

# Research on Logistics Information Management System Based on Blockchain Perspective

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**Abstract:** *The current problems of information asymmetry, low process transparency and insecure information storage in logistics industry have restricted the development of logistics industry to a certain extent. Drawing on the advantages of blockchain technology in decentralization, data tamper-proof and data confidentiality, the article analyzes the typical application scenarios of blockchain in logistics, proposes a blockchain-based logistics information management framework, and gives a typical logistics blockchain network topology and information management process.*

**Keywords:** *Logistics, Blockchain, Information Tamper-Proof, Data Security*

## 1. Introduction

With the continuous improvement of China's logistics infrastructure conditions and the country's continuous investment in road traffic [1, 2], China's logistics industry has been growing faster in recent years, and the volume of logistics transportation has been increasing year by year. In 2014, China's express business volume only entered the era of ten billion, and nearly seven years to 2021, the total logistics business has completed the leap from ten billion to one hundred billion. Logistics includes packaging, loading and unloading, information processing, storage, transportation, circulation processing, distribution and other interlocking complete chain, and ultimately provide users with comprehensive, multi-functional integrated services. Logistics should consider issues including the distribution of goods from the manufacturer to the consumer, the procurement of raw materials from suppliers to the manufacturer and the internal transportation and storage information of the manufacturer during the production process [3]. Logistics is a strategic measure to meet consumer needs and unify manufacturing, transportation and sales market conditions. The use of inter-enterprise Internet technology and information management systems allows for the rapid and timely transmission of information on commodity demand, customer management, and sales tracking, and the coordination of information [4, 5]. At the same time of information coordination, the efficiency of logistics circulation should be improved, timely and accurate distribution, and truly realize the flow of information in the flow of animals, and drive the integrated operation of logistics capital flow. However, there are problems of information asymmetry and lack of trust in China's logistics industry. Blockchain technology is a good medicine to solve these symptoms [6, 7]. An important area for blockchain to improve business ecology is supply chain and logistics, and with the technical advantages of blockchain, cargo information can be traced, capital utilization rate is greatly improved, and cargo transportation routes are more optimized, all of which are remarkable manifestations of supply chain and logistics industry to reduce costs and increase efficiency, save social resources, and open the era of intelligent management.

## 2. Blockchain technology characteristics

Blockchain was firstly originated from Bitcoin transactions and is mainly used to record all the information of transactions that occur. In essence, blockchain is not a new technology, but a new technical standard and protocol formed on the basis of the integration of existing technologies, and its main features can be summarized into four aspects: (1) decentralization. The blockchain can be regarded as a distributed network without a control center, and the data is stored in multiple nodes so that the system can operate normally even if a node has problems or is destroyed. (2) Information traceability. A unified ledger is established based on block and chain structure to keep data. The ledger

is jointly maintained by multiple nodes and can only be added and not modified to ensure data authenticity. (3) Information disclosure. Once joined to the blockchain network, nodes can enjoy the same rights and obligations. Any node can view the data, eliminating information asymmetry. (4) Smart contract. Blockchain drives the operation of bookkeeping and other transactions in the form of digital contracts, and according to its trigger conditions, it automatically executes and fulfills the contract contents without the participation of processing center and human, which enhances the fairness and impartiality of contracts.

### 3. Problems of logistics information management

In recent years, logistics enterprises have generally introduced logistics information technology to collect, store, gather and analyze the information generated by the logistics process. The continuous improvement of logistics information technology has played an important role in improving logistics efficiency and reducing logistics costs. With the development of logistics business specialization and industrial intensification, specialized warehousing and transportation companies are emerging, and logistics information management is moving from within logistics enterprises to between enterprises, becoming a bridge for enterprises to share consultation and communication, and playing a key role in the efficient coordination of all parties involved in logistics.

At present, domestic logistics resources are scattered, and the scale and system of logistics upstream and downstream enterprises vary, making it difficult to establish trust mechanisms among logistics enterprises, and logistics enterprises are reluctant to share information with each other. At the same time, due to the lack of effective technical means to ensure the security and credibility of data of logistics parties, enterprises cannot exchange information through effective channels. This leads to: (1) asymmetry of logistics information in the hands of enterprises. Some small and scattered logistics enterprises, as well as enterprises seeking logistics services, are unable to obtain effective and sufficient logistics information, which will inevitably have an impact on their operations. (2) The logistics information is not transparent. All parties involved in logistics cannot accurately understand the state of materials and discover problems in time, which affects enterprises to make relevant decisions. (3) Difficult to identify the responsible body. Once the logistics problem occurs, due to the lack of sufficient information support, it is impossible to confirm the subject of responsibility for the accident, and the later proof and recovery are also affected. The above problems have become bottlenecks for the improvement of logistics information management level, which restricts the development of logistics industry.

### 4. Blockchain application scenario

In view of the problems of logistics information management, blockchain can provide a technical way to improve logistics data sharing, ensure the authenticity of logistics data, implement effective confirmation of rights and responsibilities, and enhance the security of logistics data.

