Development and Application of Offshore Trade Authenticity Verification Platform Based on Blockchain

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Abstract. Offshore trade is a widely used business model in international trade, but because of its opaque capital flow, transaction information is not open, offshore trade has certain risks. In order to guarantee the national economic security and trade interests, the authenticity verification of offshore trade has become an important issue. This paper designs and implements the offshore trade authenticity verification platform based on blockchain technology through the mapping relationship between the user demand analysis of offshore trade authenticity verification and platform functions. The application test of the constructed digital platform is carried out, and the test results show that it also has stable average response time and efficient TPS performance advantages under the premise of meeting daily business needs. This platform can actively promote regional trade facilitation, stimulate financial institutions' demand for industry exhibition, and achieve digital empowerment for the development of background offshore trade.

Keywords. Offshore Trade, Authenticity Verification, Demand analysis, Blockchain

1. Introduction

At present, the internal and external environment and conditions faced by China's opening up have undergone significant changes, and foreign trade has become more dependent on innovation-driven development. Fostering offshore trade is an important part of promoting the innovative development of foreign trade and exploring and developing new trade modes. Although offshore trade has some practical experience in China, it has not been fully developed because of the particularity of its trade form. The core of offshore trade development is to form an appropriate institutional environment, and the difficulty of offshore trade development is how to strike a balance between openness and security. From the overall plan of China's respective trade pilot zones, Shanghai, Guangdong, Liaoning, Zhejiang, Henan, Tianjin, Hainan, Hunan and Guangxi have all proposed the development of offshore trade business needs, Shanghai Free trade Zone has taken the lead in launching the pilot whitelist of new offshore international trade, and Tianjin has created a new type of trade in the real economy "Binhai model". Each trade zone is trying to explore the innovative development of offshore trade business in accordance with local conditions [1-4].

Blockchain technology is one of the areas of innovation in the digital transformation of business and society today. It has the characteristics of decentralization, non-

tampering, information transparency, traceability and other technical advantages. In the field of trade finance, blockchain is mainly used in letters of credit, supply chain finance and cross-border payment credit enhancement to simplify financial financing procedures; In the field of logistics, the application of blockchain can simplify the exchange of information in the supply chain and enable digitization. Therefore, the application of blockchain technology has important practical significance for the systematic research on the innovation and development of offshore trade in the pilot free trade zone [5], which can promote the simplification of offshore trade financing lending process, establish cross-border transaction verification and provide risk control mechanism, etc., and enable the creation of new models in the field of digital trade [6].

2. Basic concepts and pain points of offshore trade

2.1. Offshore trade

Offshore trade refers to the trade of goods conducted by traders within a country/region, delivered directly from upstream producers outside the border/customs to downstream customers, without passing through the trader's own country/region. As a new type of trade mode, the most significant feature of offshore trade compared with traditional trade mode is the "three-flow separation" of order flow, goods flow and capital flow [7]. That is, the trade related fund settlement and document circulation processing activities occur in China, while the actual goods transportation activities occur outside China.

Offshore trade is the inevitable result of the continuous refinement of international trade division of labor, the inevitable product of economic globalization, and one of the important means for countries to control and master the global resource elements. The development of offshore trade in the China Pilot Free Trade Zone is conducive to smooth the domestic and international economic cycle, accelerate the construction of a new system of high-level open economy, deepen market-oriented reform, and create a business environment governed by law, internationalization and facilitation.

2.2. Pain points of offshore trade

1)There are regulatory risks in the authenticity verification of offshore trade.

At present, under the domestic demand for the convenience of offshore trade settlement, financial institutions and foreign exchange management approval standards put forward higher requirements for the authenticity verification of offshore trade. At present, the certification requirements for trade authenticity verification are customs declaration, bill of lading, record list and other materials that can reflect the actual flow of goods, as well as commercial documents reflecting the transfer of goods rights such as contracts, invoices and receipt and payment vouchers, so as to achieve superficial compliance verification of the authenticity of the overall trading business [9].

However, there are still some risks, which make it difficult for banks and regulators to grasp whether there is a real trade background in the transaction, and the certificate of goods rights cannot be verified by the third-party platform. If enterprises cooperate with overseas sale order companies, they collude with each other to forge contracts and fabricate bills of lading, which can realize fund transfer or arbitrage in disguise.

2) Lack of digital means for authenticity verification of offshore trade.

