Application Analysis of Blockchain Technology for 6G Network

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Abstract. In the 6G environment, society and information and communication technology are more and more closely combined. With the continuous improvement of communication rate, many data security problems will arise. Risk prevention will also be a focus of 6G technology that cannot be ignored.

Blockchain technology takes cryptography as the carrier, and the underlying supporting technology lays the foundation for 6G network. In the 6G era, blockchain will have more room for development. With the rapid development of information technology and the wide application of Internet technology, the accelerated development of global economic integration, and the increasingly frequent communication between countries, human society has entered a new historical period - the information age. In this process, the phenomenon of information leakage is becoming more and more serious.

Blockchain has the characteristics of decentralization, transparency and inviolability, and many technical improvements will provide a strong security guarantee for 6G. The latest development of 6G is described in detail, and the key performance of 6G and blockchain is discussed. Deeply analyze the technical basis of 6G blockchain, make a preliminary study on the application of blockchain technology in 6G, introduce blockchain related technologies, introduce the application of blockchain technology in spectrum management, analyze the challenges faced by the application of blockchain technology in 6G, and look forward to the future development prospects.

Keywords: Block chain · 6G · Data sharing · Information security

1 Introduction

1.1 A Subsection Sample

The pace of technological innovation in wireless communications has never been interrupted. 6G has higher transmission rate; Higher mobility; Greater security. In 6G network, people have higher and higher requirements on the service field [1]. There are a large number of edge devices and sensitive information of users, which need to be transmitted through traditional network infrastructure, thus bringing huge data security risks. Therefore, it is necessary to protect these sensitive data. By analyzing the security

requirements of 6G network and the shortcomings of existing technologies, an information security solution based on blockchain technology is proposed to effectively cope with the challenges faced by 6G network security. Traditional network infrastructure is vulnerable to single point of attack, single point of failure and other factors, resulting in privacy leakage risk, which leads to serious data security problems [2].

Existing data privacy protection and centralized data processing methods require third-party trusted entities to serve them, and edge device data needs to be processed by third-party entities. None of these methods can guarantee that users' sensitive information will not be tampered with or deleted, nor can they meet the needs of distributed storage in cloud computing, so massive sensitive data will be abused, privacy leakage and other hidden dangers [3].

Blockchain is one of the key technologies to realize 6G, which can effectively solve the network security and privacy issues. The blockchain technology is introduced into 6G network, and the distributed collaboration mechanism of blockchain is used to support more secure and robust interaction between communication service nodes, so as to further improve the communication network coverage and communication capability.

2   6G Network and Blockchain Related Technology Overview

New basic communication technologies, including signal sampling and channel coding, support 6G network applications through innovations in coding mechanisms, spectrum sharing and spectrum balancing [4]. 6G era is based on artificial intelligence, with the performance of wireless communication technology, three-dimensional space integrated communication, wireless antenna network and other proprietary technologies, through the lowest level of wireless network, to break the limitations of the region and space, and finally achieve the purpose of transmission network.

6G mobile communication is bound to make new breakthroughs in technology, and has already realized industrial applications, but the key technology is the new spectrum communication technology.

With the rapid development of wireless communication services, the demand for spectrum is increasing. Due to the scarcity and non-renewable characteristics of spectrum, spectrum resources become very tight. At present, all countries in the world are facing a serious spectrum crisis [5]. Especially in China, the domestic spectrum resources are in short supply and demand is huge. When the traffic volume increases and the usage decreases sharply, the spectrum resources will become scarce.

6G trusted blockchain fragmentation system consists of blockchain layer and application layer. In the blockchain layer, the blockchain backbone is placed on the edge server, and the fragmented blockchain is deployed on the edge device. In order to deal with the large amount of data obtained from the edge network effectively, the blockchain sharding system is used to process massive transactions in parallel. This paper proposes a distributed transaction security solution based on blockchain fragment technology. Firstly, the public identification node of the blockchain is sliced and segmented, and separate blocks are established for different slices. In the slices, the consensus mechanism is used to verify the legitimacy and integrity of the block. On this basis, the hash table is used to store the association information between each block. The second is

to reassemble the block established by each fragment, and get the final identification between fragments, and finally add a new block in the main chain [6].The blockchain hierarchy architecture is shown in Fig. 1.
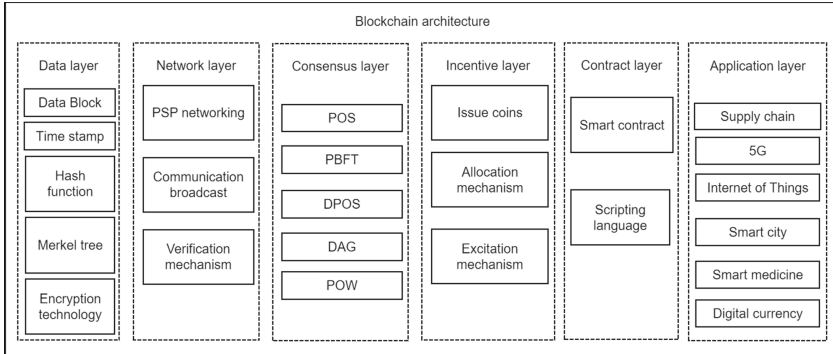