(1) Logistics information sharing. Based on enterprise business information system, information or public information that needs to be recognized by all parties, for example, storage information, distribution information, vehicle capacity, etc., is unified and saved in the data ledger of blockchain through blockchain. This information can be open to all logistics nodes in the network, and any node can query the data in the ledger through a predefined interface to realize the sharing of logistics information and ensure a high degree of transparency in the logistics process.

(2) Non-repudiation of "responsibility and authority". Relying on the way of data recording by blockchain, any bookkeeping request submitted by any node needs to be endorsed by the consensus node in the network and approved by it before it can be written into the ledger, and once the logistics information is recorded, it cannot be tampered with, which ensures the authenticity of data. At the same time, blockchain uses asymmetric digital encryption technology for identity verification to ensure the authenticity of the identity of both parties to the transaction. If there is a problem in the logistics process, the advantages of blockchain in guaranteeing data authenticity and identity authenticity can be used to implement effective recourse.

(3) Enhance the protection of logistics information security. Blockchain's improvement of logistics information security is reflected in four aspects: ① Implementing authentication system for nodes accessing blockchain network, only the authenticated nodes can access to the blockchain to prevent illegal nodes from accessing to the network. ②The association between identity information and

logistics information is cut by means of anonymous transactions, so that attackers cannot obtain user identity information by analyzing logistics data. ③Based on P2P network, communication is carried out through relay forwarding, so it is difficult for attackers to discover the real source and destination of information disseminated in the network through eavesdropping. (4) Distributed storage method is used, so that there is no need to store data centrally anymore and avoid the risk of data leakage caused by the attack on traditional servers.

(4) Automatic fulfillment of logistics contracts. Using the smart contract mechanism of blockchain, the traditional paper contract can be transformed into a digital contract stored in the network, and the blockchain automatically judges the contract conditions and automatically executes the contract according to the condition satisfaction. Take transportation contract as an example, once the conditions formulated in the contract are met, the blockchain automatically executes the payment. Relying on blockchain's guarantee of data authenticity, this method can meet the demands of both parties for reducing contract risks and improving contract performance efficiency compared with the traditional contract performance process.

## 5. Blockchain-based logistics information management system architecture

Combined with the above logistics application scenarios, the architecture of blockchain-based logistics information management system is mainly divided into five aspects. First, it provides logistics data storage service, and logistics data storage is the basis of logistics information guarantee. According to the storage principle of Fabric, the logistics data storage is divided into three types, which are ledger type, ledger storage and data interface. Among them, ledger model refers to the establishment of logistics state information into a model, while defining data items and types of data. At the same time, blockchain distributes logistics data storage to logistics ledger. Meanwhile, the global data retrieval and update interface is provided for the upper layer to call. Second, logistics information consensus service. The logistics information consensus service is the core of data management. It is mainly based on the trust model between nodes, and realizes logistics information endorsement by all parties involved in logistics through consensus mechanism, while ensuring that logistics data distributed in different nodes are kept synchronized and fault-tolerant. At present, the commonly used consensus algorithms include: workload proof mechanism, share proof mechanism, practical Byzantine fault tolerance, Kafka, etc. In the process of application, it is necessary to choose a certain algorithm with specific scenarios for corresponding adaptation and optimization. At the same time, based on Fabric's multi-channel mechanism, separate channels can also be established for different types of transactions to ensure data isolation and confidentiality between interactions. Third, logistics information node service. Logistics information node services provide services for blockchain nodes, mainly including: account management, contract management and data access services. Account management provides services such as node registration, issuance of registration certificate, issuance of transaction certificate, certificate demand and revocation using authentication mechanism. Smart contract management manages the smart contracts deployed on the nodes, realizing contract installation, deployment, triggering, invocation, etc. Data access provides ledger data access services for smart contracts and other applications on the nodes. Fourth, the logistics information global service. The logistics information global service is mainly based on the logistics information stored in the blockchain, and extracts, statistics, analysis and visualization of logistics information around the logistics process and material status. Among them, logistics process information management mainly monitors logistics status from the perspective of logistics process, for example, different logistics links such as receiving, transit and transportation. The material status is mainly used to trace and manage the status of logistics flow with materials as the core. At the same time, this part of the service can also be called by other applications to query logistics process information and material status data. Fifth, the blockchain platform supervision. Through the blockchain platform supervision, the overall operation status of the blockchain can be viewed, and problems can be found and warned in time, including: storage monitoring, network node monitoring, logistics transaction monitoring, and logistics contract monitoring. Data storage monitoring mainly monitors the storage ledger situation of each node and displays the summary of the stored information. Network node monitoring mainly displays the basic network topology of the current blockchain and the status information of each node. Logistics transaction monitoring mainly combines with logistics contract to view transaction operation information. Logistics contracts mainly monitor the operation status of smart contracts deployed on different nodes.

## 6. Conclusion

The system test results show that the blockchain-based intelligent logistics system designed and implemented in this paper meets the basic functions of logistics system and has good system performance, while the blockchain technology ensures the trustworthiness and non-falsifiability of data, improves the stability and data security of logistics system, and provides new ideas and solutions to solve the problems of traditional logistics system.

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