Construction of Financial Platform Model Based on Internet of Things and Blockchain Technology

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Abstract. With the rapid development of small and medium-sized enterprises in China, their financing needs are also continuously increasing. However, the traditional centralized supply chain finance system cannot truly and effectively solve the financing problems of small, medium-sized, and micro enterprises due to the problems of data tampering and low financing efficiency. The purpose of this article was to research the construction of financial platform based on the Internet of Things (IoT) and blockchain technology. This article integrated blockchain technology and supply chain finance, thereby solving the problems of low financing efficiency and data tampering existing in traditional supply chain financial service systems, and better meeting the financing needs of enterprises. On this basis, the consistency algorithm based on PBFT (Practical Byzantine Fault Tolerance) was studied and optimized. It was applied to financial service platforms of the IoT and blockchain, and finally verified. The results showed that the improved consistency algorithm studied in this paper had less latency compared to the PBFT consistency algorithm.

Keywords: Internet of Things Technology · Blockchain Technology · Financial Platform · Platform Mode

1 Introduction

China is currently in a period of economic transition, and the financing difficulties of small and medium-sized enterprises are increasingly prominent. More and more enterprises are facing the dilemma of "transition". This problem can be effectively solved by integrating various information generated during the financing process online. This online supply chain finance model can quickly and efficiently solve financing problems, promote the upgrading and development of modern service industries such as e-commerce, logistics, and online payment, and accelerate the pace of China's economic transformation [1, 2]. The online supply chain financial service system is a symbiotic system composed of multiple subsystems that cooperate with each other to ensure their orderly operation [3, 4]. If there is no effective collaboration between various subsystems, the supply chain financial services on the network cannot form a complete system. Only when financing entities, financing support, and financing objects cooperate with

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each other can information be ensured to be timely and efficient, risk be minimized, and supply chain finance be truly online [5]. Applying blockchain technology to supply chain finance brings supply chain finance into a new era. Moreover, as regulatory authorities and enterprises continue to deepen their understanding of blockchain inventory financing platforms, the problems arising from the use of IoT technology on such platforms have been gradually resolved.

Supply chain finance is one of the important ways of financing for small and medium-sized enterprises, and it is also one of the main reasons for the difficulty of financing for small and medium-sized enterprises. Arief Rijanto established a trusted information sharing platform among four major entities, including supply chain alliances, logistics enterprises, financial institutions, and regulatory authorities, using the "blockchain + IoT" technology [6]. After in-depth analysis and research on the characteristics of the financial loan system, Kareem Mohamed introduced this technology into traditional system platforms, forming an alliance chain [7]. Therefore, it is of practical significance to study the construction of financial platform based on the IoT and blockchain technology.

Currently, there have been some achievements in applying blockchain technology to the field of supply chain finance. However, overall, it is still relatively small. Most of them are theoretical, and the analysis of individual cases is not thorough. The innovation of this paper is to analyze the key points of technologies such as the IoT and blockchain, summarize their advantages and disadvantages, and provide specific application strategies on financial platforms. In view of the current lack of research on supply chain financing models under the operational mechanism of such platforms, this topic takes the "IoT + Blockchain" financial service platform as an example to verify it, and also complements research in this field.

2 Technical Highlights of Financial Platform Based on the IoT and Blockchain Technology

2.1 IoT Technology

In the overall data platform of the IoT, data and related information on production products can be updated in real time, and have a direct impact on property rights regulation and decision-making behavior in supply chain management, which has a significant impact on the overall planning of logistics in supply chain finance [8, 9]. Using the IoT technology, all property rights and goods rights are converted into visual goods documents, which greatly improves the authenticity and reliability of financing enterprises' pledged warehouse receipts in supply chain finance. It avoids many systemic defects in supply chain finance such as repeated pledges. The problem of removing false data sources and verifying the authenticity of transaction contracts in blockchain technology has been resolved [10].

2.2 Blockchain Technology

In traditional supply chain finance models, there are often multi-level suppliers, and it is difficult for core enterprises to quickly allocate accounts receivable to suppliers at all

levels. The converted electronic vouchers can be split, transferred, and discounted for financing, which solves the allocation problem of multi-level supplier credit vouchers, and further solves the financing difficulties caused by the lack of pledge vouchers [11, 12]. A smart contract is a mechanism that must execute a contract after meeting the contract trigger conditions. Its contract is defined in digital form, so it has a high degree of automation, greatly reducing the default situation in various aspects of supply chain finance [13, 14]. In the supply chain, all data is uploaded to the system in real time. These block data arranged in timestamp order ensure the credibility of informatization. These data also greatly enhance the data collection cycle, and also reduce the labor costs required by supply chain parties to integrate data in the past, which greatly facilitates the review and financing risk control of financial institutions and regulators.

