Research on Energy Internet Power Line Communication Technology Based on Block Chain

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Abstract. With the continuous development of energy Internet technology, its requirements for communication systems are getting higher and higher. As for the energy Internet, it is based on the concept of the Internet and the existing smart grid. Its communication system also needs to rely on the existing power communication system. In the energy Internet, the use of block chain and intelligent contract technology to meet credible and automatic point-to-point energy transactions can improve the overall operating efficiency of the system, reduce management costs, and make the energy Internet a self-organizing and self-regulating structure. In essence, energy Internet and block chain technology must be built on the Internet of Things, a common intelligent device. This paper takes the power line communication technology of the Internet in the current power system as the research object, analyzes the main challenges and problems in the construction of energy Internet based on blockchain, and then provides the corresponding research basis for the future heterogeneous network integration.

Keywords: Energy Internet, Block chain, Power line.

1. Introduction
The increasing depletion of fossil energy and a series of problems such as environmental pollution brought about by it have been paid more and more attention by human society. Developing green, clean and renewable energy will effectively solve this problem. Energy Internet is a new hot topic in current academic circles [1]. With the development of energy Internet, the intervention of a large number of producers and consumers will generate new commercial forms and form direct bilateral transactions of electricity [2]. The Energy Internet, with the power system control network as its core, integrates a large amount of distributed renewable energy, and can achieve two-way interaction between energy flow and information flow by using advanced information and communication technologies, power electronics technologies and other cutting-edge technologies [3]. There are still many challenges in the landing process of the energy internet, which covers a large number of equipment, including power generation, electricity consumption, energy storage and power transmission and transformation equipment, which form a huge system. It is one of its important challenges to achieve automatic, credible, accurate, balanced and real-time transactions among numerous devices [4]. Block chain technology has strong internal consistency with the concept of energy Internet. In essence, energy Internet and block chain technology must be built on the common intelligent device Internet of Things [5]. The technical
characteristics of the block chain are naturally suitable for the energy field. The "energy block chain" enables people to see the opportunity of completely reconstructing energy and electricity from the underlying structure to the commercial platform.

The effective utilization of renewable energy is based on distributed architecture, i.e. local collection, local storage and local use. The access of a large number of producers and consumers will generate new business models and form free bilateral electricity transactions [6]. The increase of market participants makes the quantification of transaction information and the management of power transactions much more difficult. Therefore, it is necessary to find an effective way to manage power transactions [7]. The construction, management and maintenance costs of traditional centralized solutions are too high, and it is difficult to support the collection, transmission, reception, storage and analysis of mass equipment data [8]. The point-to-point direct transaction between two intelligent devices has a good cost advantage. The current popular block chain technology will help to establish a credible direct transaction between devices and accelerate the landing of energy Internet [9]. In the era of energy Internet, these digital devices will further achieve extensive interconnection through the Internet of Things, obtain local intelligence through high-performance embedded design, and obtain cloud intelligence through the Internet of Things to form an Internet-based cluster intelligent device Internet of Things network [10]. Use block chain and intelligent contract to establish credible, autonomous and automatic energy transactions between massive energy Internet devices, and complete automatic matching between demand and consumption [11]. This paper takes the power communication of the Internet in the current power system as the research object, analyzes the main challenges and problems in the construction of the energy Internet based on the block chain, and then provides the corresponding research foundation for the future heterogeneous network convergence.

2. Principle of Power Line Communication and Its Application in Energy Internet
With the depletion of conventional energy sources and the increasingly serious environmental pollution, more and more organizations have begun to attach importance to environmental protection issues, and at the same time have begun to actively explore various new energy sources. There are many factors for attenuation of power line carrier signal, including input impedance of power line, load of distribution network, communication distance, etc. In the block chain network, every transaction is traceable and difficult to tamper with. Therefore, when both parties to a transaction conduct a transaction, they can check the previous transaction records to verify whether the transaction can be reached. In power line carrier communication, signal attenuation is generally divided into two types of line attenuation and weighted attenuation. The reasons for line attenuation include complex network structure, too many nodes and impedance mismatch, which can cause signal attenuation. The participants are independent and have no trust and communication mechanism, which cannot ensure the automatic execution of the supply and transaction of energy systems. The emergence of block chain technology makes the realization of energy Internet at the technical level possible.

