

# *IEEE1588 Protocol in Information Transmission of Distributed Generation System*

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**Abstract:** With the development of modern power system, distributed generation also appears, and wireless communication technology plays an important role in it. This paper analyzes and studies the IEEE1588 private network transmission protocol. Firstly, the working principle and implementation method of the protocol are introduced. Secondly, the solutions and improvement schemes for the key links such as information data acquisition, processing process and signal power distribution in the transmission line are proposed. Finally, a complete distributed power system model is established by using MATLAB software and verified by simulation under the conditions of the designed communication channel parameters. The comparison and analysis of simulation test results show that the device has the following basic performances: (1) high reliability. (2) Good stability. When a fault occurs, it will not affect the stable operation of the whole network, and can provide users with reliable, efficient and safe power supply services.

## **1. Introduction**

Distributed generation has many advantages, such as resource saving and environment-friendly, but the power quality in China is not high. Therefore, in order to meet people's higher requirements for high-quality life and work season, the power system must improve its stability [1-2]. However, with the development of large-scale integrated circuit technology and the expansion of communication capacity, more new problems have emerged in the distributed power supply market. The traditional large bandwidth transmission mode can not adapt to the changes of the times and the challenges of network demand, and it also increases the burden of power grid construction [3-4].

At present, distributed generation technology has been widely used, such as the United States, Europe and other countries have relatively mature and advanced experience. China is still in the initial stage in this field. With the development of power electronics and microcomputer

communication system. Foreign countries focus on the test and analysis of the capacity and power characteristics of small-scale distributed wind turbines and have achieved some results. In China, the research and development of distributed power generation is mainly carried out in Beijing [5-6]. As for large-scale centralized energy power generation, Chinese scholars have proposed that China is currently in the stage of grid connection. With the acceleration of power grid construction, the growth of power demand of users, the development of new energy and other factors, how to realize the combination of centralized heating and decentralized coal-fired power generation has become an important issue. At the same time, many experts and researchers have conducted corresponding discussions and studies on this issue [7-8]. Therefore, this paper studies the IEEE1588 protocol and discusses the information transmission of distributed generation system.

Electric energy is the main energy form at present. With the large-scale application of distributed generation system, it has been widely used in power communication, energy storage devices and other fields. This paper is based on IEEE1588 protocol. Firstly, this paper introduces the principle and advantages of this technology. Secondly, it analyzes and discusses several common wireless transmission methods and their advantages and disadvantages, as well as the future development trends and prospects. Finally, a star network hierarchical multi degree distributed signal data fusion algorithm based on inverter topology is proposed to realize bidirectional communication of electric energy and improve the quality and reliability of signal line information interaction.

## **2. Discussion on IEEE1588 Protocol in Information Transmission of Distributed Generation System**

### **2.1. IEEE1588 Protocol**

#### **2.1.1. Basic Concepts**

In the wireless communication system, optical cable is a very important part. It is mainly used for information exchange and data transmission. The wireless access network can connect and share the signals of various places, so as to realize the functions of control, management and monitoring of the entire network. At the same time, it can also be used as a public place for remote services and local services. Therefore, we must understand its concept and deeply study its related technical issues to better complete the information interaction between the optical fiber network nodes in the wireless communication system. The distributed generation project proposed in this paper is a new energy access mode [9-10]. IEEE1588 protocol is a kind of distributed power generation. Its basic concept is to connect rechargeable batteries in the power system. It is different from the super capacitor and AC transformer used by traditional power producers in that the device directly transmits electric energy to the user side. When the power grid fails or the power generated under the influence of other factors cannot be supplied to the equipment requiring power in time, or part of the load is disconnected due to some reasons, the distributed power supply will provide backup capacity to the load to make up for this problem. The protocol involves the independent operation system between the distributed power supply and the distribution network, between the power factor converter and the load side converter, and between the two. This standard provides basic information and data support for each capacity level of the power system to meet the power demand of different users, and can also realize safe and reliable operation of distribution network equipment and relevant control units. Fig. 1 is a basic module composition diagram of IEEE1588 protocol.

