Building Logistics Block Chain Platform Based on Cloud Computing

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Abstract: With the rapid development of the new generation of information technology and e-commerce, the modern logistics industry chain has emerged. The logistics blockchain platform enables all kinds of users to participate in the whole information transmission process together. It establishes the logistics blockchain cloud platform deployment jointly participated by the government, enterprises, schools, institutions and communities. According to the practice, different blockchain deployment modes are adopted, A new multi agency data sharing framework is designed to promote the application of blockchain in the logistics industry.

1. Introduction
With the development of modern network technology and information technology, the informationization of logistics management has developed rapidly, which makes the methods, means and strategies of logistics management and operation change every day. Logistics is a comprehensive industry, involving many fields. Industrial competition is normal. How to make the logistics industry compete orderly, reduce costs, improve quality and efficiency has become an important part of the development of the logistics industry.

2. Current situation of logistics industry
1) Modern logistics mostly adopts the centralized management mode of resources and services. The problems caused by large-scale logistics service transactions are highly centralized. The poor synergy among logistics systems and the cumbersome processing lead to huge storage space and unable to quickly traverse data. Once the transaction documents are lost, risk can not be controlled, traceability investigation, etc.

2) Logistics enterprises still focus on warehousing and distribution. It is not feasible and costly for small and micro enterprises to build high-performance logistics information platform. Large-scale logistics enterprises build their own logistics platforms to improve their logistics service trading experience to a certain extent, which will inevitably lead to a large number of small and micro enterprises idle logistics service capabilities, unable to participate in market competition well. How to mobilize the enthusiasm of service trade in the whole logistics industry, guide the benign development of small and micro enterprises, realize resource sharing, and curb the rate of bad trust? Block chain technology is introduced to realize distributed bookkeeping database of logistics network. Logistics practitioners can compete benignly in the network. While lowering the entry threshold, the whole
network supervises the quality of logistics service transactions.

3) The supervision of logistics industry is loose, and the quality of logistics service transaction is neglected while maximizing the benefits. The lack of trust in enterprise cooperation and the low cost of breach of contract have hindered the pursuit of cooperation by high-quality enterprises. Therefore, it is urgent to realize the automatic cooperation of intelligent contracts and carry out cooperative transactions under the supervision of the whole network. For non-standard enterprises, they can quickly give feedback and let them withdraw from the trading links.

The application of cloud computing real-time monitoring capabilities, combined with the characteristics of block chain network monitoring, non-tampering, strong anti-aggression, it is particularly important to build a logistics block chain cloud platform.

3. Logistics transaction process analysis
At present, the third party logistics service is the main form of logistics service transaction. The transaction subject finds and evaluates the transaction object through node resources, so as to realize the logistics service transaction process based on distributed network. As shown in the figure 1:

1) Identify and determine logistics service transaction data. Logistics identifies the resources of each node, centralizes data processing, and uses self-built logistics network to adjust the rapid response capability of animal flow nodes.

2) Discovery and scheduling of information resources in logistics service transactions. The related scheduling algorithm is applied to rationally adjust the relevant nodes in the animal flow network, and the centralized logistics information management platform is applied to process, collect and store data in all aspects of logistics. Data analysis algorithm is used to provide decision analysis results for managers.

3) Find the object of logistics service. According to the request description and demand of the logistics initiator, the logistics centralized management platform finds the service object.

Figure 1 Logistics Transaction Logic Diagram

4) Credit evaluation of logistics service transaction. Evaluate the quality of transaction subject and object, the quality of product, the timeliness of credit information feedback and the timeliness of payment.

5) Logistics service transaction payment service. Third-party payment instruments or bank transfers approved by both parties shall be applied to both sides of the transaction.

4. Feasibility Analysis of Block Chain Technology Applied in Logistics Industry
With the invention of Bitcoin by Nakamoto, virtual money is very popular all over the world. Bitcoin's block chain technology has the characteristics of decentralization, transparency and trustworthiness. Many scholars and venture capitalists have attracted much attention. Block chain technology has also been extended from the initial bit digital currency to all walks of life. Especially in the logistics transportation, logistics supply chain industry is regarded as highly subversive. Block chain contains all users in the process of logistics service. In the whole process of information transmission, through data encryption and consensus verification, a logistics block chain is formed, thus ensuring the authenticity, transparency, untouchable modification and traceability of logistics service transaction.
information. Block chain can break through all links of logistics service transaction, solve trust security and repeated auditing and other enterprise credit problems, and improve the competitiveness of small and micro enterprises in the market. Therefore, under the background of logistics service transaction, it is reasonable and feasible to introduce block chain technology into logistics.

