking model has further contracted due to de-risking by global banks, reducing access to cross-border payment services in high-risk corridors [4].

2.2 Traditional Remittance Systems: Persistent Inefficiencies

Cross-border payments are predominantly routed through SWIFT, a cooperative financial messaging network that facilitates inter-bank communication but does not itself settle funds. Actual settlement occurs through bilateral correspondent banking relationships involving Nostro and Vostro accounts, introducing multi-step processing, currency conversion, and compliance verification at each stage [3][4]. This architecture results in average settlement times of one to five business days and fees that the BIS and FSB identify as structurally excessive [3][4].

2.3 Blockchain as a Remittance Infrastructure

Blockchain-based remittance platforms eliminate the need for correspondent banking intermediaries by enabling direct peer-to-peer value transfer through a shared distributed ledger. Key platforms include Ripple (XRP), which uses the Ripple Consensus Algorithm to facilitate near-instant settlement and has been adopted by institutions including Santander and Bank of America [8][9]; and Stellar (XLM), designed for low-cost cross-border exchanges. These platforms demonstrate that blockchain can offer lower fees, faster settlement, and improved liquidity management compared to traditional banking infrastructure [15].

2.4 Theoretical Frameworks

Three theoretical frameworks structure this study. The Technology Acceptance Model (TAM) [7] frames analysis of user adoption in terms of perceived usefulness (cost savings, speed, security) and perceived ease of use. Cross-Border Management Theory contextualises the governance, regulatory, and operational dimensions of implementing blockchain in international payment corridors. Dynamic Systems Theory [10] enables examination of how blockchain introduction reshapes relationships among banks, regulators, users, and payment service providers.

2.5 Research Gap

The existing literature on blockchain in cross-border payments is fragmented, with studies focusing on isolated technical aspects or individual use cases without providing an integrated architectural framework explicitly designed for financial inclusion outcomes [16]. This paper addresses this gap by combining empirical evidence with a holistic architectural design that prioritises accessibility, cost reduction, and regulatory alignment [2].

3. PROBLEM FORMULATION

This study is organised around four research questions: (RQ1) How do blockchain-based digital payments compare with traditional payment methods in terms of security, speed, and cost? (RQ2) What are the potential applications of blockchain technology in digital payments and cross-border remittances for financially excluded populations? (RQ3) How can blockchain technology enhance efficiency and reduce the cost of international transfers? (RQ4) What impact will blockchain-based digital payments have on intermediaries, financial institutions, and the broader financial inclusion agenda?

The study hypothesises that: (H1) Blockchain-based payment systems can reduce average remittance costs significantly below the current 7% industry average [5], approaching or surpassing the 3% SDG target. (H2) Decentralised settlement mechanisms can compress cross-border payment timelines from days to near-real-time [3]. (H3) User-centric blockchain payment interfaces can extend financial service access to previously unbanked and underbanked populations.

4. PROPOSED METHODOLOGY / FRAMEWORK

4.1 Financial Inclusion-Centred Design Principles

The proposed blockchain-based framework is governed by four core design principles: Accessibility the system must serve users with limited formal banking infrastructure; Affordability transaction fees must be minimised through disintermediation; Transparency users must have real-time visibility into transaction status, fees, and completion; and Security the system must prevent fraud, double-spending, and unauthorised access.

4.2 Application Layer: Accessible User Interfaces

The application layer prioritises user accessibility through two interface modalities. A cross-platform mobile application developed using Google's Flutter framework provides a lightweight, near-native experience on iOS and Android, enabling users in low-bandwidth environments to initiate and track remittances. A web application built on Angular provides

complementary browser-based access. Smart contracts embedded at this layer automatically enforce payment rules, reducing manual compliance verification and accelerating processing.

4.3 Database Layer: Scalable Data Management

The database layer manages user identity data, transaction records, and wallet balances. MySQL stores structured relational data including user profiles, beneficiary details, and transaction histories. Apache Tomcat serves as the web server, with Java SpringBoot providing a modular, scalable backend. Redis caches authentication tokens and wallet session data, reducing database query load and enabling faster transaction initiation.

