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Designing a Credit Bank Model Based on Blockchain Technology

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Abstract: In the implementation of credit bank, the transformation of learning accomplishments cannot be automated, and the workload of credit achievement management is large. Credits cannot interact freely across different credit banking systems. In order to solve the aforementioned problems, this study proposes the use of alliance chain technology to overcome the technical challenges encountered in the establishment of credit bank. In line with the basic framework of the alliance chain, a credit bank model based on blockchain technology is designed. At the moment, only the model design has been completed; the implementation of the model will take place in the later stage.

Keywords: Alliance chain; Credit bank; Blockchain; Lifelong education

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1. Introduction

In China, the credit bank project is an important part of the national education development plan. It is a bridge for people's lifelong learning. In the construction of credit bank, it is necessary to develop and improve credit bank institutions as well as learning achievement certification institutions [1-2].

Learning achievement certification reflects the authenticity and effectiveness of students' learning. It can be used to improve students' learning enthusiasm, which is more conducive to the smooth implementation of continuing education. Therefore, learning achievement certification is one of the core functions of credit bank [3-4]. In the implementation of credit bank, there are several challenges.

(1) Learning achievement certification cannot be automated, resulting in repetitive work

At this stage, when the credit bank certifies the learning results, it must pass the management center's assessment in various phases to certify the results [3,5], and the students need to provide most of the supporting materials. These processes are performed manually by the management center. The approval and management processes are manual and cannot be automated, resulting in a significant amount of repetitive work.

(2) Human intervention will affect the public reliability of learning achievement

Learning achievement certification must be managed through the audit center. The audit center operates a management system without decentralization, and the audit results are not tamper-proof or attack-proof.

(3) The exchange of credits between banks requires technical support

There are now four credit banks [6]. Credit banks are managed and operated in the same way as normal banks. Students can study at any credit institution and earn credits. These credits can be saved in a lump sum or transferred across credit banks. If a student earns one half of the course credits from a credit bank

and the other half from another credit bank, the student is entitled to a degree. Policy support and decentralized technical solution are required for depositing and withdrawing credits freely across different credit banks while promoting credit banks to trust each other.

Considering the existing achievement management form and pressure of credit bank, this paper proposes the use of blockchain technology to solve the problems encountered. Using blockchain technology in the achievement management of credit bank can realize the decentralization of achievement management and the automation of credit certification and conversion. It ensures that the learning achievements are not tampered with and have high credibility, thus reducing the pressure on employees and saving management resources.

2. Introduction to blockchain technology

Based on different use scenarios, blockchain can be divided into three types: private chain, alliance chain, and public chain [7-18]. Public chain refers to a network that is accessible to everyone. Blockchain transactions and maintenance are decentralized, and everyone may participate. The private chain is mostly utilized within organizations, and while it cannot solve the issue of trust, it increases auditability [8]. On the other hand, alliance chain is halfway between private and public chains. Only members of the alliance chain can read and maintain the blockchain data. The access rights to stored information are restricted by these entities, which can be visited by outsiders only under certain conditions [19-29].

At present, there are four credit banks. Considering the classification of blockchain openness, it is more appropriate for credit banks to establish an alliance chain. Together, all the credit banks form a blockchain network. Credit management is automatically carried out by the alliance chain, and each credit bank has an equal position.

2.1. Key technologies of credit bank alliance chain

The alliance chain is a blockchain jointly used by multiple organizations. Multiple preselected nodes are designated as accounting nodes in the organization group. These accounting nodes ensure that the data of each organization are consistent with the consensus algorithm. Anyone can carry out restricted queries through the blockchain's API. Each node can only join or exit after being authorized, and each organization is allowed to run one or more nodes. The consensus process is controlled by preselected nodes. Since there are a few nodes participating in the consensus, the practical Byzantine Fault Tolerance (pBFT), consensus algorithm [30-35], and the distributed consensus algorithm raft [36-40] are adopted.

The basic structure of credit bank alliance chain is shown in **Figure 1**.

