Research on Blockchain Application for E-Commerce, Finance and Energy

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Abstract. Research and apply blockchain technologies for e-commerce, finance and energy. The blockchain system includes blockchain technology components, blockchain application programming interfaces, and applications. The blockchain-based applications cover supply chain finance, e-commerce transactions, product traceability, user credits, financial services, trust systems, new energy, etc. Based on blockchain technology, it builds a creative and security trading system, payment system and trust system for e-commerce, financial services and new energy business.

1. Introduction

At present, e-commerce, finance, energy and other fields are developing rapidly, and new technologies are changing with each passing day. In traditional e-commerce, user information leakage risk events occur from time to time. How to use blockchain technology to improve the security of e-commerce systems is an urgent need [1]. As the scale of e-commerce cross-border trade continues to increase, the volume of cross-border payment is rising. In the current cross-border payment process, each transaction needs to be transmitted between multiple organizations. There are problems such as high intermediate costs, low payment efficiency, high membership threshold, and centralized security risks. Traditional e-commerce transactions have their records in a centralized organization, which is inefficient, costly and opaque.

The blockchain distributed ledger guarantees the fairness and authenticity of the transaction, and avoids the possibility of transaction being tampered [2]. The advantages of blockchain-based applications are optimizing business processes, reducing operating costs, and improving synergy efficiency. These advantages have been gradually reflected in financial services and supply chain management [3]. Blockchain-based financial asset rights trading and circulation drive the development of financial markets, financial instruments, financial intermediation, and financial system. The payment clearing system is the basic support of economic and financial activities. And the payment clearing process is a typical multi-center scene, which is highly matched with the blockchain characteristics.

2. Methods

The blockchain implements peer-to-peer transaction, coordination and collaboration based on distributed node systems, by means of data encryption, time stamping, and consensus. Solve the problems of insecure data storage that are common in centralized system. Establish a blockchain

technology application platform to support e-commerce applications, supply chain financial applications and new energy applications.

Through the technologies of blockchain distributed ledger, consensus mechanism, identification, smart contract, encryption algorithm, etc., system optimizes the e-commerce business model, improves operational efficiency, and ensure financial security.

A blockchain-based business service platform, has the features of distributed data storage, time-series and tamperproof data, intelligent execution of smart contract, security and privacy protection.

Build blockchain-based trusted system such as e-commerce, finance, and new energy. Blockchain technology can enhance the transparency of financial transactions [4], strengthen the flexibility of system operation, and automate processes. Which will have a profound impact on the business model of finance [5], e-commerce, data storage, accounting, and payment methods. The distributed ledger uses consensus mechanism to negotiate the contents of the ledger [6], uses cryptographic algorithms and digital signatures to ensure the integrity of e-commerce, finance, and energy transactions [7].

3. Technical solutions

Based on the blockchain architecture, the transaction system, payment system and trust system in e-commerce, it realizes the interconnection and intercommunication of e-commerce information value chain. Application blockchain technology optimizes the process and operational architecture to enhance the user experience.

Build an intelligent, real-time, automatic, efficient and secure blockchain e-commerce system. Optimize e-commerce payment clearing, financial transactions, smart contracts, etc. Realize the digitization of assets such as accounts receivable, bills and warehouse receipts. Make e-commerce business smooth and efficient through smart contracts.

Build a distributed account ledger model of user credits, and solve the problem of cross-business exchange. Standardize the application framework of supply chain finance, evidence preservation, and new energy. Construct a blockchain public service platform to support multiple businesses.

Design the trusted service architecture of the business system, analyze the security risks of the blockchain technology applied in the business system. Propose a security assessment method for the blockchain technology, and build a service chain trustworthy service support system. Improve the supply chain, use the blockchain technology to achieve the accurate supply of materials and the dynamic evaluation of supplier credit. Construct a supplier credit evaluation mechanism based on blockchain trusted data, provide accurate supply of materials, and support for supplier evaluation and credible service.

