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ENHANCING GLOBAL FINANCE: A BLOCKCHAIN-BASED SOLUTION FOR EFFICIENT AND COST-EFFECTIVE CROSS-BORDER PAYMENTS

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Abstract: This study explores the transformative potential of blockchain technology in revolutionizing cross-border payment systems. Traditional methods are hindered by inefficiencies such as high transaction fees, prolonged processing times, and opaque operations, which impede seamless global financial interactions. Blockchain, with its decentralized and immutable ledger, offers a secure and transparent alternative that can significantly streamline payment processes. This paper examines how blockchain can facilitate real-time settlements, eliminate intermediaries, and enhance data integrity, thereby reducing costs and improving efficiency. Further, it addresses the practical applications and regulatory challenges associated with integrating blockchain into existing payment infrastructures. Ultimately, this research aims to provide actionable insights for developing a more efficient, transparent, and cost-effective cross-border payment ecosystem.
Keywords: Blockchain technology; Cross-border payments; Financial efficiency; Cost reduction

1 INTRODUCTION

In an era of increasing global economic interdependence, the demand for efficient cross-border financial transactions has never been higher. However, traditional cross-border payment systems are plagued by inefficiencies that hinder their ability to meet modern demands. These systems are characterized by complex processes involving multiple intermediaries, which lead to extended processing times, high costs, and a lack of transparency. These challenges not only burden businesses with increased operational costs but also limit the accessibility of cross-border transactions for small and medium-sized enterprises (SMEs) and individual users. In response, blockchain technology has emerged as a promising solution, offering a decentralized, transparent, and immutable ledger that can revolutionize the way cross-border payments are processed. This study aims to investigate how blockchain can optimize payment efficiency and reduce costs, providing a theoretical foundation for the development of a more efficient and cost-effective cross-border payment system.

With the deepening development of global economic integration, the demand for cross-border trade and financial transactions is increasing. However, the existing cross-border payment system is facing many restrictions and has become a "bottleneck" factor in international financial transactions. Traditional cross-border payment processes are cumbersome and involve multiple intermediaries, resulting in long processing time, high cost and lack of transparency. This situation not only increases the operating costs of enterprises, but also limits the convenience of cross-border transactions between small and medium-sized enterprises and individuals. In this context, how to optimize the efficiency of the cross-border payment system and reduce the transaction cost has become one of the research priorities in the global fintech field[1].

Blockchain technology, as a distributed ledger technology that has emerged in recent years, has brought new possibilities for cross-border payments. Its decentralization, transparency and imtamable features can significantly reduce the mediation of the payment system and improve the processing efficiency and security. Therefore, cross-border payment systems based on blockchain technology have gradually become the focus of attention in both academia and industry. This study aims to explore the potential of blockchain technology in cross-border payment systems, focusing on how to improve payment efficiency and optimize costs through this technology, so as to provide theoretical support for the construction of a more efficient and low-cost cross-border payment system[2-3].

2 CURRENT SITUATION AND CHALLENGES OF CROSS-BORDER PAYMENTS

2.1 Overview of the Traditional Cross-Border Payment System

Traditional cross-border payments rely heavily on established financial intermediaries and networks such as SWIFT, RTGS, and ACH. While these systems have long been the backbone of international finance, they are not without their drawbacks. SWIFT, for instance, excels at transmitting transaction information globally but relies on correspondent banking relationships for actual fund settlements, leading to delays and high costs. Similarly, RTGS systems, designed for high-priority payments, struggle with cross-border transactions due to their localized nature and the need for international bank participation. These complexities result in slow clearing speeds and increased transaction costs, highlighting the urgent need for innovation in cross-border payment systems.

Traditional cross-border payment systems often rely on banks and other financial intermediaries to complete the transnational transfer of funds. The main systems include SWIFT (Global Association for Banking, Finance and Telecommunications), RTGS (real-time full settlement system) and ACH (automatic clearing system), etc. SWIFT system is a widely used cross-border payment information transmission network in the global banking industry. It helps banks to transmit cross-border transaction information through its standardized information format and global network support. However, SWIFT does not directly liquidate the funds, and still needs to complete the actual capital flow through the account transfer between the corresponding bank and the agent bank. This process is usually more complex, involving multi-party participation, and a long information transmission process, leading to the actual settlement speed of funds[4].