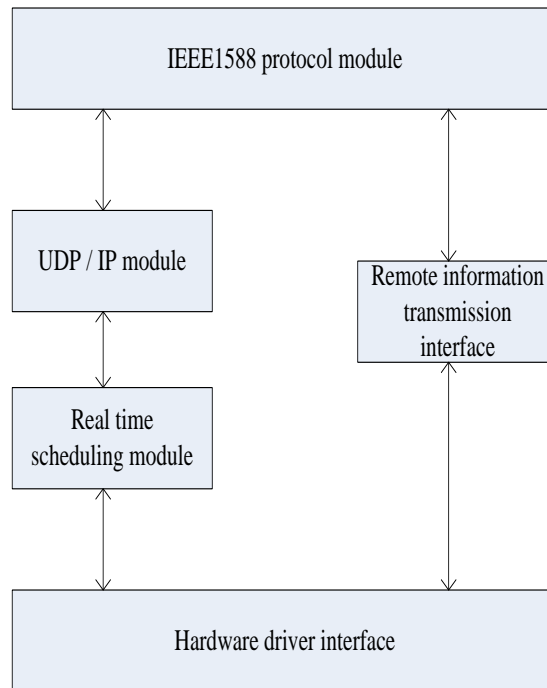


Figure 1. The IEEE1588 protocol module

### 2.1.2. Specifications

In this protocol, there are mainly two kinds of distributed access, one is centralized information transmission system. It consists of two independent power supplies and multiple backup batteries. When the power network fails, a unified standard is needed to protect and maintain the power network. When the power grid fails to operate normally in case of power failure, it needs to use services provided by another country or region to ensure the safe and stable operation of the power grid. At this time, IEEE1588 protocol will be adopted to regulate the information transmission requirements and implementation methods of these two distributed access systems. The main purpose of this protocol is to solve the problems of information communication transmission delay, data loss and network failure in distributed power supply system [11-12]. In terms of definition, it not only includes the related technologies involved in this group of messages and the development status of the power industry, but also includes some important parts, such as the connection module between the server and the power distribution device, the control strategy of the inverter and the design of the distributed power supply access circuit.

### 2.2. Effect of Distributed Generation on Information Transmission

Due to the large scale and large number of users generated by the combination of centralized heating and decentralized distribution, there are a large number of distributed energy supply terminals or power load centers in the system. In the power system, the distributed power supply is to provide power to users directly from the power grid, and send the power from the power plant to each user through the transmission and distribution network. Because different types of loads have different characteristics and effects. Therefore, in order to improve the transmission capacity of the power network, meet the needs of various power demands, and provide reliable basis for

dispatching, the role of distributed generation on information transmission is considered. Distributed generation is a new type of power generation technology. Its core content is distributed energy network, which can realize the comprehensive utilization of renewable energy, biomass energy and wind power. In the future, more new types and larger scale integrated circuits will be applied to power systems. By establishing a unified access point between the large power grid and the scattered regions, the problem that the load power demand cannot be met under the large-scale centralized load power supply mode can be solved. Through the distributed energy network, the distributed power generation system can realize effective control of power quality, capacity and stability. In the process of information transmission, the main function of the distributed energy system is to supply power to the power network, and monitor these power generation modes through communication technology and various control strategies. Therefore, it is necessary to realize the effective monitoring of related parameters such as the access mode, capacity and power of distributed power supply, so as to monitor the grid voltage in real time [13-14].

