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Principle of block chain technology and its application in electric power industry

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Abstract: Block chain is an important sub-concept of Bitcoin, which is essentially a comprehensive database without intermediary structure. Block chain technology, as a distributed data storage database technology, has broad application prospects in the power industry. Starting from the basic conceptual structure characteristics of block chain technology, this paper explains the principle and core technology of block chain technology, and explores the application of block chain technology in power transmission, power terminal services and energy fields.

Key words: block chain technology, technical principles and characteristics, power industry, application.

1. Introduction

With the rise of new digital money, bitcoin, the technology of block chain is gradually known by more people. Block chain is a technical concept accompanied by Bitcoin, which essentially belongs to an intermediary-free database. Using block chain technology in Bitcoin is to generate a series of relevant data blocks based on cryptographic principles. The data blocks have some relationship with each other. Each data block accurately records the information of a Bitcoin network transaction. This information is an important criterion to verify the authenticity of the Bitcoin network transaction. At the same time, it is also an important foundation for the next data block generation. At present, the advantages of block chain technology are undoubtedly obvious. In the banking field, the use of Bitcoin technology can effectively shorten the processing time of text information (from 3 hours to 25 minutes); in the field of power energy, block chain technology is used to balance power supply and demand, making power transmission and supply more flexible [1-2]. The application effect of block chain technology in the field of network finance has been obvious to all. The research shows that block chain technology still has deep application foundation and broad application space for the traditional power industry.

2. The concept, principle and characteristics of block chain technology

2.1. The concept of block chain technology

The concept of block chain technology can be explored from two aspects: narrow sense and broad sense. Firstly, in a narrow sense, block chain technology belongs to a kind of de-intermediated database, which connects all data blocks in time order to form a chain data structure. At the same time, block chain technology in a narrow sense can also be regarded as a distributed book. Data blocks are interrelated by

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the principles and methods of cryptography. Each data block is like an account book, which cannot be forged and tampered with.

Secondly, from a broad point of view, block chain technology is a completely new way of computation. This method uses block-chain data structure to store data, uses distributed node consensus algorithm to automatically generate and update data, and uses the principles and methods of cryptography to ensure the security and reliability of data transmission [3].

2.2. The principle and characteristics of block chain technology

The principle of block chaining technology can be represented by an infrastructure model.