Cloud computing is a new computing service framework that uses hardware and software to work together. Cloud computing makes full use of computer networks to integrate various heterogeneous computing resources, thus forming a parallel, virtualized and dynamically scalable computing resource pool, and then according to user needs, cloud computing and cloud storage provide various forms of network services for it. Logistics cloud computing model integrates all kinds of logistics resources by means of cloud computing service platform, and encapsulates them into services, and rationally allocates logistics resources according to the actual needs of customers.

Cloud computing and block chains remove the server central node in the network topology, and adopt the point-to-point decentralized network structure. Block chain removes the authentication of centralized organization, divides data, and introduces timestamp and signature key to encrypt data. It stores data in distributed node network, so data can not be tampered with. Through a specific consensus algorithm, even if there is a hacker attack or intent to destroy, 51% of the attacks are carried out on the whole network. The distributed storage structure of cloud computing, through node virtualization technology, has high robustness and stability enough to deal with risks.

Applying cloud computing and block chain technology in logistics model, block chain can realize the block chain of information from all nodes involved in logistics service exchange. All logistics nodes can inquire and monitor the source and process of logistics service transaction information in real time, which guarantees the security of logistics information and is very beneficial to the interests of all logistics parties.

5. Design Principles of Logistics Block Chain Cloud Platform

Logistics Block Chain Cloud Platform integrates various links of logistics services, completes the function realization of logistics data information from multiple scenarios like generation, encryption, storage, consensus algorithm, transmission, and others. The goal of Logistics Block Chain Cloud Platform is to establish enterprise-level logistics block chain service, build an open and win-win logistics block chain service ecosystem with high performance, good expansion, general scene, safe contract, beautiful interface, friendly interface and simple deployment. To this end, the logistics block chain cloud platform architecture needs to follow the following design principles:

1) The design of logistics block chain cloud platform needs to be business-oriented. This is the first design principle of the logistics block chain cloud platform. One of the characteristics of logistics scenarios is the diversification of demand and high performance requirements of each process. Logistics block chain cloud platform is positioned as enterprise-level block chain platform, which needs to be applied to a wide range of enterprise scenarios. Therefore, in the design, we first design the protocol mode, data structure and functional characteristics of the logistics block chain cloud platform from the core logistics transaction scenario.

2) Standardization of Logistics Block Chain Cloud Platform. Because the block chain application scenario is a cross-agent scenario with multi-party participation and cooperation. Logistics Block Chain Cloud Platform has designed standardized protocols and data structures from the top level. The goal is to make the Logistics Block Chain Cloud Platform truly become a standardized Internet infrastructure protocol.

3) Loose coupling and modularization of logistics block chain cloud platform. Logistics block chain cloud platform adopts modular design. By defining clear interfaces between modules to achieve loose coupling between modules, good scalability of logistics block chain cloud platform can be achieved. Logistics Block Chain Cloud Platform uses different pluggable module components according to the needs of different users and scenarios.

4) Safety auditable. Logistics block chain cloud platform needs to ensure the security and auditability of the system.
6. The Framework System of Logistics Block Chain

The goal of Logistics Block Chain Cloud Platform is to provide enterprise-level block chain technology and services. In the architecture, we need to combine our own experience in large data and distributed systems. Using industrial policy, we can solve the problems of concurrent performance, data storage performance, functional completeness, scene universality and system usability of logistics block chain in enterprise level, realize the landing of block chain in logistics industry business, and promote the development of logistics block chain technology and ecology. As shown in Figure 2, the system architecture consists of three layers: block chain protocol, component framework and platform service.

![Figure 2 Block Chain Architecture](image)

1) Logistics block chain cloud platform "protocol" as the top-level architecture design. It defines the data format standards of logistics block chain, including four content data standards: account status, historical proof, account operation set and contract instruction set.

2) Logistics Block Chain Cloud Platform "Component Model" is the framework of Logistics Block Chain Logic Components. It is a framework to implement the cloud platform protocol of logistics block chain, which includes four components: consensus network, account book, persistence engine and contract engine.

3) Logistics Block Chain Cloud Platform "Service Platform" is the specific implementation of Block Chain Protocol and Component Model of Service Platform, including gateway, service, node network, SDK and a set of tools.