2.3 PBFT Consensus Algorithm

The distributed consistency of blockchains is mainly reflected in consensus algorithms. The practical Byzantine fault-tolerant algorithm PBFT is the current mainstream consensus algorithm for alliance chains. Compared to the Byzantine fault-tolerant algorithm, the PBFT consistency algorithm has smaller communication complexity, higher computational efficiency, and faster transaction confirmation speed. It can fault-tolerant one-third of the Byzantine nodes [15]. The PBFT consistency algorithm can well solve Byzantine fault tolerance in terms of algorithm efficiency, fault tolerance rate, and resource utilization, and is more suitable for enterprise applications. In the PBFT algorithm, the number of nodes N in the system must reach N greater than 3 f + 1, where f is the number of Byzantine nodes.

2.4 Optimization of Consensus Algorithm

This paper presents a new fault detection method for Byzantine non synchronous distributed systems. This algorithm divides the state of replica nodes into two types in a distributed system. One is the normal operation mode, and the other is the fault handling mode. When there is no BFT (Byzantine Fault Tolerance) problem in the system, the system is in normal operating mode. All replicas in the system can be divided into two types. One is an active state replica, and the other is a passive state replica. Passive state replicas can not participate in request processing and consensus voting in this system, thereby reducing message transmission in distributed system networks, and improving the performance of the entire system. During this process, activating a copy not only involves participating in user requests, but also voting for user consensus. When an activated replica receives a request from a customer and broadcasts the request, one node of the replica acts as a master node and the other node acts as a slave node.

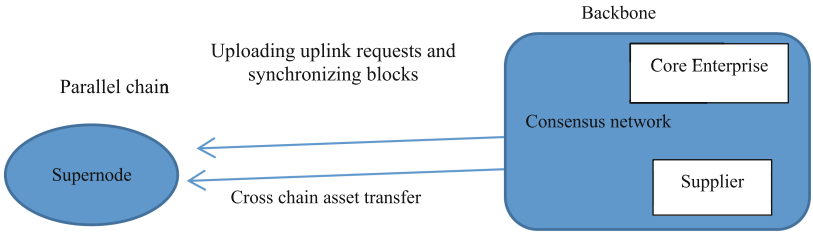

Fig. 1. System blockchain architecture network topology

3 Construction of a Financial Platform Model Based on the IoT and Blockchain Technology

3.1 Introduction to Financial Service Platform

On the "IoT + Blockchain" financial service platform, financing enterprises have not only gradually formed their own complete corporate credit portrait, but also obtained the only equity certificate - standardized blockchain warehouse receipts. Based on the consensus mechanism, multiple parties have jointly generated standardized blockchain warehouse receipts, which not only can achieve the non tampering and traceability of warehouse receipt information, but also can make the transfer and transaction of warehouse receipts more convenient. At the same time, it can also directly connect with financial institutions to achieve effective financing purposes.

3.2 Network Architecture of Blockchain

The blockchain architecture network topology of this platform is shown in Fig. 1. In the main chain of the platform, two organizational nodes are arranged as a core enterprise node and a supplier node. On this platform, all vendors have the same status and permissions. At the same time, on this platform, a parallel chain connected to the main chain is deployed. In the parallel chain, a super node is established, and a super account is configured for this node to implement functions such as cross chain asset transfer, synchronization of blocks, and uploading uplink requests. Intelligent contracts are applied to parallel chains, enabling the entire supply chain financial business to operate in parallel chains, where the main chain plays a role of coordination and packaging transactions.

4 Test Experiment of Financial Platform

4.1 System Functional Test

The operational functions of the "IoT + Blockchain" financial service platform described in this article have been tested. On this basis, the operator's account was used to log in to the system, and various functional points of the system were verified. This article listed the functional tests of the core enterprise subsystem, as described in Table 1.