4. System architecture

The blockchain system includes blockchain core technology components, blockchain application programming interfaces, blockchain-based applications, as shown in Fig.1.
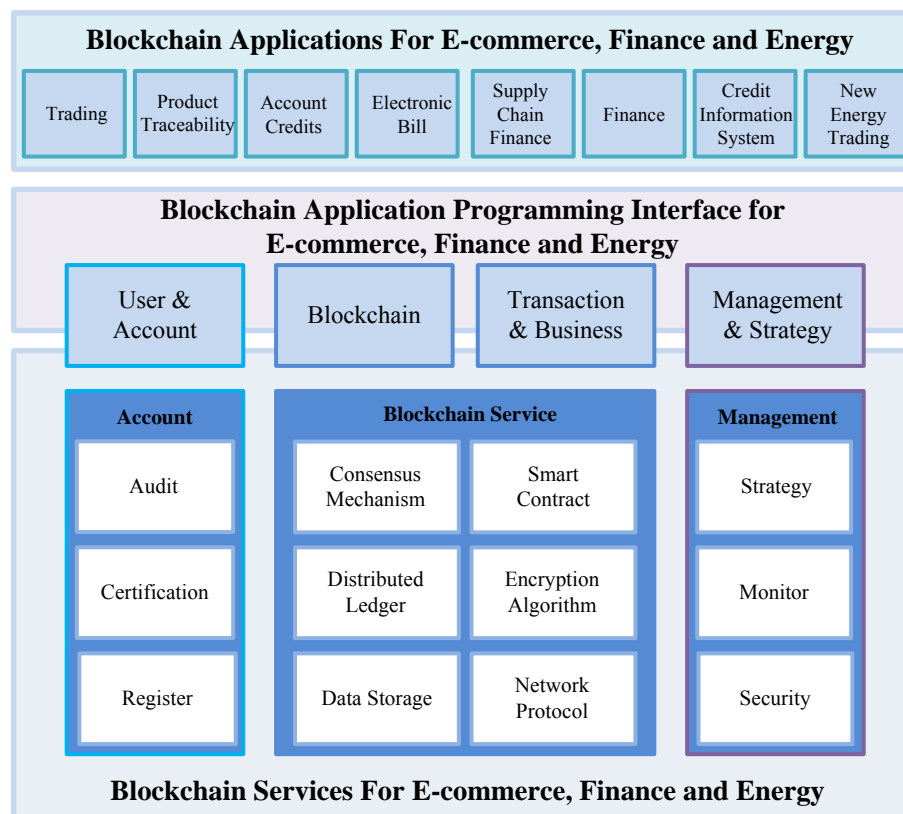
Figure 1. Blockchain application architecture for e-commerce, finance and energy

The blockchain core technology component implements the blockchain basic function service. The blockchain nodes of each institution form an alliance. The blockchain nodes perform consensus and data synchronization to provide blockchain alliance supports.

The blockchain application programming interface provides interface services for business applications in e-commerce, finance, and energy sectors, including supply chain finance, new energy, digital protocol centers, commodity traceability, and credit services.

Business applications include multiple applications in the fields of e-commerce, finance, and energy.

5. Blockchain platform and components

5.1. Technical Components
The blockchain core technology components include components such as consensus mechanisms, security mechanisms, storage, communications, etc.

The consensus mechanism, utilizes mathematical algorithm to achieve agreement between different nodes on the accounting content. It is the basis for nodes to achieve synergy [8]. When the number of failed nodes is less than the number of fault tolerance, the entire system can still work unceasingly. The system consensus is highly efficient, and meets the requirements of the business system for concurrency, throughput, and response time.

P2P, multicast technology, distributed networking mechanism and data dissemination mechanism are the basis of communication between server nodes, and compose a communication component.

Storage is the carrier of distributed ledgers, including file system, block data structure and Hash association chain structure between blocks, database and other technologies. Non-critical data and large files that exceed the block size limit can be stored in the file system.

The block includes a block header and a block body. The block header consists of a time stamp, a block number, a hash value of the previous block, etc. [9]. The block body stores transaction data, transaction records, asset information, identity information, etc.

In the decentralized distributed system, a consensus is reached on the validity of the block data.

Asymmetric encryption algorithm is used for information encrypting, digital signature, and user authentication. The hash algorithm is used to obtain digest of original data, verifies the integrity and consistency of the data, and prevents data tampering. Use privacy protection mechanisms such as homomorphic encryption and zero-knowledge proof to prevent the leakage of private data.