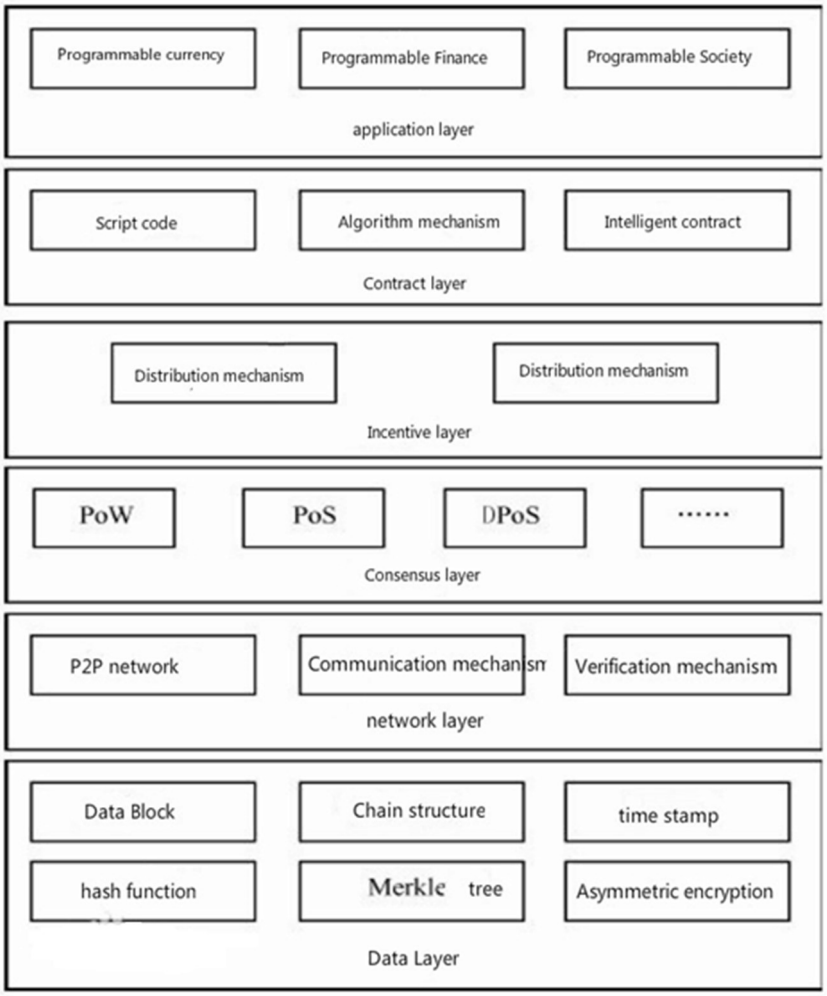


Fig. 1 Infrastructure model of block chaining Technology

As shown in the figure, block chain technology can be seen as a well-structured database system (block chain system), which consists of six layers, such as data layer and network layer, as shown in the figure. Among them, the data layer contains basic data and basic algorithms; the network layer contains data verification and dissemination mechanism; the consensus layer mainly includes consensus algorithms of network nodes; the incentive layer integrates economic factors into data blocks to formulate economic allocation mechanism; the contract layer mainly contains various scripts, algorithms and so on. The application layer includes various case models that can be applied [4].

The main features of block chain technology are four core technologies. First, distributed accounts. The so-called distributed account book means that network transactions are implemented by multiple

nodes, each node records a complete transaction item, for this reason, each node can be used as a proof of network transactions, with legal effect. At the same time, the nodes in block chain technology are independent of each other, which ensures the synchronization and unity of data through consensus mechanism, and has high security. Second, asymmetric encryption authorization technology. The transaction information in the block chain is open to the public to ensure that every transaction is under the supervision of the law; but for account information, it is strictly confidential, which uses asymmetric encryption and authorization technology to ensure data security. The flow of asymmetric encryption algorithm is shown in the following figure.

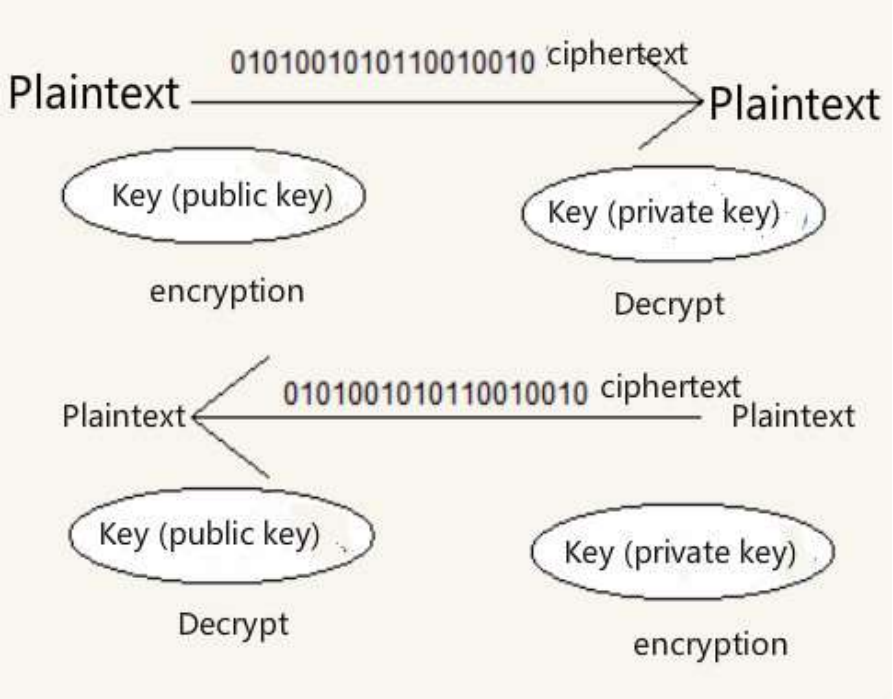


Fig. 2 The flow of asymmetric encryption algorithm

Third, consensus mechanism. The so-called consensus mechanism refers to a set of rules between nodes, through which each node determines the validity of data records. In the block chain technology, there are four kinds of consensus mechanism, which can be adapted to different scenarios of transaction demand. Fourth, intelligent contracts. The so-called intelligent contract is based on detailed and reliable data, automatically generated a series of rules and provisions. The emergence of intelligent contract technology greatly improves the efficiency of transactions and reduces the risk of human operation (because only when the computer determines that the data is safe, reliable and accurate, will the corresponding terms be generated, which greatly reduces the contract risk) [5].