At present, banks rely on manual participation in the statistics of offshore trade balance data for post-tracking. For example, for the payment of goods in advance and the payment of goods in advance, the bank staff need to manually register the account and regularly contact the enterprise to understand the customs declaration information. This kind of manual work process has a large workload, passive management and high error rate, and there is a certain lag, which is difficult to timely reflect the situation of new entities and business types in the current period, and the regulatory body can not track the business situation in a timely manner. From the perspective of enterprises, in order to cooperate with the bank's verification management, it is necessary to submit various certification materials repeatedly, which is tedious and time-consuming.

3)The authenticity verification of offshore trade lacks credible data support.

At the same time, as the most important part of the authenticity verification of offshore trade business, that is, to verify the existence and circulation of goods. Because shipping has the advantages of large carrying capacity, can provide transportation services adapted to different types of goods, and developed global port network, the transfer of goods in offshore trade business often chooses shipping transportation mode. The shipping trade has a large number of participants, with shipping routes all over the world, and numerous organizational units for trading and transportation design, such as shipping companies, shipping port companies, terminal operators, ports, etc. Besides, the business systems of each organization are relatively discrete, and data information among organizations cannot be interconnected, resulting in data islands. As a result, users cannot obtain standardized and reliable data support with comprehensive scenarios, clear links, and reliable data.

3. Offshore trade authenticity verification platform functional demand analysis

1) Demand analysis of trading enterprises.

In the process of business transformation and industrial upgrading at this stage, enterprises need to further strive for the improvement of settlement financing efficiency.

2) Demand analysis of financial institutions.

The development of offshore trade business of financial institutions has been faced with compliance problems for a long time, so it is necessary to collect multi-dimensional verification data for cross-verification, improve the management efficiency of trade verification, and innovate the financial service model.

3) Demand analysis of government departments.

Although the policy level has clearly supported the development of offshore trade, the regulatory authorities have been faced with the problem of difficult supervision and compliance of offshore trade for a long time, and it is necessary to establish effective digital means to carry out risk control on the trading behaviors of overseas counterparties and access enterprises, so as to ensure the positive development of offshore business.

According to the user's business requirements, it is mapped into the platform function requirements, and then the correlation analysis of user requirements and platform functions can be carried out to prioritize the function development and construction. The mapping table of user requirements and platform functions is shown in **Table 1**.

Table 1. Mapping table of user requirements and platform capabilities

User demand	Function
W_1 Multi-dimensional verification data cross validation	R_1 Gateway
W_2 The innovation of financial service model	R_2 Trade verification inquiry
W_3 Trade verification management efficiency improved	R_3 Data inquiry
W_4 Effective digital means of offshore trade regulation	R_4 Report management
W_5 Improving the efficiency of offshore trade settlement financing	R_5 Abnormal risk monitoring
W_6 Foreign counterparty risk control	R_6 Statistical analysis of business development
W_7 Risk control of access enterprises	R_7 Blacklist management
	R_8 Message management
	R_9 Policy news display
	R_{10} Dynamic sharing
	R_{11} User message

In this paper, the score of user needs and functional needs is given by the expert group, and the degree of function meeting user needs is recorded as 5 points, 3 points, 1 points and 0 points from high to low, indicating strong correlation, medium correlation, weak correlation and no correlation. Calculate the absolute weight value for each function requirement as follows:

$$H_i = \sum_{i=1}^{n} W_i R_j \ (j = 0,1,2,\ldots,m) \tag{1}$$

H_i represents the absolute weight value of the function i, and R_{ij} represents the correlation degree value of the function i and the user demand j. According to the publicity, the weight value of each platform function is calculated and sorted, as shown in **Table 2**.

Table 2. Relationship matrix between user requirements and platform functions

User demand	Importance Degree	Function										
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
W1	6.98	1	5	5	0	0	0	0	0	0	0	0
W2	5.53	3	0	0	3	0	3	0	1	3	1	3
W3	6.24	0	5	5	0	5	0	0	0	0	0	0
W4	6.35	5	0	3	5	0	5	0	3	0	0	0
W5	5.69	0	0	1	0	0	3	0	0	0	0	0
W6	6.76	0	3	0	1	5	0	3	0	0	0	0
W7	6.69	0	0	0	1	5	0	3	0	0	0	0
Weight H		55	86	91	62	98	65	40	25	17	6	17
Rank		6	3	2	5	1	4	7	8	9	11	9