### 2.3. Distributed Information Transmission Algorithm

In the distributed power system, the signal is composed of different transmission channels, which requires high communication quality in practical application. Therefore, it is necessary to frame the signal. This algorithm can deal with different types of loads hierarchically. When the capacity of the access point is small, it can be divided into several independent units and connected to the distribution network terminal through the communication interface. If it is necessary to increase new nodes or reduce the number of new nodes in order to meet the higher requirements of networking operation, more bandwidth resources can be obtained. For distributed power generation, the non minimization cost function method is used in information transmission based on the standard layer to optimize the data flow parameters and related communication protocols among various nodes in the power network, However, in practical applications, it is necessary to match the network topology of the distributed energy transaction management system with the general architecture [15-16]. Fig. 2 is a flow chart of information transmission.

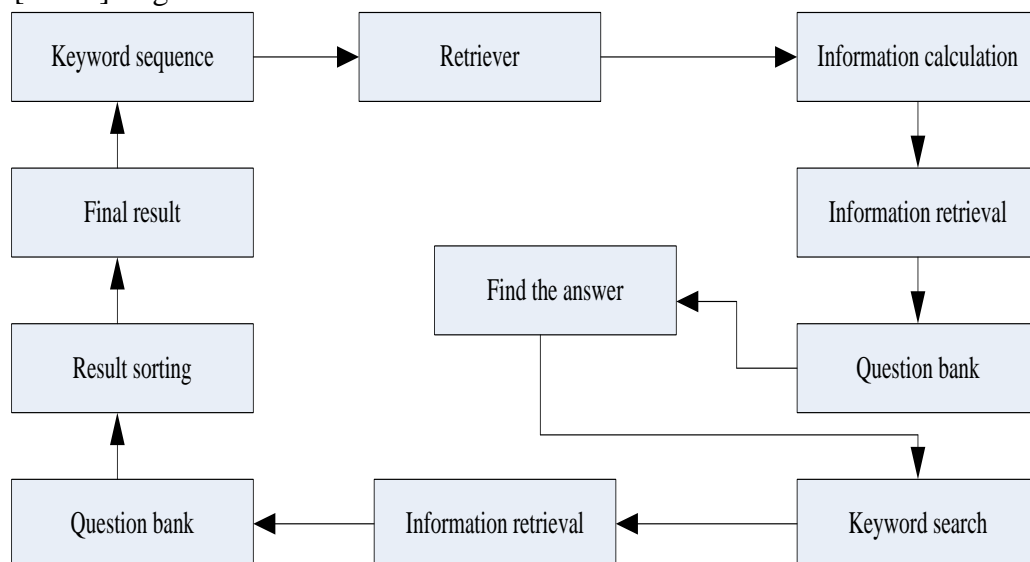


Figure 2. Flow chart of information transfer and retrieval

When power data is transmitted in distributed power system, the collected information must be

processed first, and then these signals are transmitted to the communication channel. This algorithm is a new technology based on the theory of probability and statistics. This method mainly includes the following methods. The first method is to establish a simple, reliable, safe, stable and separable wireless transmission between the signal source and the receiver with certain delay characteristics (i.e. the frequency is within the range of signal-to-noise ratio). The second is to extract the distribution parameters from the distributed power system, and then use the mathematical model to express the required information [17-18].

$$t_{offset} = t_{s1} - t_{m1} - t_{Delay} \tag{1}$$

$$t_{Delay} = [(t_{s2} - t_{m2}) + (t_{s3} - t_{m3})] / 2 \tag{2}$$

Since the communication protocol is implemented in layers, whether the time scale transmitted in the information is taken from the application layer, the data link layer or the auxiliary hardware circuit is directly used on the physical layer largely determines the synchronization accuracy that the protocol can achieve. The closer to the physical layer, the higher the time scale accuracy, and the higher the accuracy that the system can achieve.