3. Application and Prospect of block chain technology in electric power industry

At present, the electric power industry is facing a rapidly changing market environment. Traditional non-renewable energy and new renewable energy supply the current energy demand together. The storage, transmission and management mode of energy are accelerating changes. Under this background, researchers in the electric power industry begin to pay attention to how to make blocks. Chain technology is integrated into the power industry to promote healthy and sustainable development of the power industry [6].

3.1. Application of block chain technology in power transmission and distribution

At present, there are more and more power production and transmission devices, and power transmission occupies a large proportion in the power industry. As can be seen from Figure 3, the state's support for power transmission is increasing. The uncertainty between the various systems in the process of power transmission and distribution is also increasing [7]. Due to the lack of effective trust mechanism, power transmission and distribution work is difficult to rely on the intelligent system itself. The application of block chain technology in power transmission and distribution makes "intelligent power transmission" possible [8]. There is a key intelligent contract layer in block chain technology. The intelligent contract layer can realize the automatic processing of power transmission, which greatly reduces the dependence on power intermediaries and effectively reduces the cost of power transmission.

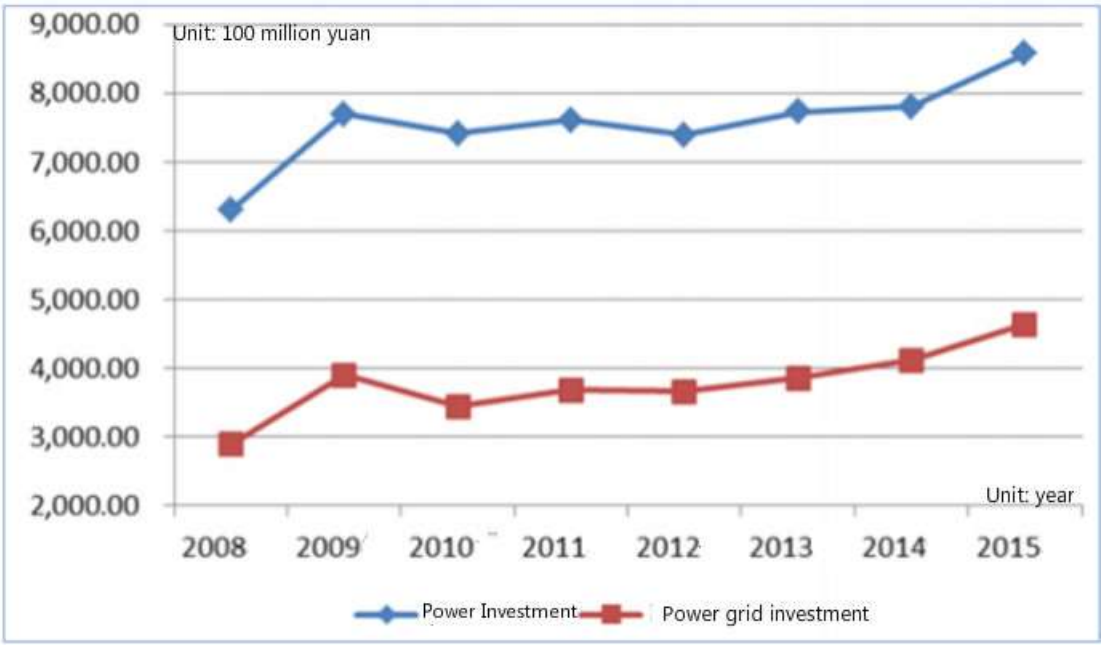


Fig. 3 2008-2015 investment in power grid

3.2. Block chain technology provides higher quality service for power end users

Direct cross-linking between user terminals and power companies can make the whole power service process more convenient and efficient. Under the traditional power supply mode, this is almost impossible. Introducing block chain technology into power industry can give more automation and humanization functions to user terminals and realize seamless docking between user terminals and power companies. Depending on the support of intelligent contract layer in block chain technology, power transmission and power exchange will become more smoothly, and it is no longer difficult to achieve "point-to-point" power supply. Especially for new energy vehicle users, the use of block chain technology will make their lives more convenient. According to data released by the China Automobile Association, in 2017, China's new energy vehicles produced about 794,000 vehicles and sold about 777,000 vehicles. Although this data is quite different from the traditional gasoline vehicle, compared with 2016, its production and sales increased by 53.8% and 53.1%. This data shows the