The RTGS system is mainly used for large, high-priority payments, which is characterized by full settlement within the same day and is suitable for a single large cross-border transaction. However, RTGS systems mostly operate in a single country or region, while cross-border RTGS payments rely on financial institutions from other countries to join in. Therefore, the efficiency of RTGS in cross-border payment is limited. At the same time, traditional cross-border payment systems usually rely on multiple account structures, with banks having agent accounts in different countries, which makes the clearing speed in the cross-border payment process slow and increases the transaction costs[5].

2.2 Major Challenges of Cross-Border Payments

The inefficiencies in traditional cross-border payment systems manifest in several critical areas:

Delays: The involvement of multiple intermediaries in cross-border transactions often results in significant delays. Even with advanced networks like SWIFT, settlements can take days or even longer when multiple countries and banks are involved. Time zone differences and varying operational hours further exacerbate these delays, making real-time payments a distant goal.

High Costs: Each intermediary in the payment chain charges fees, leading to cumulative costs that can be prohibitively high, especially for SMEs and individual users. Additionally, exchange rate fluctuations and bank conversion fees add to the financial burden, limiting the economic feasibility of cross-border transactions for many.

Lack of Transparency: Tracking the flow of funds and understanding fee allocations in traditional systems is challenging due to the involvement of multiple layers of intermediaries. This lack of transparency not only affects user experience but also increases the risk of fraud and reduces trust in the payment process.

Traditional cross-border payment system faces multiple challenges in its practical operation, mainly reflected in the following aspects:

Delay: Cross-border payment processes usually require multiple intermediaries, resulting in a long time to transfer funds. Even with SWIFT, funds can be settled for days, especially when transfers between multiple countries and banks, often extending further. In addition, differences in operating times and time zones of different banks may also lead to payment delays, making it difficult to meet the demand of real-time payment.

High fees: Cross-border payment involves multi-party participation, and each intermediary agency will charge a certain handling fee, and the total cost is relatively high after superposition. In the traditional system, intermediary banks and agent banks will charge intermediary fees in the transaction process, and the exchange rate difference and the conversion fee of the bank will also increase the transaction cost, and bring additional economic burden to both parties. Especially for small and medium-sized enterprises or individual users, this high cost is an important obstacle to their participation in cross-border transactions.

Lack of transparency: In traditional cross-border payment processes, capital flow, real-time state and fee allocation are often difficult to track because transfers involve multi-layer intermediaries and multinational banks. This lack of transparency not only affects the user experience, but also increases the risk of money being withheld or falling under fraud, and reduces the security and trust of transactions[6-7].

3 OVERVIEW OF BLOCKCHAIN TECHNOLOGY

Blockchain technology represents a paradigm shift in the way data is stored and shared. By leveraging cryptography and consensus algorithms, blockchain creates a decentralized and immutable ledger that records transactions in a transparent and tamper-proof manner. Each block in the chain contains a unique cryptographic hash linking it to the previous block, ensuring data integrity and security. This decentralized structure eliminates the need for intermediaries, allowing for direct peer-to-peer transactions. The transparency and immutability of blockchain not only enhance trust but also provide a robust foundation for secure and efficient financial transactions.

Blockchain is a distributed ledger technology that enables the decentralized storage and sharing of data through cryptography and consensus algorithms. The core idea is to package transaction data into blocks and connect them in chronological order to form an immutable and traceable chain. Each block contains a collection of data records, which includes the transaction records and the hash values of the previous block. All the data in the blockchain are verified and transmitted through the encryption algorithm, and are jointly maintained by each node through the consensus mechanism, which ensures the integrity and security of the data[8].

Blockchain is decentralized, transparent, and tamper-proof. This decentralized structure reduces the reliance on third-party intermediaries, allowing all participants to reach an agreement without full trust. The imtamability of the blockchain stems from its chain structure: each block contains the hash value of the previous block, and tampering with

any block will lead to a mismatch in the hash value on the chain, thus revealing traces of changes. Therefore, blockchain provides a technical guarantee for the realization of the high security and reliability of data[9].