### 3. Experimental Process of IEEE1588 Protocol in Information Transmission of Distributed Generation System

#### 3.1. Framework of Distributed Generation System Software

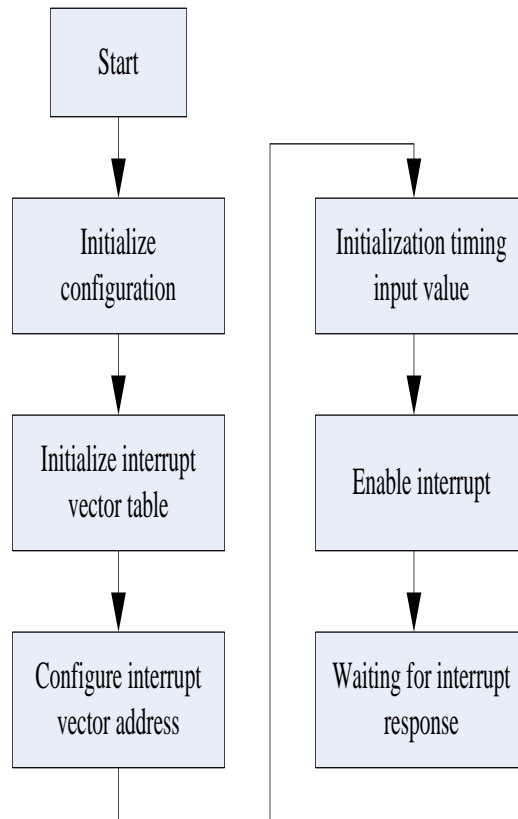


Figure 3. Distributed generation system software framework

With the access of distributed generation to the distribution network, the requirements for its information transmission are getting higher and higher. At the same time, some new problems will appear. These technologies are mainly based on the following aspects to realize multi-channel switch control, as shown in Fig. 3. In the traditional power system, the single loop feedback voltage regulation mode is usually used for signal frequency stability and amplitude stability. However, this method has certain limitations - it can not meet the requirements of bandwidth capacity and real-time load fluctuation when the distributed power supply is connected to the distribution network, so it needs to use other communication means to realize information transmission. The distributed generation system software framework is mainly composed of two parts: one is the program for the inverter and the main station, and the other is the monitoring system. We can define the network layer as a group of interconnected multi-channel switching devices, which are distributed power communication protocols and control interfaces connected together to form a unified and complete information interaction platform (Fig. 2). When the terminal is accessed, the network layer will detect whether the power grid operation is normal, and judge the load distribution and power factor to meet the different needs of users.

### **3.2. Information Transmission Function Test of Distributed Generation System**

The system is responsible for receiving, transmitting and processing the system information. The user will distribute it to the central controller in the distributed power module according to the dispatching command, and the central controller will control the communication of each terminal node. Packet detection is performed by using the IEEE1588 based backup capacity protection protocol. If there is a fault, it will return to the triggered state. If all the data are saved normally and the power is requested before the original address is restored, and the corresponding response signal is sent to the server to indicate that the group number has been activated but not consumed. The information transmission function of distributed generation system mainly refers to the collection and processing of data distributed in different access points, grid connected / household network, and the realization of communication between users and service providers. Through the test, it can be seen that the protocol provides a complete network structure and the interconnection relationship between various nodes within it. At the same time, it can also be found that there is a certain degree of information leakage between the access layer and the aggregation layer. The function of this module meets the basic performance requirements of users for data acquisition and processing. In addition, it also has certain fault tolerance and reliability indicators, such as load balance control, power supply stability monitoring and fault diagnosis capability, etc. it can also classify and sort the information of different types of distributed generation systems, and select appropriate access points according to the needs, providing reference for the next test equipment configuration and communication protocol formulation.

## **4. Experimental Analysis of IEEE1588 Protocol in Information Transmission of Distributed Generation System**

### **4.1. Analysis and Test of Information Transmission Function of Distributed Generation System**

Table 1 is the test data of information transmission function of distributed power generation system.