According to the weight ranking of functional requirements, trade verification, data query, risk monitoring, and business development statistics will be the key content of the design of the offshore trade authenticity verification platform based on blockchain.
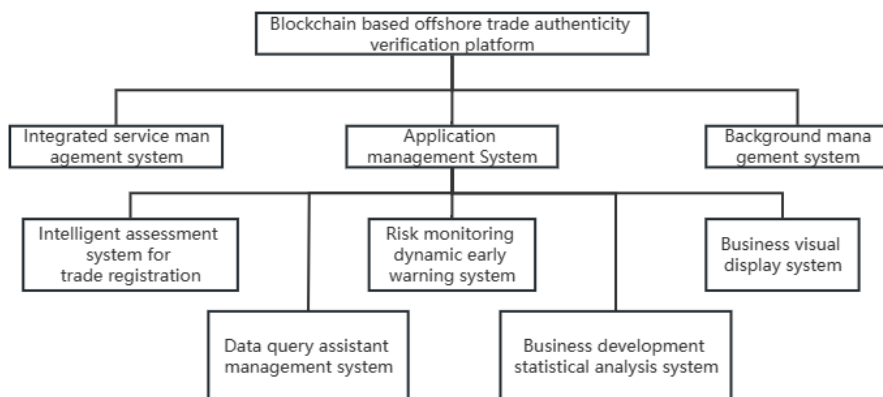
4. Architecture design of offshore trade authenticity verification platform based on blockchain

4.1. Platform design concept

The blockchain-based offshore trade authenticity verification platform is a service platform for enterprises, banks and government regulators with the ultimate purpose of offshore trade authenticity verification and compliance assurance. By integrating external data resources, using blockchain rights confirmation and encryption as data trust and security guarantee, using artificial intelligence technologies such as risk identification and behavior judgment as capabilities, tracking and cross-verifying information of transaction-related commercial documents and logistics links, and assessing enterprises and transaction information with credit risks according to preset standards, risk management and control are implemented. It provides strong data support for the authenticity verification of enterprises' offshore trade background and business supervision [8-10].

4.2. Platform function structure

Due to the business function requirements of efficient offshore trade authenticity verification, logistics data query, and risk control management service capabilities, the blockchain-based offshore trade authenticity verification platform is mainly summarized as "1+1+1", an integrated service management system, an application management system, and a background management system, as shown in **Figure 1**. The application management system is composed of five functional subsystems, which mainly include: trade registration intelligent evaluation system, data query auxiliary management system, risk monitoring dynamic early warning system, business development statistical analysis system, and business visual display system [11-14] .

Figure 1. Function structure of Offshore trade authenticity verification platform.

4.3. Overall platform architecture

The offshore trade authenticity verification platform is composed of database (SQL), blockchain platform (Hyperledger Fabric), etc., and the running environment is Microsoft Windows Server 2008 and above. According to the development principles of system completeness, reliability, maintainability and expansibility, follow the information security guarantee service standards, and ensure the development specifications and operation safety of information systems. The system data logic structure is divided into five levels: infrastructure layer, data service layer, application support layer, application layer, and display layer. The overall framework of the offshore trade authenticity verification platform, which is supported by the dual systems of IT system standards and specifications and system maintenance and information security.

4.4. Blockchain network security architecture

Blockchain itself is a tamper-proof, decentralized distributed digital transaction record, which is jointly maintained by multiple parties, uses cryptography to ensure the privacy and security of transmission and access, and can achieve consistent data storage and difficult to tamper with the accounting technology [8]. Blockchain relies on a peer-to-peer network that no one party controls, and authentication of network transactions (transactional authentication) is achieved through cryptographic means and mathematical consensus protocols that define rules for updating the ledger and allow participants who have no specific trust in each other to collaborate, rather than relying on a single trusted third party.