Table 1. Functional test table

Test function	Testing procedure	Expected results
Supplier Management	First, search based on the supplier name or supplier code, and display it in a list form. Then bind or unbind related suppliers from the retrieved supplier list.	Query and obtain supplier information based on query criteria, and bind suppliers.
Order management	Enter the information of the initiated purchase order and query the status of the order it initiated.	Successfully input procurement information into the system, and be able to query the initiated order information.
Purchase Settlement	Enter the order information that has been paid and query the order information that has been paid.	Query the paid order information and successfully enter the paid order information.
Receiving management	Query the receipt status after the receipt confirmation.	Core enterprises can confirm the receipt of orders and query the receipt status of orders.

4.2 System Performance Test

Generally, performance testing of blockchain systems is conducted from aspects such as throughput and latency. On this basis, the differences between PBFT and the improved consistency algorithm are emphatically analyzed. In this article, TPS (Transaction Per Second) is used to represent throughput. The TPS calculation formula is as follows:

$$\text{TPS} = \frac{\text{Number of blockchain transactions written per unit time}}{\text{Unit time}} \tag{1}$$

Generally speaking, the throughput or ability to withstand pressure of a system is closely related to the response speed of request IO (input/output) and external interfaces, as well as the consumption of CPU (Central Processing Unit). When a request consumes less CPU resources and higher IO response, the throughput of the system increases. Delay is the time from when a customer initiates a transaction to when the transaction is confirmed and recorded on the blockchain. It measures the efficiency of network communication and consensus algorithm processing across the entire system by initiating multiple transactions with the client and calculating the average delay. System delay is a key factor that affects the customer experience. If the delay value is small, the customer waits for less time. On the contrary, if the delay value is large, the customer waits for more time. The system delay is calculated using the following calculation formula:

$$\text{Delay} = \frac{\text{Total transaction time}}{\text{Total number of transactions completed during this period}} \tag{2}$$

In the Github library, the PBFT source code for Hyperledger Fabric has been modified to complete the improvement of the PBFT based algorithm described in this article. Next,

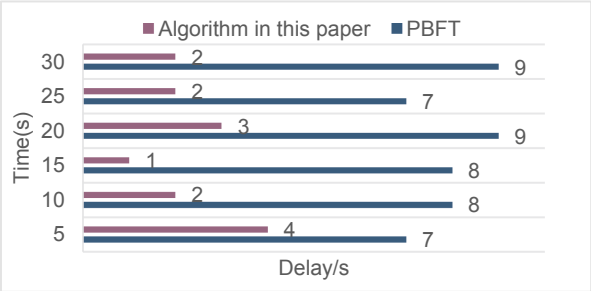

Fig. 2. System throughput change

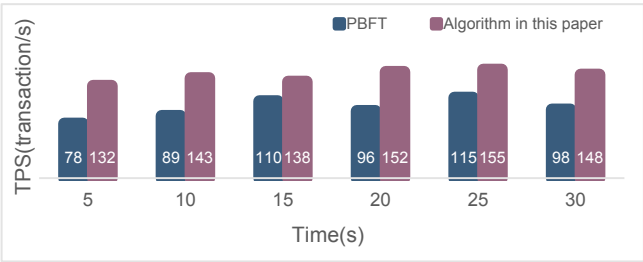

Fig. 3. System delay changes

the proposed algorithm and PBFT algorithm are tested for throughput and latency. The results are shown in Figs. 2 and 3.

Through the changes in system throughput, it can be learned that the improved PBFT algorithm proposed in this article can effectively improve the system throughput.

By analyzing the latency of the platform, the results show that the improved PBFT algorithm can effectively reduce the latency of the platform. Since the latency of the platform mainly comes from the processing process of the consistent algorithm, the improved algorithm proposed in this paper reduces the number of consistent nodes. Therefore, the number of messages that nodes need to process in a consistent protocol is reduced, which greatly enhances the transaction performance of the platform.

5 Conclusions

Blockchain technology was combined with the IoT technology in the supply chain financial service platform to form a full-process automation system, which further reduced the financing costs of enterprises in the supply chain, improved the financing efficiency of enterprises, enabled the activation of accounts receivable in the supply chain, and solved the problem of financing difficulties for small and medium-sized enterprises. Based on this, this article put forward some countermeasures and suggestions for the development of supply chain finance, thereby providing some reference for the financing work of small and medium-sized enterprises, and promoting the business growth of

financial institutions. This project focused on online supply chain financing, with multiple participants as the research object. The research content is very broad. Due to the constraints of knowledge structure, time, energy, and other factors, many issues are not well considered and require further research in the future. In subsequent work, a specific synergy mechanism can be selected for in-depth research.

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