Table 1. Test of the information transmission function of the distributed power generation system

Number of information entries	Retrieval time(s)	Information transmission accuracy rate(%)	Information recall rate(%)
200	3	94	78
300	4	93	76
400	4	94	73
500	5	95	76
600	5	95	79

The main function of distributed power system is to provide stable, reliable, efficient and safe power supply to users. In the process of testing this topic, we must first ensure that the distributed generation system has good data transmission capability. Secondly, ensure that the device can work normally. Distribute electric energy according to user requirements. When the power network breaks down, it will be monitored by remote monitoring or direct patrol inspection, and the work status report will be reported to the dispatching center, so as to deal with the losses caused by emergencies in a timely manner. At the same time, corresponding functional modules can be installed in the system to realize data upload and exchange operations, and provide help for improving transmission efficiency. As shown in Fig. 4, through comparative analysis, it is found that the device has the following basic performance: (1) high reliability. (2) Good stability. When a fault occurs, it will not affect the stable operation of the whole network, and can provide users with reliable, efficient and safe power supply services.

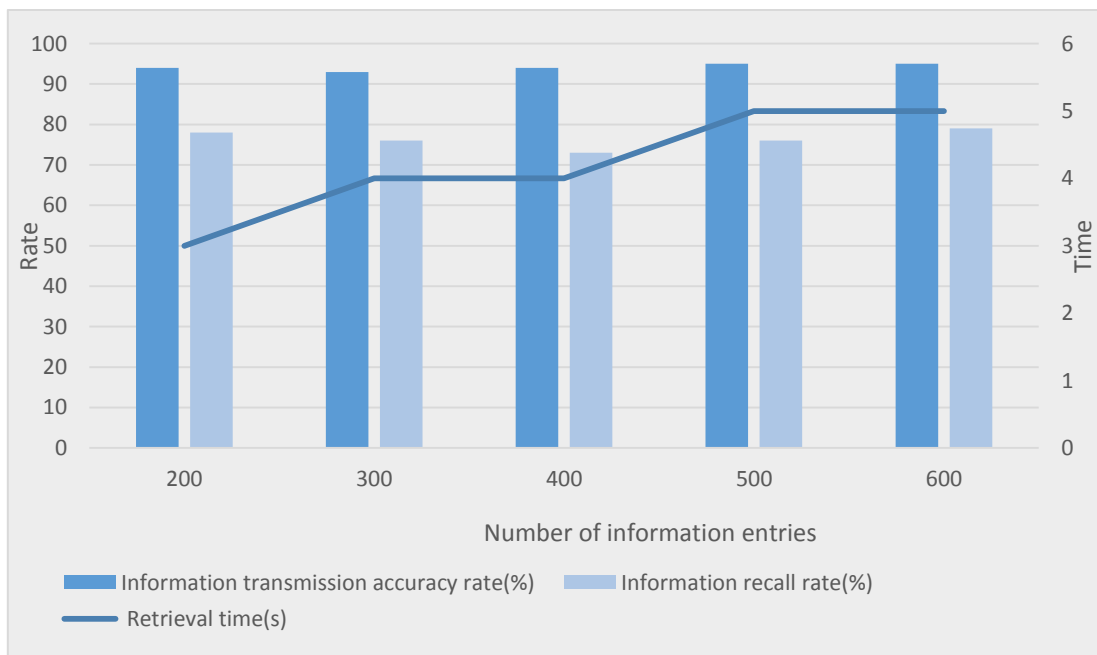


Figure 4. Function test

## 5. Conclusion

Distributed energy refers to the renewable energy that can be regarded as clean under certain

conditions. Distributed generation system has the advantages of large scale, low cost, high efficiency and low energy consumption. This paper mainly discusses the power electronic signal quality problem in the process of power data transmission in IEEE1588 protocol and how to improve the communication channel capacity to reduce the communication interference. Meanwhile, corresponding improvement measures are proposed for these technologies, and their feasibility and application prospects are analyzed and verified, providing reference and reference significance for solving the defects in the above research.

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### Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

### Conflict of Interest

The author states that this article has no conflict of interest.

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