The "Service Platform" function module is shown in Figure 3. It is divided into four parts: block chain gateway, block chain node service, block chain basic network and supporting tools. The Block Chain Gateway is designed as a lightweight gateway system. It is usually deployed in the participants'network environment. It provides functions including private key management and fully localized private key storage. Privacy protection, end-to-end encryption means to achieve privacy protection. Protocol Conversion: Provides lightweight HTTP Restful Service that adapts the block chain node API of TCP protocol. Block Chain Node Service is an application-oriented and general functional component based on Block Chain Basic Network. Its purpose is to provide reuse of common functions, including application-oriented account management, account authentication and authorization, object-oriented account data access framework, event notification mechanism and intelligent contract management. Block chain consensus network: A network consisting of consensus nodes, based on P2P network and consensus algorithm, ensures the consistency of transaction data among nodes. Tools: A complete set of tools, including SDK, data management, installation and deployment tools, monitoring services.
7. Design of Logistics Block Chain Cloud Platform

The urgent problem to be solved in the logistics block chain is to design a consensus algorithm, which makes the logistics transaction information reach a consensus in an untrustworthy network and stores the logistics transaction data distributed in the network nodes. In the logistics block chain model based on cloud computing, the roles of each node are divided into:

(1) Logistics transaction node

Logistics transaction node is the sender and recipient of logistics transaction. Both parties register node information through the client, and Hadoop block chain cloud platform allocates exclusive nodes. The sender agrees and confirms circulation to the recipient through the cloud platform.

(2) Consensus Participating Node

Consensus Participating Node is the exclusive node of the cloud platform to distribute the logistics nodes, which is used to receive the logistics block chain data sent by the initiator of logistics service transaction. Firstly, we should ensure the integrity and correctness of logistics block data. Secondly, we should realize the consistency of data in the logistics block chain of consensus participating nodes. Finally, we should agree that all data copies in the process of logistics service transaction are stored by consensus participating nodes.

Logistics Block Chain Cloud Computing model integrates the real logistics service transaction scenario, and realizes the functions of data generation, encryption, transmission, consensus and storage. It provides a software and hardware environment for the design of logistics block consensus algorithm based on cloud computing. From the perspective of model architecture, our algorithm runs through the whole logistics block chain data processing process, which is conducive to demonstrating the feasibility of the logistics block consensus algorithm based on cloud computing.

In the transaction of logistics service based on block chain, from the originator, distributor, participant and recipient of logistics, the requirement of 3f+1 node of practical Byzantine consensus algorithm is satisfied. Therefore, the logistics model based on block chain is considered. However, each node needs a large-scale computing cluster to quickly complete the consensus authentication process. In order to achieve resource flexibility, fast adjustment of nodes, low cost and high robustness of user needs, each transaction agent does not need to deploy large-scale computing cluster locally. All consensus authentication processes are implemented by block chain cloud platform. Therefore, it further proposes to build a logistics block chain model based on cloud computing. Logistics block chain model based on cloud computing really achieves the core requirement of decentralization, and multi-authentication nodes jointly verify the transaction behavior in logistics activities. From the point of view of logistics service transaction, logistics initiator and logistics receiver are dynamic changes,
which can ensure the number of nodes and prevent large-scale destruction of malicious nodes. As the beneficiaries of logistics service transactions, each authentication node will actively abide by the consensus authentication mechanism, so the logistics block chain model based on cloud computing has high transaction stability and fault tolerance.

Figure 4 shows the design of the logistics block chain cloud platform. Based on the logistics block chain model of cloud computing, all transaction authentication actions are implemented on Hadoop block chain cloud platform. HDFS module is responsible for storing and updating block chain information. JobClient module performs query operation and submits node task request. Map module assigns task nodes to transfer and update block chain information. Reduce module completes data protocol processing through consensus protocol. Firstly, Map function dynamically allocates n nodes to each transaction subject, simulates its transaction information transmission process, transfers logistics transaction information through Hash encryption algorithm, and then completes the authentication process using Byzantine Consensus (PBFT) algorithm, and uses Reduce function to process the protocol. The overall information transmission and consensus process has better performance. High fault tolerance and security. Block chain consensus mechanism and Hadoop distributed storage technology can achieve logistics de-centralization, transaction information storage encryption, non-tampering modification, tracing the origin of the entire goods and logistics transportation process.

8. Main Module Functions of Logistics Block Chain Cloud Platform

1) JobClient Logistics Block Chain Cloud Platform Module receives the request information sent by the shipper and processes the node information of the primary node through the Input function. The node information of the primary node includes data information, node name, public key, private key, and update time. The data information includes goods information, shipment information. Subject information, receiving subject information and next subject information. Assuming that a JobClient instance is created, the first step is to establish a connection with JobTracker, obtain a Job ID by using JobSubmission Protocol, generate a directory and copy it to HDFS. According to the input of Input function, calculate the metadata information of the Job preprocessing, determine the number of maps and reduces, and so on. Configuration information is written to HDFS to ensure data reading of JobTracker module. Similarly, JobClient module submits request information to JobTracker module through JobSubmission Protocol.