Fig. 1. Block chain hierarchy architecture diagram

Edge network can realize data sharing, data trading and security management. However, due to the lack of consensus mechanism for edge devices, the energy consumption of communication and computation is high, which affects the performance of edge devices [7]. In view of the deployment problem of blockchain fragmentation system, requesters of blockchain services can design contract combinations. In order to motivate edge devices to join the block consensus mechanism of blockchain, edge devices aim to maximize their own utility.

3   Manage 6G Spectrum Based on Blockchain

Limited spectrum resources have always plagued the development of mobile communication, green development, resource conservation and other concepts put forward higher requirements for spectrum co-construction and sharing. How to measure the sharing state of dynamic spectrum is the key to ensure the smooth operation of the whole network, which can achieve accurate processing, efficient and real-time settlement of dynamic spectrum sharing transactions [8]. The existing mainstream spectrum sharing methods have different degrees of shortcomings.

Blockchain spectrum sharing can provide users with flexible wireless services. This paper proposes a trust-based utility design, resource scheduling and negotiation mechanism, and a method to improve the efficiency of spectrum utilization across systems. For unreliable, decentralized, sensor nodes provide payment and other incentive mechanisms, smart contract for mobile operators, realize spectrum sensing and service functions, and has been successfully applied in a variety of occasions. Traditional wireless access networks are facing a rapid increase in the number of users and high real-time access requirements, resulting in slow allocation of spectrum resources, and it becomes more difficult to meet user requirements [9]. The entity relationship based on the blockchain spectrum management system is shown in Fig. 2.
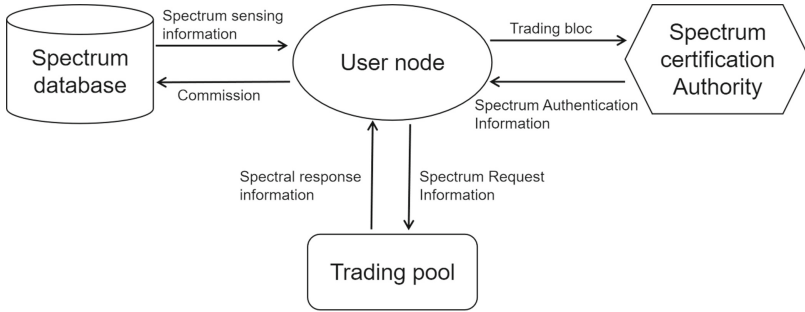
Fig. 2. Entity relationship of spectrum management system based on blockchain

The spectrum resource management and distributed spectrum sharing method based on blockchain has the characteristics of low spectrum utilization and good stability, which provides a scalable spectrum sharing and resource management solution for large-scale deployment in the future. The algorithm adopts asymmetric key agreement mechanism. Data distribution is secure, confidential and reliable, with good expansibility. The distributed blockchain network has simple structure, adopts point-to-point communication, has high security and low transmission cost, and effectively realizes spectrum sharing in wireless network through blockchain technology [10]. The advantages of blockchain applied to spectrum management are shown in Fig. 3.
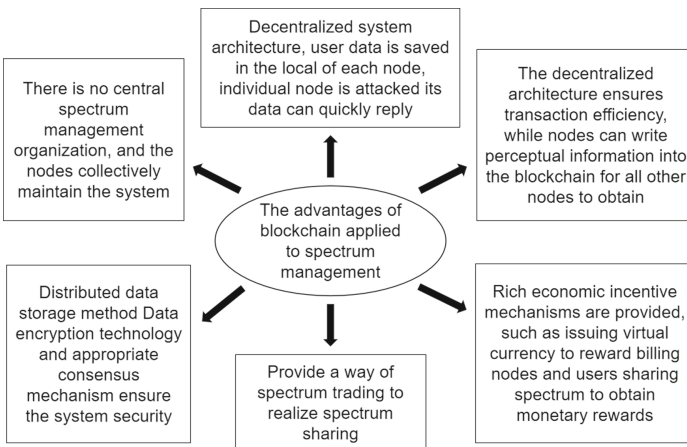

Fig. 3. Advantages of blockchain applied to spectrum management

In 6G network environment, digital encryption scheme based on distributed hash table cannot meet the demand of spectrum sharing. The distributed ledger algorithm based on decentralized structure can balance the contradiction between spectrum sharing and privacy protection well. At present, the research on the combination of blockchain and spectrum management has been carried out at home and abroad, but there are still many key problems to be solved.