great application prospect of new energy vehicles (new energy vehicle demand for power battery see below). New energy owners only need to recharge in the "smart wallet", and they can quickly enjoy the basic power supply facilities to charge the car. In addition, the convenience of block chain technology also radiated into the field of smart home. Industry data show that in 2017, the smart home industry in China has reached 90.8 billion yuan, while in 2018, the smart home industry reached 133.4 billion yuan, an increase of 46.9%. It can be seen that the development space of the smart home industry is also very huge. The vigorous

development of smart home industry will promote the expansion of the power industry market. Block chain technology will further shorten the distance between smart home and power supply. Users can purchase and consume electricity conveniently, quickly and automatically through smart contracts. At the same time, it benefits from the de-intermediation characteristics of block chain technology. Users and power companies will save a large amount of agency fees in the transaction process [9].

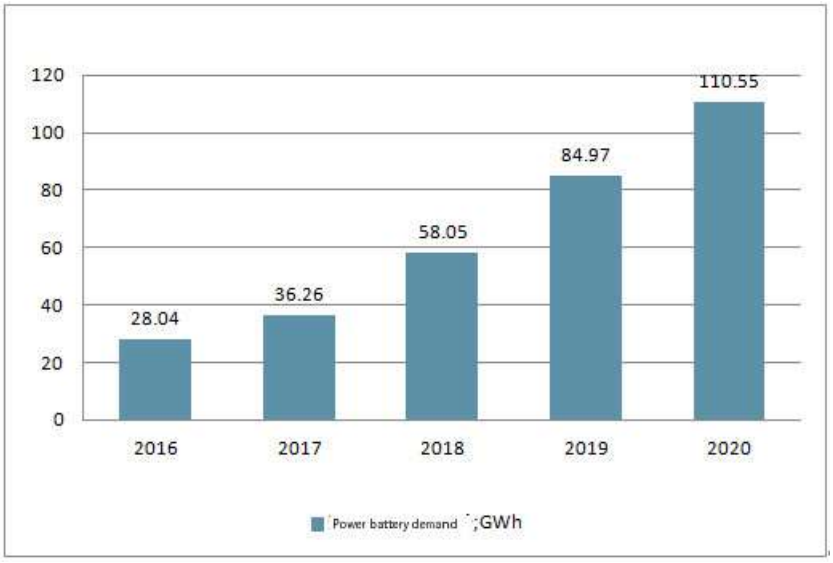


Fig. 4 Demand forecast for domestic power battery in 2016-2020 years

3.3. Assist in the issuance of renewable energy certificates

The certification of renewable energy is a rigorous and large-scale work, which is of great significance for improving energy efficiency and protecting the environment. It is not easy to certify renewable energy and renewable energy certificates in the power industry. At present, the evaluation index of renewable energy certificate issuance is mainly the numerical value of energy generation, which needs to be predicted and estimated. Predicting and estimating energy generation is a huge task, and it often costs a lot to get the actual value accurately. The introduction of block chain technology, using sensors matched with intelligent contracts in the block chain to predict and estimate power generation will be very convenient. Intelligent contracts record each data accurately in each block and issue renewable energy certificates according to the actual energy generated. This will effectively reduce the cost of renewable energy regulators and significantly improve their efficiency.

4. Summary

In summary, block chains can be regarded as a de-intermediated database or as a new computing method. At present, block chaining technology has been applied in finance, insurance, energy, electricity and other industries. It is predicted that in the future, block chain technology will be more widely used in the power industry. It will promote the reform of the power system, save a lot of power service costs, and improve the quality and efficiency of power service.

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