The progress of energy Internet technology is based on information and smart grid. It draws on the development form of Internet. When evaluating the power communication network, one index cannot be selected as the evaluation standard, and the power network should be considered as a whole to comprehensively consider various reliability indexes. Fully and completely reflects the running state of the power grid. Power communication system is a complex network, which can be divided into three parts according to its functions: transmission network, service network and support network. Under the condition of constant quality, the more samples, the better. The data normally used as tags will clearly know their target information, and the real tags should clearly know the performance of the user in the target business [12]. The data appearing in the learning process is also increasing, and the degree of Internet communication is getting higher and higher. The input impedance characteristic can change the efficiency of the transmitter and the input power of the network by Ya. The change of learning mode has led to the rapid growth of the generated Internet data at a speed of one million times, and with the increase of the degree of interconnection, the format and form of interactive data generated by online teaching are also constantly updated. The research on the reliability of network topology needs a
comprehensive, complete and reasonable analysis from the two aspects of network devices and service load. The algorithm flow is shown in Fig. 1.

![Algorithm flow](image)

**Fig. 1** Algorithm flow

### 3. Block Chain Technology in Energy Internet

Block chain technology was originally designed for bitcoin as a centralized and untrusted collective database maintenance technology. The block chain can enable all participants in the system to cooperate to generate a set of time-sequential, tamper-proof, trusted and data-safe database in an environment without mutual trust. Block chain technology will achieve the changes from information internet to internet, and can be applied to finance, securities, trading system, energy, internet of things and other fields. In power communication visualization, visual analysis of node accessibility is a very important aspect. The block chain borrows a fixed consistent algorithm to enable all nodes in the whole structure to exchange data reliably in an environment without trust and approval. The speed of remote power communication is a key factor affecting the level of network service [13]. The reason why computers can achieve the goal of interconnection is that the host computer and the computer terminals are linked together through data transmission lines. In some public places, the network may be too slow, which may lead to serious data delay in the process of network data transmission. The Internet is an open communication platform, which is a unique attribute of network media. The monopoly era of traditional media communication is gone forever.

When forecasting and analyzing the core performance indexes in the mobile communication network, besides the general mathematical model, the influence of realistic factors should also be considered. The traffic volume carried by the power communication network also becomes larger and larger. The safety and stability of power communication network need more and more attention from relevant staff. For example, Table 1 shows the name node and data node sizes obtained from four operations. Fig. 2 shows the relationship between name node and data node size.

**Table 1. Name node size and data node size**

| Serial number | Name node size | Data node size |
|---------------|----------------|----------------|
| 1             | 36             | 1500           |
| 2             | 59             | 2400           |
| 3             | 64             | 4700           |
In a network with $h$ nodes, the sum of distances from one node to another node is generally not less than $h-1$, so the normalized tightness index is:

$$P_h = \frac{\sum_{i=1}^{h} \sigma_i^2}{\sum_{i=1}^{n} \sigma_i^2}$$  \hspace{1cm} (1)

The data point can make the minimum value of the distance from point $k$ to any point where the area compactness is higher than it:

$$U_{ij} = \frac{H_{ij}}{\sqrt{\sum_{i=1}^{k} H_{ii}^2}} , i = 1, ..., n, j = 1, ..., k$$ \hspace{1cm} (2)

The particle will update its velocity and position by:

$$I(X;Y) = \sum_{y \in Y} \sum_{x \in X} p(x,y) \log \frac{p(x,y)}{p(x)p(y)}$$ \hspace{1cm} (3)

There is the possibility that nodes with high density have no large value, but this is of great significance in data transmission. The degree values of some nodes are relatively small, but their parameters will be larger. When these nodes are maliciously attacked, the network architecture may collapse. Table 2 shows the data of node degree, compactness and parameters. Fig. 3 shows the correlation between node degree, compactness and parameters.

**Table 2.** Data of node degree, compactness and parameters

| Node degree | Compactness | Node parameter |
|-------------|-------------|----------------|
| Node degree | 1           | 0.86           | 0.42           |
| Compactness | 0.68        | 1              | 0.67           |
| Node parameter | 0.74     | 0.69           | 1              |
4. Summary

Energy Internet can be defined as a combination of multi-energy integration, information physics integration and multi-market integration. It will profoundly affect all aspects of energy production, transmission, storage and consumption in the future, and promote the efficiency and cleanliness of energy production and utilization. As the core of the energy Internet, the establishment of an efficient and reliable information transmission system must rely on the existing power communication system. However, facing various communication modes in the current communication system, how to realize the integration of multimedia heterogeneous networks is an important factor to improve the performance of the communication system. Extending the block chain technology into the energy internet to meet the needs of safe, credible and equivalent energy transactions can significantly reduce costs and promote the implementation of the energy internet. The development of block chain technology provides a good opportunity for the progress and promotion of energy Internet. It has become an important way to promote China's energy transformation, innovate the energy market mechanism, achieve energy conservation, emission reduction and sustainable development. It will have a profound impact on the entire energy industry and society.

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