4   Related Technologies of Blockchain and 6G Fusion

4.1   6G Network Enabling Technology

6G era will rely more on blockchain technology to achieve communication interconnection. As an emerging technology, blockchain technology has been widely used in various fields. Typical block-to-block, chain structure, or directed acyclic graph structure are used to store data. Cryptography is used to ensure the security of transmission and access, make data storage easy to tamper with, and prevent rejection [11]. In the low-cost competitive environment, this paper provides a new trust computing paradigm and cooperation mode of trust network.

With its unique trust establishment mechanism, blockchain is changing the application scenarios and operation rules of many industries. The higher the frequency, the higher the path loss, the smaller the coverage radius, the higher the cost. Regardless of the business requirements or cost effectiveness, network co-construction and sharing is likely to be the main direction of 6G network development in the future [12]. Blockchain is a new form of decentralized distributed ledger that is tamper-proof and traceable. In the scenario of network co-construction and sharing, trust interconnection based on blockchain is open and trusted for multiple operators under network co-construction, which can effectively track network quality, monitor network equipment, provide digital identity authentication and network roaming settlement services.

4.2   6G Hybrid Cloud and Blockchain

The 6G era brings new requirements and challenges to data centers. 6G has prominent technical characteristics such as large bandwidth and low latency, which can flexibly meet the specific needs of business, and then promote the improvement of social and economic efficiency and cost. In this process, how to coordinate the development of bandwidth and latency has become one of the research hotspots. Hybrid cloud is an effective method to solve this problem. Currently, there are many solutions, which complement each other. Hybrid cloud technology enables application developers and content service providers to seamlessly connect between the edge and center of the 6G network, enabling cloud computing [13]. Hybrid cloud is a complex and open system that needs to be managed by a trusted third party to ensure the security and integrity of user data. At present, there is no effective solution to hybrid cloud security problem. As a new distributed ledger technology, blockchain technology has been widely concerned and has broad prospects. In actual deployment, blockchain platforms or applications can be deployed on the hybrid cloud server side to support different application scenarios.

The hybrid cloud allows computing to take place at the edge of the mobile network. Hybrid clouds can be used to solve congestion and 6G network delays caused by mobile networks [14]. This paper proposes the combination of blockchain and hybrid cloud technology to construct the future 6G application scenarios under two different modes, and analyzes its service environment. Ensure the distributed deployment of computing resources, transaction data traceability, through the distributed deployment of hybrid cloud server, can be very convenient to achieve blockchain spectrum sharing.

4.3   6G Cybersecurity and Blockchain Technology

In order to deal with various complex privacy challenges, blockchain has brought possible solutions to 6G privacy protection, which can provide a strong guarantee for the construction of a distributed secure and trusted transaction environment [15]. Due to the complexity and imtamability of data information, traditional encryption methods are difficult to meet the demand of high access control for privacy, while blockchain technology can effectively solve this problem. Security is the most critical requirement and attribute of 6G network, and blockchain technology will play a decisive role in 6G network.

Traditional broadband wireless access technology based on fixed frequency can no longer meet the needs of users with rapid development in the future, and the demand for application speed and delay in the 6G era will continue to increase. New services also lead to increased requirements for lightweight and dynamic computing, so a communication network closely connected with information transmission and application needs is urgently needed to achieve full frequency domain, full scene effect, flexible adaptation of all services, and resource coordination [16].

Using the blockchain technology, combined with the decentralized and distributed 6G network deployment, the scalability of the blockchain is enhanced by reducing the processing overhead of data mining, so as to defend against various security attacks. Based on the consensus mechanism, the security of the system is enhanced. The use of consensus mechanism enhances transaction verification, prevents malicious attacks, tampering with information data and other behaviors, and reduces the risks of network attacks, malicious node spoofing and external environment attacks [17].

Network security technology is not mature, the future 6G era will have stronger computing power, but also faces the challenge of complex heterogeneous and distributed characteristics on computing power. Blockchain technology can be considered as a technological means to enhance the security of computing power and support the transaction of computing power.

5   The Fusion Application of Blockchain and 6G

With its unique key technology and distinctive characteristics, blockchain endows mobile communication with new connotation, enhances the security guarantee ability of mobile communication, and establishes a safe and reliable implementation mechanism.

