Marine data security based on blockchain technology

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Abstract. With the development of marine observation technology and network technology, the volume of marine data is growing rapidly. This brings new challenges for data storage and transmission. How to protect the security of marine big data has become an urgent problem. The traditional information security methods’ characteristic is centralization. These technologies cannot provide whole process protection, e.g., data storage, data management and application of data. The blockchain technology is a novel technology, which can keep the data security and reliability by using decentralized methodology. It has aroused wide interest in the financial field. In this paper, we describe the concept, characteristics and key technologies of blockchain technology and introduce it into the field of marine data security.

1. Introduction

With the development of information transmission, the internet technology and ocean observation technology, the amount of the marine data is growing rapidly. This brings new challenges on secure storage, transmission and application for marine big data. For example, in ocean data storage, the existing storage security depends on the security of the server / node or the credibility of the node itself. In order to resist the stealing of data, one way is the data storage methods based on encryption [1], the other way is to hand over the management authority of data access to a number of different managers [2].

The great values of large marine data include supervision and decision making in many ocean fields such as ecology, environment climate, biology, disaster and so on. Exploring the great value of marine data is the goal of marine data management, and the security of marine data is essential for marine data management. Under the environment of big data, how to build a demand-oriented security system for protection of marine data storage and transmission has become an urgent problem. For marine data, because of the large number of data sources, numerous fields, long time spans, differences of observation methods and processing methods in different periods, the information content, data acquisition, updating methods, data standards, data formats, storage media, management and service method are different.

The traditional information security methods’ characteristic is centralization. The information security construction includes whether the computer room environment meets the safety standard, whether the security technology adopts digital signature, data encryption, access control and whether the information system access control management is strict. These technologies are the control of the information transmission terminal, and cannot provide whole process protection. Blockchain
technology [3] is regarded as a novel disruptive technology after the cloud computing, the internet of things and the big data, and has got great concern by the governments, financial institutions and technology companies [4]. The characterization of the blockchain technology is decentralization, which can provide security and reliability environment for the whole process of data management and application. The technology can fit well with the problem of big data security, especially the ocean big data security. Therefore, this paper introduces blockchain technology into marine data security. This remaining of the paper is organized as follows, In Section 2 an overview of the blockchain technology is presented. In Section 3 the proposed method and discussions is presented. Finally, some conclusions are drawn in Section 4.

2. Related Work

The marine big data has brought great challenges to the security of data, including storage security, access security, shared security and regulatory security issues, etc. To overcome these problems, this paper introduces the blockchain technology into the management and application of ocean data.

The blockchain is the key support technology of the digital encrypted monetary system that represented by bitcoin [5]. Bitcoin is the most successful blockchain application. The first block of the bitcoin blockchain was built on January, 2009, held by the founder Dorian S. Nakamoto [6]. The blockchain is considered as the fifth computational paradigm following the mainframe computer, personal computer, Internet, mobile and social network. Blockchain technology is the prototype of the next generation of cloud computing. It has attracted the attention of government departments, financial institutions, technology companies and the capital market. With the rapid development and popularization of bitcoin in recent years, the research and application of blockchain technology also show the explosive growth trend. The concept of blockchain is derived from the digital currency and it is a data structure to combine the blocks in a chain [7]. The main advantage of the blockchain technology is decentralization. Through the using of data encryption, time stamp, distributed consensus, economic incentives in the distributed system, the blockchain can provide point to point transactions without nodes’ mutual trust. Therefore it can provide solutions to the problems of high cost, inefficiency and insecurity in data storage [8]. The blockchain technology can build a reliable database [9,10,11,12] by this collective mutual verification. For the above reasons, the blockchain technology can relieve many practical application problems, e.g., double payment problem. Double payment problem is one of the key problems in digital cryptocurrencies. In the traditional financial and monetary systems, cash is a physical entity that can naturally avoid double payments. But for digital currency, we need credible third-party institutions. By building a decentralization trusted system, the blockchain technology can solve the double payment problem based on the verification and consensus mechanism of distributed nodes without the third party. Currently, more and more technology giants, research institutions and technical groups have recognized the subversion of blockchain technology and have taken part in the study of blockchains [13,14,15,16]. Compared to the traditional central organization, the bitcoin blockchain forms an algorithmic-defined credit. By introducing the blockchain technology, the marine big data security issues will be better resolved.

3. The Proposed Method and Discussions

By studying the applications in financial field, the blockchain technology has great development values such as eliminate the intermediate trading platform, reduce operational risks and so on. The blockchain technology has brought new challenges and great effects for financial domain and has provided inspiration for marine data field as is shown in Figure 1.

The architecture of the marine data security system based on block chain include two modules, i.e., marine data security storage and marine data security transmission.

(1) Marine data security system

For the important marine data, such as ocean exploration data, can be stored in the blockchain to prevent information loss or tampered. In order to solve data fraud, a security and credible marine system can be built based on the high reliability blockchain technology. The blockchain technology has changed the traditional model that highly relies on intermediaries
into a decentralized network model. The blockchain technology provide a new way to protect marine data.

(2) Marine data security storage
In the field of marine big data security, the marine data can be distributed storage in the marine big data security system. There is a central server in the technology scheme of blockchain. Each computing device that runs the blockchain software is a peer node in the chain network. There is no need to establish a trust relationship between the nodes. Digital fingerprints are computed by the exchanged information using cryptography method. It is recorded in the data block and is used for the connection of the next data block. This system can form security protection for marine data and ensuring the security of information for data sharing. Based on this, the marine data can be shared to universities, research institutes and related enterprises as an important basis for scientific research.

(3) Marine data security transmission
The blockchain technology can reduce the cost and risks by reducing human intervention. Because of the decentralized property, we can construct the connection between receiver and resources in marine data transactions and no intermediary platform is required. This transaction platform can reduce cost and simply operation process. This can encourage the integration of data in different marine areas and promote scientific research.
Compared with traditional data management system, the marine big data security system based on blockchain technology has its own advantages. (1) The contract information is automatically extracted by the blockchain, this can guarantee the reliability and stability of the system. (2) The contract information is recorded in the blockchain. This can ensure the authenticity and effectiveness of the transaction procedure. (3) The system can achieve point-to-point transactions. This can save the operation and maintenance costs of the intermediary platform. By introducing blockchain technology, we can build a new ecological environment of marine data resources, as shown in Figure 2. This can improve the security of data sharing, and provide effective and effectiveness data transfer and exchange.

4. Conclusions
In this paper, we introduce the blockchain technology into the field of marine data security. Due to the excellent safety property of blockchain technology, it can effectively improve data security for the marine data area. By analyzing the technical properties of blockchain technology, a new ecological environment of marine data resources is also proposed and discussed.

Acknowledgments
This work is supported by the Aoshan Innovation Project in Science and Technology of Qingdao National Laboratory for Marine Science and Technology (No. 2016ASKJ07).

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