5.2. Application Programming Interface

The application programming interface provides API and SDK of the blockchain.

The blockchain platform verifies the calling rights of the API. Only the authentication is passed, can the functions provided by the API be called.

Provide transaction record and query interfaces, data certification and query interfaces, etc. for e-commerce, finance, energy applications.

Provides smart contract related interfaces, including creating, deploying and executing smart contract, etc.

Allow release of digital assets in a programmatic manner, enable the writing of smart contracts through configuration scripting language. Allow apply smart contract, and support the safe and automatic execution of energy Internet transactions. Promote safe and stable system operation through incentive mechanisms. Provide member management functions for the alliance chain and the private chain.

5.3. Tools and the Environment

Provide test tools and environment, maintenance and operation management system, and security monitoring functions.

6. Blockchain-based trading system and payment system

Blockchain-based e-commerce transactions, payment clearing and cross-border payment realize efficiency, transparency, and robustness. Blockchain-based cross-border transactions and payments are real-time, automated and uninterrupted.

Support the distribution management and circulation of asset rights. The blockchain-based point-to-point circulation characteristics enhance the liquidity of financial instruments and improve the efficiency of financial services.

The application of blockchain technology in supply chain finance supports information exchange among suppliers, enterprises, banks, and financial organizations.

The application of blockchain in cross-border payment enables international banks, enterprises or individuals to conduct peer-to-peer financial transactions with each other, and realizes cross-currency payment transactions. Build digital asset, and use it as a medium to secure payments.

Thereby, it implements a blockchain-based transaction and payment system.

7. Blockchain-based trust system

7.1. Trust System

The trust system is an important foundation for e-commerce, financial services, and energy applications. Building a trust system based on blockchain technology is conducive to improving social and economic efficiency, ensuring financial security, and enhancing the core competency of the system.

Blockchain can improve the accuracy of credit evaluation, clarify data ownership, broaden the coverage of credit assessment, ensure data security and privacy protection, etc. Blockchain-based trust system guarantees that data cannot be tampered. Synergy efficiency is improved. Blockchain technology provides a new core foundation and supports for establish of trust system.

The blockchain-based trust system includes: blockchain service layer, blockchain credit platform application programming interface layer, and trust system applications.

7.2. Credit Data

The use of blockchain can figure out the problem of trusted data sources. Every step of user registration, login, transaction, etc. will be written into blockchain, broadcasted and monitored by the whole nodes. For example, in the case of financial services, user verification, transaction approval, lender information, borrower license, borrower commitment, contract signing, transaction processing, clearing and settlement, and repayment information will all be written to the distributed ledger.

The data in the blockchain is tamperproof and nonrepudiation. The data includes two types, one is original data recorded directly on the blockchain, and the other is data digest recorded on the blockchain. It saves the original data to the local file system, submit digest information to the blockchain. And it provides data query for the clients with access control rights. It verifies the consistency of the original data and ensures that the credit data has not been tampered.

7.3. Alliance Chain

A chain of alliance is established between large Internet companies, which hold credit information. It provides a multi-dimensional credit data report. It establishes a whitelist and blacklist, as credit reference. And it plays a role in risk control, and builds a trust system based on blockchain.

8. Application

For e-commerce, finance, and energy, it applies blockchain technology in the following business scenarios.

(1) It realizes blockchain-based evidence certification platform. The key information, such as hash value of evidence file, is write to blockchain to realize evidence collection of important document in the whole process. .

(2) Blockchain-based payment clearing and settlement improve operating efficiency.

(3) Blockchain-based supply chain finance application is achieved.

(4) Blockchain-based trust system application is realized.

(5) It applies blockchain in material bidding process to record the performance of suppliers and bidders, and provides basis for credit evaluation.

(6) It realizes visual display and monitoring of block node information, such as block height, block hash, transaction information, time, etc.

9. Conclusion

Research and apply blockchain technologies for e-commerce, finance and energy. The blockchain system includes blockchain technology components, blockchain application programming interfaces, and applications. The blockchain-based applications cover supply chain finance, e-commerce transactions, product traceability, user credits, financial services, trust systems, new energy, etc. Based on blockchain technology, it builds a creative and security trading system, payment system and trust system for e-commerce, financial services and new energy business.

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