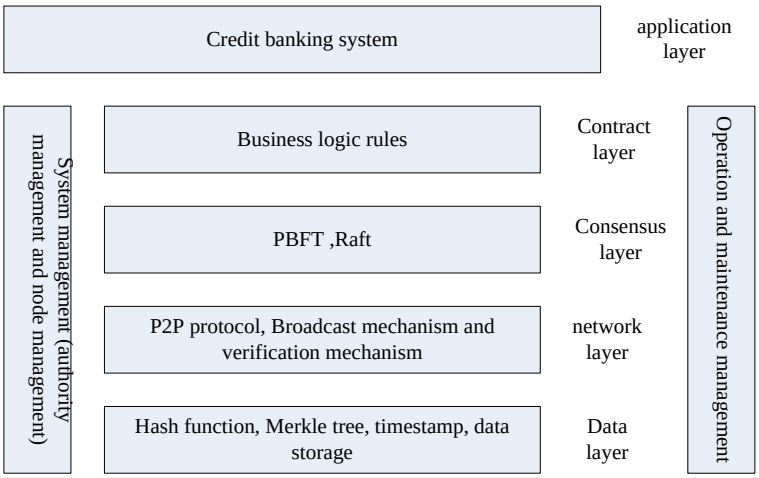

Figure 1. Basic structure of credit bank alliance chain

2.2. Role of each module of the alliance chain technology framework in credit bank

(1) Data layer

The data layer is primarily intended for security and data storage. Security is primarily achieved through the use of digital signatures, hash functions, and asymmetric encryption technology. There are two kinds of data storage: the first is block storage, which involves a Merkle tree [41-43], a timestamp, a hash function, and a data structure to be stored for credit conversion; the other is persistent data storage, in which the data in the block are the only core credit information storage, and the students' academic achievements still need to be saved in a durable distributed database.

(2) Network layer

The alliance chain adopts the peer-to-peer (P2P) networking technology. Its primary function is to determine neighboring nodes, verify the identity of nodes, and finally create links with neighboring nodes. Following the establishment of links, the consistency of block messages across nodes can be realized through the consensus algorithm and broadcast mechanism.

(3) Consensus layer

The consensus layer largely addresses the data consistency of distributed nodes in the blockchain network.

(4) Contract layer

In the contract layer, when students finish a course, the contract should be able to actively submit scores to the blockchain. When a student has accumulated certain credits, the contract should indicate the academic qualifications that the student can withdraw.

(5) System management

System management has two important functions: permission management and node management. Permission management involves the control of nodes in the blockchain network to access and operate the chain; node management authenticates and validates the identity and authority of the node through the authentication mechanism.

(6) Operation and maintenance management

The operation and maintenance management layer is mainly responsible for the daily operation and maintenance of the blockchain system, such as node viewing, contract viewing, log browsing, user management, etc.

3. Credit bank alliance chain design

According to the characteristics of credit banks, a credit bank model based on alliance chain is designed. The model is designed based on the basic framework of alliance chain, and its operation steps are described in detail.

3.1. Credit bank alliance chain model design

The credit bank alliance chain model is shown in **Figure 2**. The basic premise is hierarchical design based on business data flow. The credit bank model is divided into four layers: data, network, smart contract, and application.