4 CROSS-BORDER PAYMENT SYSTEM DESIGN BASED ON BLOCKCHAIN

A blockchain-based cross-border payment system aims to address the inefficiencies of traditional methods by offering a streamlined, low-cost, and transparent solution. The system architecture typically comprises several layers: user interface, smart contracts, consensus mechanisms, and distributed data storage. By leveraging real-time data synchronization and eliminating intermediaries, the system significantly reduces transaction times and costs. The payment process, from initiation to settlement, is automated through smart contracts, ensuring transparency and reducing the risk of errors or fraud.

Blockchain-based cross-border payment systems aim to achieve low-cost, real-time payment solutions. The system architecture typically includes a user layer, a smart contract layer, a consensus layer, and a data storage layer. The user layer is responsible for receiving payment instructions, the smart contract layer sets payment conditions and execution logic, the consensus layer ensures the validity of the transaction, and the data storage layer saves the transaction data through the distributed ledger. Real-time data synchronization between the nodes eliminates the intermediary dependence, simplifies the payment process, and improves the anti-aggression and fault tolerance of the system, and ensures the data security[10].

The payment process generally includes payment initiation, transaction verification, settlement execution, and result confirmation. After the user initiates the payment, the system will trigger the smart contract, check the account balance and authentication, confirm it through the consensus mechanism, and broadcast to the blockchain network to complete the settlement. The decentralization of the payment process significantly shortens transaction time, and users can track payment status in real time, improving transparency.

4.1 Consensus Mechanism Selection and Optimization

Consensus mechanism affects the efficiency and security of cross-border payment systems. Byzantine fault tolerance (BFT) and proof of equity (PoS) are commonly used mechanisms, among which BFT is suitable for small-scale and high-trust networks, with fast confirmation speed, while PoS is suitable for large payment systems, with low and stable energy consumption. In order to improve the transaction efficiency, the system can adopt a multi-level consensus mechanism, such as PoS in a large range of nodes and BFT in a small range of nodes. At the same time, combined with the penalty score mechanism to deal with malicious nodes, to improve the security and stability of the system.

4.2 Smart Contract Design and Application

Smart contract is an important tool for automated transaction, which can be used for the setting and execution of cross-border payment conditions, such as exchange rate conversion, account balance verification, etc., which can be automatically executed after the conditions are met to reduce intermediary intervention and manual operation. In order to ensure the accuracy and safety of the contract, strict tests need to be conducted, and a double confirmation mechanism is introduced when necessary to reduce the risk of contract execution.

4.3 System Security and Compliance

Blockchain payment systems should pay attention to data security and compliance. Prevent data tampering through multiple signatures and encryption algorithms, and comply with anti-money laundering (AML) and KYC (understand customer) requirements to ensure the authenticity of user identity and transaction compliance. The combination of on-chain and off-chain data helps to achieve transparent management and facilitate regulatory review.

5 CONCLUSIONS

Through decentralized and transparent operations, blockchain can significantly enhance payment efficiency and reduce costs. The proposed blockchain-based payment system, supported by advanced consensus mechanisms and smart contracts, offers a secure and efficient alternative to existing methods. However, challenges related to scalability and regulatory compliance must be addressed to fully realize the benefits of blockchain in cross-border payments. Future research should focus on overcoming these hurdles to pave the way for a more efficient, transparent, and cost-effective global payment ecosystem.

This paper studies the application of blockchain technology in cross-border payment systems, aiming to solve the problems of high cost, low efficiency and insufficient transparency in traditional cross-border payment systems. Blockchain offers new solutions for cross-border payments through its decentralization, immutability and high transparency. This paper designs a blockchain-based cross-border payment system, including system architecture, payment process, and key technology implementation. Through multi-level consensus mechanisms, smart contracts, and multiple security guarantees, the system automates and reduces low cost of payment processes, and improves payment efficiency and security. At the same time, this paper discusses the compliance and application challenges of the

blockchain payment system. Despite scalability and legal compliance issues, blockchain has broad prospects in the cross-border payment field, bringing efficient and secure solutions to the global payment system.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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