The platform designs the blockchain network security architecture based on the alliance chain. As shown in **Figure 2**, decentralized ledger nodes are established in the alliance chain to ensure that each node is open, flat, equal and highly autonomous, and there is no mandatory control function between nodes and the data is open and transparent. It is composed of ledger nodes. Data information such as logistics, capital flow, business flow and enterprise behavior information of offshore trade are accessed and stored in each ledger node of the overall network through the Fabric SDK. Establish smart contracts covering secure encryption algorithms and authorized access mechanisms between various user roles, enabling key players in the organization to complete each verification application seamlessly by linking trade-related information data recorded in each node's ledger in real time. Each update information and verification report is stored to the data block in the form of a unique and immutable hash value using timestamp and asymmetric encryption to further improve data source management. By comparing with the historical chain data, it helps users quickly and effectively verify the authenticity of offshore trade information. At the same time, banks and regulators can effectively track and trace relevant behaviors according to the on-chain query, verification, verification and other behavioral information, so as to prevent information leakage and illegal operations caused by abuse of rights.
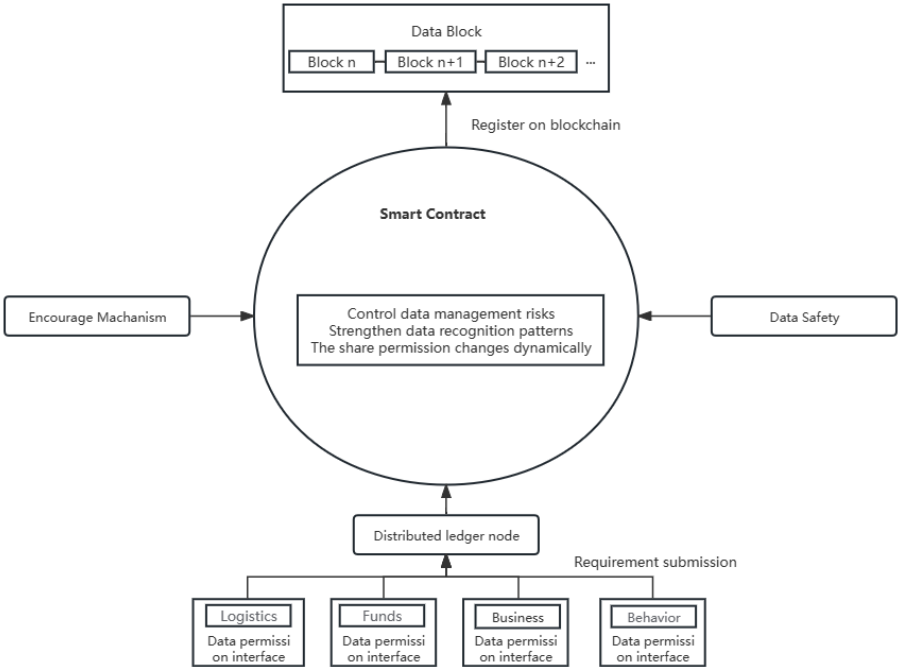
Figure 2. Blockchain network security architecture.

5. Application and test analysis of offshore trade authenticity verification platform based on blockchain

In this paper, the automated load test tool (Jmeter) was used to deploy the execution script in the Alibaba Cloud test environment, simulate the functional applications of various related systems to establish the test cluster environment, and respectively set up the stress test under the application scenario that the number of users applied for trade verification service is 50, 100, and 200, and the server is concurrent for 5 minutes. Focus on detecting host resource usage, including average server response times and transactions per second (TPS).

5.1. Response Time Test

The test results of the average response time of the server are shown in **Figure 3**. The horizontal axis is the concurrent duration, and the vertical axis is the response time.
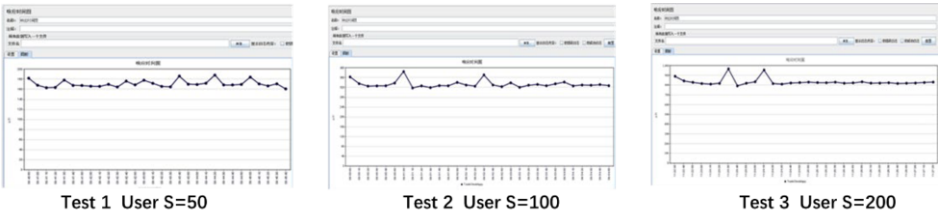
Figure 3. Server Average response time test results.

5.2. TPS Test

Transactions per second (TPS) test results are shown in **Figure 4**,with concurrent duration on the horizontal axis and transactions per second on the vertical axis.

Figure 4. Average TPS test results.

5.3. Analysis of stress test results

The above stress test results are summarized as shown in **Figure 5**, and the following conclusions are reached:

(1) When the number of simulated concurrent users S=50, the average response time is 170ms and the tps is 310.3 per second, and the system performance is satisfactory;

(2) When the number of concurrent simulated users S=100, the average response time increases slightly to 337ms, and the TPS fluctuates slightly to 307.9 per second, indicating that the system performance is still good;

(3) Under the high load of simulating the number of concurrent users S=200, when processing more user requests, the average response time is slightly slowed down due to the limitation of server resources, but it can still ensure that 95% of the online transaction response time is less than 1s, although the TPS is reduced to 293.5 per second, no abnormal situation of requests being blocked or rejected is generated.