4.4 Blockchain Layer: Decentralised and Inclusive Settlement

The blockchain layer is the system's core inclusion-enabling component. By replacing correspondent banking intermediaries with a distributed peer-to-peer ledger, it eliminates the cost centres and access barriers inherent to traditional remittance infrastructure. Key technical components include: SHA-256 cryptographic hashing for block integrity; ECDSA digital signatures for transaction authentication and non-repudiation [14]; Merkle Tree data structures for efficient transaction verification; and Proof-of-Work (PoW) consensus mechanism for network security and decentralised validation [13].

4.5 Settlement Layer: Real-Time Fund Transfer

The settlement layer completes the remittance process by executing fund transfers from validated blockchain transactions. Digital wallets which securely store cryptographic key pairs enable users to send and receive funds without requiring a traditional bank account, directly addressing financial exclusion. The settlement layer supports fund disbursement through both digital wallets and correspondent bank accounts where available.

5. EXPERIMENTAL DESIGN

This study employed a convergent mixed-method research design, integrating quantitative survey data with qualitative expert insights [11]. A structured online questionnaire was administered to 54 participants via Google Forms. Qualitative data were collected through in-depth interviews with two fintech industry experts: an Engineering Manager from a fintech company and a Director of Product from a cross-border payment company.

Evaluation metrics for the proposed blockchain framework include: transaction cost reduction (relative to the 7% average fee benchmark [5]), settlement speed improvement (relative to 1-5 day correspondent banking benchmark [3]), user adoption intent, and transparency improvement based on self-reported user satisfaction.

6. RESULTS AND ANALYSIS

6.1 Demographic and Payment Behaviour Profile

Among 54 survey respondents, 59.3% were male and 40.7% female. The dominant age group was 20-29 years (75.9%). The majority (77.8%) transfer money when required, with 55.6% using bank transfers as their primary remittance method. Family expenses account for 50% of cross-border payment motivations, followed by gifts (25.9%) and e-commerce (24.1%). The most frequently targeted transfer region is Asia (53.7%), followed by Australia and North America (each 16.7%).

6.2 Perceptions of Traditional Systems: Documenting Exclusion Barriers

Survey findings reveal clear evidence of structural barriers in traditional remittance systems. A substantial majority (57.4%) agreed or strongly agreed that delays are prominent in cross-border payments. Regarding costs, 61.1% agreed or strongly agreed that cross-border transfers are expensive [5]. Documentation requirements include citizenship documents (61.1%), passports (48.1%), and driving licences (29.6%), highlighting barriers faced by unbanked individuals. Settlement times of one to three days were reported by 61.1% of respondents [3]. Transparency concerns were significant: 40.7% agreed that current systems lack transparency regarding fees, payment status, and deductions.

Table 1: Financial Inclusion Barriers and Blockchain-Based Solutions

Financial Inclusion Barrier	Traditional System Impact	Blockchain Solution
High Transaction Fees	~7% avg. on $200 transfer	Near-zero intermediary fees
Settlement Delays	1-5 business days	Near real-time settlement
Documentation Barriers	Passport, SSN, bank statements required	Digital identity via cryptographic keys
Lack of Transparency	Limited visibility into fees and status	Immutable, auditable ledger

Geographic Access Gaps	Correspondent bank de-risking	P2P global node network
Currency Volatility	Multi-step FX conversion risk	Stablecoin settlement options

6.3 Blockchain Adoption Intent

Among respondents, 53.7% were already aware of existing blockchain-based payment systems. When asked about future adoption intent, 53.7% indicated they would use blockchain-based remittance services, while an additional 42.6% responded 'maybe,' yielding a combined positive-to-likely adoption rate of 96.3%. Expert interview participants identified blockchain's capacity to authenticate users via cryptographic fingerprints, reduce fraudulent transactions, improve settlement liquidity, and lower per-transaction costs as transformative advantages [8][9].