6G is a new era of mobile communication, realizing the connection of intelligent artificial intelligence, the deep coverage of the Internet of things, holographic information interaction, all-weather ubiquitous connection and other ideas [18]. In this new era, people need more efficient and reliable network technology to support various business applications. It achieves high performance such as peak rate, high device strength and ultra-low latency, but still has data leakage and other security issues. Can achieve the purpose of protecting information, tamper-proof, traceability and other advantages, make up for security loopholes. The application prospect of blockchain in 6G is shown in Fig. 4.

Based on the basis of existing research, blockchain may play an important role in the 6G era:
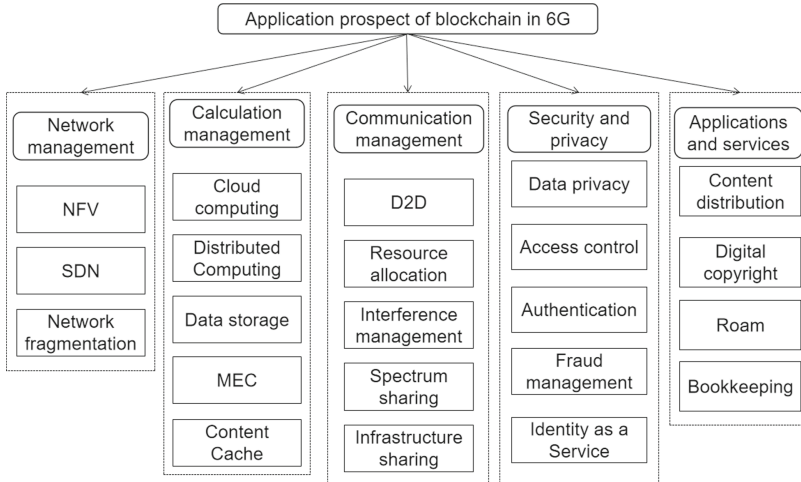
Fig. 4. Application prospect of blockchain in 6G

(1) Sharing spectrum, infrastructure and other resources. 6G can use the smarter, more distributed blockchain Dynamic Spectrum Sharing Access (DDS) technology to use blockchain to flexibly share network infrastructure and allocate it on demand to reduce operator costs and save energy.

(2) Authentication. With the increasing number of 6G network terminals, the centralized authentication may cause network bottlenecks and delays. In order to solve these problems, an identity authentication scheme based on blockchain is proposed, and its security is analyzed. The results show that the scheme has high security performance [19].

(3) Network security. With the advent of the 6G era, "Internet of everything" brings a large number of new business needs, but also challenges the next generation of Internet. In order to meet these new requirements, it is necessary to introduce security protection measures in the new generation network communication architecture. One of the most critical is information security.

The traditional "external" and "patch-type" network security protection mechanism can no longer adapt to the ubiquitous attacks that may exist in the future 6G networks, and the security risks are uncertain. With its unique communication technology, blockchain has become one of the hot spots in the future research of 6G network endogenous security strategy [20]. Blockchain will provide many security services for 6G, including access control, data integrity, identity verification and privacy protection.

6 Conclusion

Using cloud computing, edge computing, artificial intelligence and other emerging technologies, the blockchain is applied across the network, intelligent and efficient interconnection across fields. The integration of 6G and blockchain can improve user experience,

reduce service costs, and improve communication channel utilization. At present, many countries around the world have put forward plans to promote the construction of network security, but the implementation effect is not optimistic [21]. Information security is the key to the success of 6G.

The application of blockchain technology in 6G is initially discussed. In the future, the development of blockchain will be promoted to the physical layer, and will develop in synergy with artificial intelligence and edge computing, which will significantly improve the computing, communication and storage performance of communication networks [22]. The deep integration of blockchain technology and 6G to realize intelligent consensus among distributed nodes will face new challenges such as new architecture and new technology, and also put forward new requirements for it.

In terms of blockchain technology itself, its basic theory and key technologies need to be further improved and breakthrough to lay the foundation for its integration into 6G. Combined with the characteristics and architecture of 6G, it is necessary to start with design and planning to form a blockchain technology suitable for 6G to support the needs of efficient, safe and convenient interconnection between humans and machines [23].

Block chain technology applied in the basic theory and key technology of 6G networks application was still in the stage of study, how to further in the next 6G network deployment, match and joint optimization performance index, security, stability, etc., the guiding ideology and target of the application of further integration specification, need further research, to ensure that the 6G block chain technology in health and sustainable development. Blockchain is both an idea and a technical approach, and further work is needed to evaluate the consistency of this idea with practical applications.

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