According to the pressure test results, the overall platform has no performance bottleneck, and the average response time is within 1 second, the exception rate is 0, meeting 99% availability, and verifying the performance advantage under the premise of meeting the daily business needs.
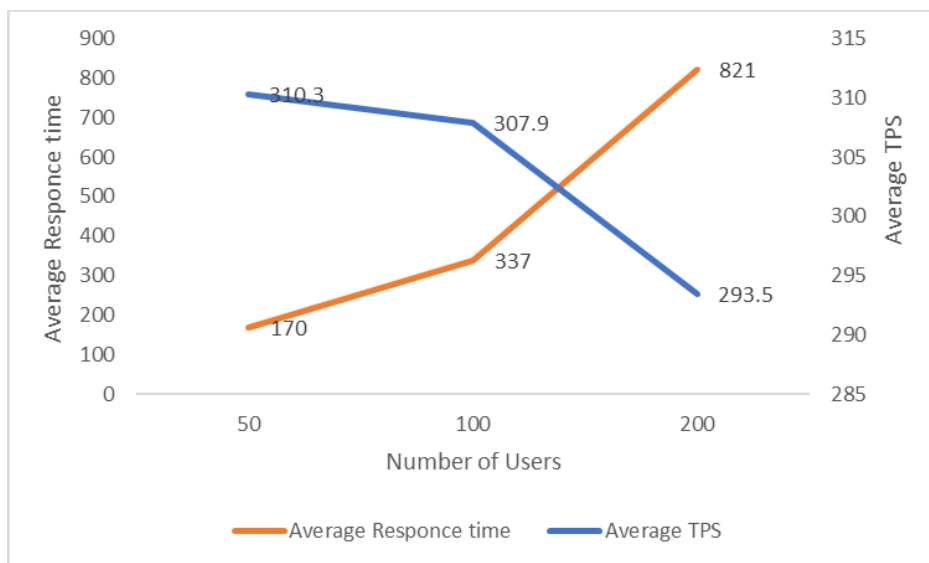
Figure 5. Pressure test results.

6. Platform design innovation

1) Integrate multiple third-party data sources, provide multi-dimensional and reliable verification data, and cross-verify to ensure efficient and authentic verification.

Integrate mature data providers in the market for multi-dimensional data analysis and trade verification. In the form of data call on demand, it provides effective evidence for offshore trade information, reduces the risk of fraud, and provides data support for banks to handle offshore trade. Achieve a more targeted whitelist review process by government agencies and regulatory authorities to reduce potential risks to customers.

2) Joint banks share key peer data, customize verification rules, break data silos, and improve risk control.

Cooperate with major banks that carry out offshore trade business, use blockchain technology to securely access the historical business inspection and processing data of shared banks, and set access rights. After obtaining authorization, different banks can retrieve the key fields of documents and obtain the processing results of documents in other banks, for example, they can know that under the same trade background, Whether the logistics document of the enterprise has been reused by other banks, or whether the document business has been rejected by other banks, but it does not show more business details.

In addition, unified risk control rules can be customized, such as requiring consistent information between trade, logistics and customs data, and preventing multiple buyers or sellers from repeating under the same logistics document. The system background automatically carries out information matching verification and returns results without manual intervention, so as to further improve the efficiency and accuracy of risk control.

3) Use big data to automate statistical analysis, improve business management initiative, and eliminate manual errors.

By updating the accumulated processing data of offshore trade, it can instantly display various report information of business enterprises, banks, industries, regions and other aspects based on offshore trade, as well as dynamic information of the development process of specific offshore trade businesses, and automatically track business conditions without regular manual communication to meet the active analysis and statistics needs of banks.

4) Relying on blockchain technology to help offshore trade authenticity verification risks controllable.

Realize intelligent acquisition functions such as overseas logistics data and customs data, form business applications for the authenticity verification of offshore trade background, and use blockchain's certificate chain, transaction traceability, and data privacy to ensure the security, effectiveness and traceability of trade authenticity verification document information, logistics information and capital information data. Objectify interactions at the bottom of the supply chain and autonomy at the end of the business, enabling fine-grained risk management based on business context authenticity through converged blockchain technology.

7. Conclusion

Trade digitalization is an inevitable trend in the development of cross-border trade. Blockchain has the ability to provide trusted data in the virtual world, and can share trusted data across the world. By building an offshore trade platform based on blockchain technology, it can actively enhance the coordination ability of the industrial chain and supply chain of banks and enterprises, and promote the supervision efficiency of offshore trade to a large extent.

The offshore trade authenticity verification platform proposed in this paper is representative in terms of system functions, innovative and diversified in terms of application services, which greatly improves the level of trade facilitation and enables digital enablement to promote the development of offshore trade in the background. Moreover, stress tests are carried out based on the platform's own performance, and the results are satisfactory. The overall platform is conducive to strengthening the convergence of key enterprises and industrial chain scenes and ecological docking, stimulating the exhibition needs of financial institutions, accelerating local governments to promote the construction of advanced manufacturing and new infrastructure, continuously optimizing the business environment, and enhancing the competitiveness of the open economy, which is a kind of technology platform worth promoting.

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