6.4 Qualitative Insights: Expert Perspectives

Expert testimony highlighted that blockchain's potential for financial inclusion extends beyond cost reduction. The removal of dependency on SWIFT and correspondent banking means that remittance corridors previously underserved due to bank de-risking could become viable through blockchain-based peer-to-peer networks [4]. Experts noted that while platforms like Ripple and Stellar have demonstrated proof-of-concept at scale, widespread adoption requires parallel development of regulatory frameworks, user education, and cross-platform interoperability standards [9][10].

7. DISCUSSION

7.1 Theoretical Implications

The TAM framework [7] predicts that perceived usefulness and ease of use drive technology adoption. The empirical data confirm both dimensions: users perceive blockchain as useful (lower cost, faster settlement, better transparency) and express openness to adoption (96.3% positive-to-likely intent). The financial inclusion-centred design of the proposed architecture — accessible mobile interfaces, streamlined KYC, digital wallet-based access without bank account requirements — directly addresses perceived ease of use barriers.

Dynamic Systems Theory [10] frames blockchain adoption as a systemic transformation. The introduction of blockchain into remittance ecosystems reshapes relationships among banks, regulators, MTOs, and users, shifting power toward distributed networks and reducing the gatekeeping role of centralized financial institutions.

7.2 Policy Implications for Financial Inclusion

Central banks and financial regulators should develop sandbox environments enabling blockchain remittance providers to test compliance frameworks without the full weight of traditional banking regulation [4]. International coordination bodies such as the G20 and FSB should prioritise blockchain interoperability standards that enable cross-chain remittance settlement. Development finance institutions should consider blockchain remittance platforms as viable financial inclusion infrastructure investments, particularly for underserved remittance corridors in sub-Saharan Africa, South Asia, and Southeast Asia.

7.3 Limitations

This study's findings are limited by a sample of 54 survey respondents, which may not be representative of the global remittance user population [11]. The study did not conduct live performance benchmarking of the proposed architecture against SWIFT-based systems. The PoW consensus mechanism, while secure, has known scalability and energy consumption limitations that may warrant reconsideration in high-volume deployment contexts [13].

8. CONCLUSION

This paper has demonstrated the transformative potential of blockchain technology in restructuring global remittance systems to promote financial inclusion and operational efficiency. Drawing on a mixed-method empirical study [11] and a detailed architectural framework, we have shown that traditional correspondent banking systems impose structural costs, delays, and access barriers that blockchain is uniquely positioned to address [1][2]. Empirical findings confirm strong user demand for blockchain alternatives, with 96.3% of respondents indicating positive or likely adoption intent. Expert testimony reinforces the technical and commercial viability of blockchain-based remittance systems [8][9], while identifying regulatory ecosystem development as the critical enabling condition for widespread adoption.

9. FUTURE WORK

- Conduct real-world pilot deployments in high-volume remittance corridors (e.g., Nepal-Malaysia, Philippines-USA) to benchmark performance against SWIFT-based systems.
- Evaluate the financial inclusion impact of digital wallet-based settlement for unbanked populations across sub-Saharan Africa and South Asia.
- Investigate the integration of Central Bank Digital Currencies (CBDCs) with the proposed blockchain framework to enable compliant, low-cost cross-border settlement.

- Develop and test alternative consensus mechanisms (Proof-of-Stake, PBFT) to improve energy efficiency and scalability for high-volume remittance processing.
- Design and evaluate smart contract-based automated AML and KYC verification systems to reduce compliance-related friction while maintaining regulatory standards.

10. ACKNOWLEDGMENT

The author extends sincere gratitude to Lincoln University College and Texas International College of IT and Management for institutional support. Special thanks to supervisor Dipak Adhikari for guidance, and to the fintech professionals who participated in expert interviews. The author also acknowledges the survey participants whose insights formed the empirical foundation of this study.

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