2) JobTracker is connected with JobClient to receive the node information of the primary node and to search the whole network to determine the whole network node including the corresponding logistics nodes of each participant. JobTracker module is essentially a background service process, which monitors and receives heartbeat information from various task execution modules, including task operation and resource utilization. After receiving the request information of JobClient module, JobTracker module assigns related tasks to subordinate module JobClient. Examples include Launch Task Action, Commit Task Action, Kill Task Action, Kill Job Action, and Task Tracker ReinitAction.
3) Map is connected with Jobtracker module to receive the node information of the primary node. It determines the node information of each logistics node according to the node information of the primary node, and sends the node information of each logistics node to the corresponding logistics node. The primary node is the former logistics node. The node information is digested by a Hash function operation. The digest is encrypted with a digital signature by the key of the node. The key encryption is a Hash function operation and the block information is a hash serial code. Verify whether the previous node is a trusted node. The latter logistics node decrypts the block information of the previous node through its public key to form a summary, and performs a Hash function operation on the received node information to form a summary b, comparing whether Summary A and summary B are identical, and if they are identical, the previous node is a trust node.

4) Each normal communication node maps virtual nodes, establishes consensus node network, and stores sub-data of corresponding normal communication nodes in each virtual node. It completes the process of node consensus through three stages: PRE-PREPARE, PREPARE and COMMIT. Among them, the PBFT algorithm authentication process can be as follows:

It is assumed that there are four virtual nodes in the consensus node network, including a virtual master node. Including C (sending requester), 0 (virtual master node), 1, 2, 3 (virtual node), sending requester C to send requests. The virtual primary node 0 receives the requests and sorts them and generates the serial number of the requests and sends them to the other virtual nodes for broadcasting. After receiving the serial number, the virtual nodes send messages to each other to confirm and complete the PRE-PREPARE phase. Each virtual node (including virtual primary node) accepts the serial number assigned by the primary node and notifies each other to complete the preparation (PREPARE) phase. Each virtual node (including virtual master node) executes the request, returns to the requester and completes the confirmation (COMMIT) phase. The sending requester confirms the result according to the number of requests obtained N. If the number of nodes in question is F, when N (> F + 1), consensus authentication is considered to be completed. Otherwise, the error node controls the network, and the reinitialization request is returned to the JabTracker module, with N at least 4. When the consensus process is completed, split fragmentation needs to merge chain information and store the final results on HDFS. Reducer module starts Copy thread to get Map node information of output file by HTTP. The redundant data stored in each normal communication node is deleted by Reduce module to form the final data.

9. Logistics Block Chain Deployment Scheme
Logistics Block Chain Cloud Platform is deployed in the following ways:

1) The main participants maintain a complete consensus node. The advantage of this method is that participants can hold logistics block chain data, but the disadvantage is that the owner has to pay a certain operation and maintenance cost.

2) The main participants only need to maintain the gateway nodes and access the logistics block chain network through open and public consensus nodes. This method has the advantages of easy self-management of the private key of logistics block chain and low maintenance. The disadvantage of this method is that the gateway node does not hold logistics data.

3) Participants access the logistics block chain network through open and public consensus nodes. This method is suitable for 2C logistics scenario where users can use official network nodes to host private keys.

4) Supervisors only deploy "backup nodes" and synchronize data from other logistics block chain nodes as data archives.

5) Supervisors deploy both gateway nodes and consensus nodes in logistics block chain. Gateways and nodes are open to the public for inquiry as "notarization of certificates".

We use different deployment modes of logistics block chain platform to realize the deployment and promotion of logistics block chain platform in various logistics industries.

After the logistics block chain platform is deployed, the overall deployment architecture is tested and tested. The experimental methods include laboratory practice and enterprise simulation. In the
laboratory Hadoop environment, the design and implementation of the logistics block chain platform are tested, and the suitable scenarios of various deployment modes are compared, which shows that the deployment mode achieves the requirements of correctness, effectiveness, fault tolerance and throughput. Enterprise simulation test is to test the general SDK for intelligent contract invocation in some enterprises in the development zone. It tests the success rate of requests under response time, throughput, memory and stress test, and completes the preliminary deployment test, so as to facilitate the large-scale promotion in the later period.

10. Conclusion

The traditional logistics platform does not centralize the detailed sensitive information of logistics links, and the whole logistics transaction process is not transparent, nor can it meet the requirements of logistics de-centralization and non-repudiation. Logistics Block Chain Cloud Platform designs a consensus algorithm for Block Chain, which enables logistics transactions to reach consensus in untrustworthy networks, and achieves fast node adjustment, strong resource elasticity, low cost and high robustness of user needs. The consensus algorithm of logistics block chain and cloud distributed storage mode make logistics transaction decentralized, information encrypted, safe and unalterable, which can be traced back to the source of each cargo and the whole process of logistics transportation. Logistics Block Chain Cloud Platform integrates various links of logistics services. It is very important to complete the construction of logistics block chain platform for informatization, resource sharing, information science and credibility of all links of logistics.

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