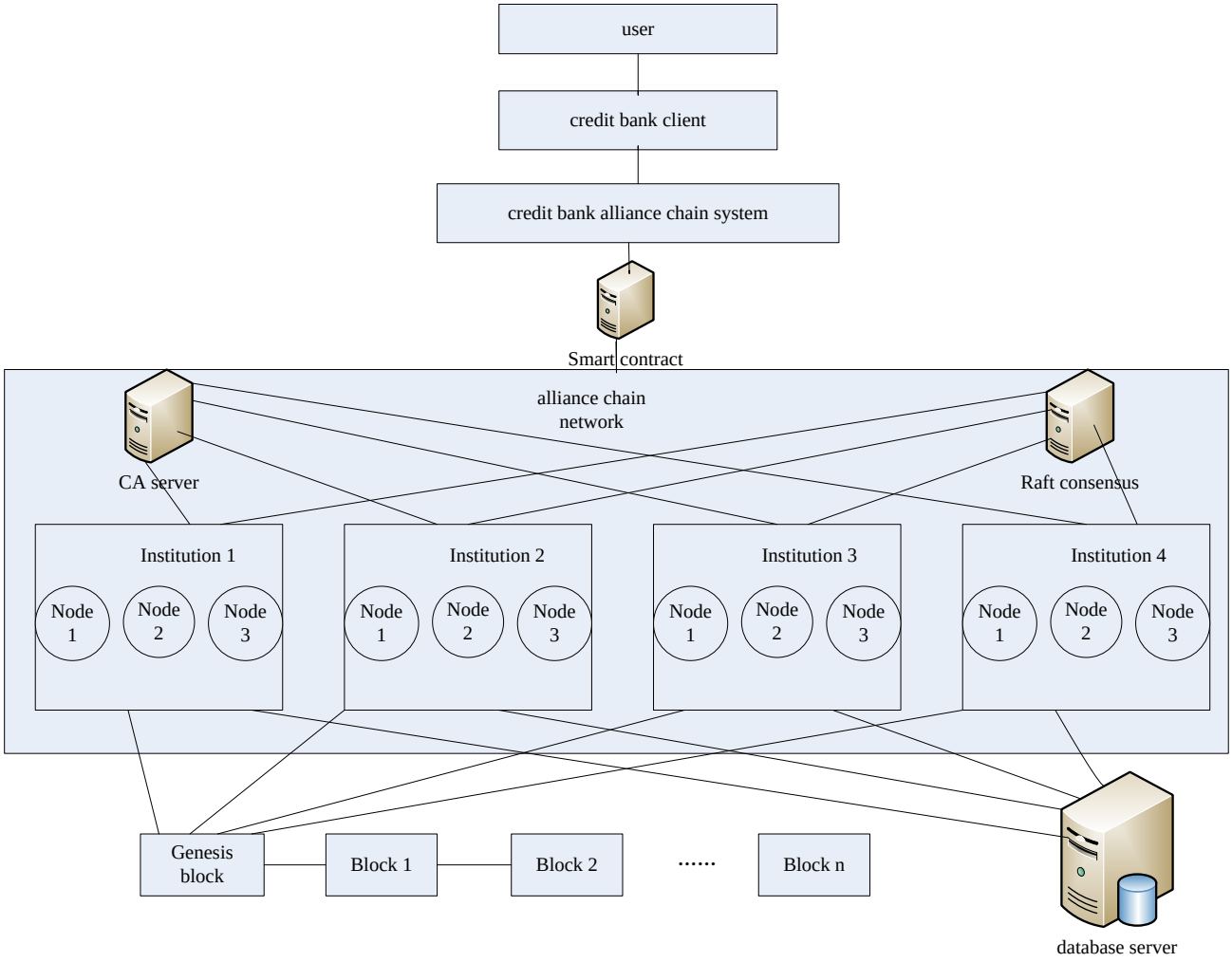

Figure 2. Credit bank alliance chain model

3.2. Operation steps of credit bank alliance chain model

(1) Construction of alliance chain network

Credit banking institutions form networks according to the P2P protocol and CA authentication. The raft consensus is used for information interaction across organizations. The accounting node, synchronization node, and data persistence node are specified in each organization.

(2) Storage of blocks and data

The accounting node in each organization generates blocks according to the raft consensus algorithm. After writing these blocks, the data persistence node writes the data to the database.

(3) System operation

First, the credit bank alliance chain network is built, and smart contracts are deployed at each accounting node in the network. Subsequently, the credit bank alliance chain system is run. Finally, users can access the whole credit bank alliance chain system through the credit bank client.

When a business needs to be written into a block, the smart contract is triggered. When the conditions are met, blocks are added to the blockchain. In the process of adding blocks, it is necessary to determine whether the blocks can be written on the blockchain according to the raft consensus algorithm and CA authentication. When new blocks are added, the synchronization node and data persistence node backup the blockchain and write the data to the database automatically.

4. Conclusion

This paper discusses the significance and existing problems in the establishment of credit banks. Based on the existing problems, the alliance chain is used to tackle the challenges of credit bank. Following studies on the technical framework of alliance chain, a credit bank model based on alliance chain is designed, and its operation process is discussed. In this study, the credit bank model is designed from the perspective of technical theory. In the following stage, the consensus algorithm and smart contract will be further investigated to actualize the credit bank model.

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