

# Application Method of Communication Technology in Integrated Automation System of Substation

Lili Xu, Chundong Song, Danyang Li

Xilingol Vocational College, Xilin 026000, Inner Mongolia, China. E-mail: goodluck20081987@126.com

Subject: A key subject from Xilin Gol Vocational College, subject name: “Design of Integrated Automation Digital Communication System for Substations”, project number: ZD-2019-09, financial support

**Abstract:** Since its application in my country, the integrated automation system of substations has been rapidly developed and popularized. Its application range has covered medium and low voltage substations, even high voltage substations, and has achieved certain application effects. With the continuous development of my country’s power industry, higher and higher requirements have been placed on the automation level of the entire power system. As the heavy pressure link of the entire power system, the automation level of the substation system will directly affect the operation level of the entire power grid. This has also prompted the continuous upgrading of the integrated automation system of this substation. This article focuses on the development status of communication technology in the integrated automation system of substations, analyzes the characteristics and requirements of communication technology in substations, and discusses the application of communication technology in the integrated automation system of substations.

**Keywords:** Communication Technology; Substation; Integrated Automation System; Application

With the continuous development of computer technology, communication technology and automation technology, my country’s substation automation technology has also been rapidly developed and improved. At the same time, this technology has also been widely applied to my country’s power system. In addition to the construction of some new substations, Some old substations are being transformed into unattended automated operation. The smooth operation of this automation system is inseparable from the support of communication technology, and it is also an important development direction for the integrated automation system of the entire substation in the future.

## 1. The development status of communication technology in the integrated automation system of substation

The integrated substation automation system has been developed very rapidly once it was introduced into our country. This system has been widely used in my country’s new and old substations. The core of the automation system lies in the strong internal communication capabilities of the substation, which is inseparable from the substation automation communication technology. It is based on computer technology to connect the secondary equipment of the substation to the computer system to improve the automatic communication function and automatic monitoring function of the entire substation equipment. This technology started late in our country and was initially concentrated through a single-chip microcomputer. Processing data, so far, the interval control and independent control of each control layer have been realized, that is, each independent system is independently controlled under data sharing, so as to avoid large-scale failures of the entire system and improve the safety index of substation system operation<sup>[1]</sup>.

Copyright© 2021 Lili Xu *et al.*

doi: 10.18686/ah.e.v5i1.3133

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Although it is said that the substation automation communication technology started late in our country, and there is still a big gap between it and the world's advanced level, but it has also achieved some obvious results. For now, the substation automation communication technology is still facing in the development process some problems that need to be solved urgently. One is the contradiction in data collection, which is mainly reflected in the various subsystems of the integrated automation system of the substation. There is no unified standard for data collection. For example, protection devices require data collection without distortion and do not pay attention to data accuracy, while measurement and control devices are just the opposite. The data needs to be very accurate. If you want to resolve the contradiction between the two, you must collect data separately, which increases the workload. The second is that much electrical equipment in the integrated automation system of substations come from different suppliers, and the user agreements provided by these suppliers are different. This has brought some obstacles to the operation of electrical equipment. The practical problems faced in the application of the integrated automation system of substations are not conducive to the management and maintenance of the entire system, and need to be resolved in future research.

## **2. Characteristics and requirements of substation communication technology**

### **2.1 Fast response capability**

The integrated automation system of the substation needs to have the ability of real-time data transmission and rapid response. It can collect and feedback the real-time operation and control data of the entire system in time, so that the staff can judge whether the electrical equipment is operating normally. Once the data information is abnormal, the equipment will automatically make The corresponding emergency response ensures that the system quickly resumes normal operation and provides normal power supply services. The entire substation integrated automation system has strict data transmission indicators, among which the actual effect of data information transmission is the basic guarantee for the system to respond quickly, and it is also one of the basic requirements for substation communication technology.

### **2.2 High anti-interference**

The entire substation integrated automation system consists of a lot of electrical equipment. These equipments in the same space will produce different electromagnetic interference. In such an environment, network communication is also susceptible to interference sources, which reduces the quality of communication. Once the communication signal of the substation automation system is interfered, it will inevitably affect the transmission quality of the information and data. For example, the authenticity and accuracy of the data will be greatly compromised. This will cause the system to misjudge the operating status of internal equipment and eventually cause the staff Produce wrong operation, and bad consequences. Therefore, the application of communication technology in the integrated automation system of substations must have very high anti-interference performance to ensure the reliability of the entire system<sup>[2]</sup>.

### **2.3 Excellent compatibility**

Substations are distributed with various large and small electrical equipment. Each electrical equipment has electromagnetic waves. These electromagnetic waves create a strong electromagnetic interference environment, such as strong electromagnetic interference such as lightning, power supply, and tripping, as well as low potential difference interference. In this very harsh communication environment, data communication networks need to take certain measures to eliminate these interferences as much as possible. It is also best for various electrical equipment to have excellent compatibility, to minimize electromagnetic interference between them, and to provide a better network environment for substation communication technology.

### **2.4 Clear layered structure**

The initial integrated substation automation system adopted centralized microcomputer control. As the system was upgraded to the current hierarchical structure, the individual control of each subsystem was inseparable from the support of communication technology. At present, my country's integrated substation automation system is divided into substation level and bay level. These two structures need to be controlled by the data communication system to achieve the control of the entire substation automation system. In addition, each level in the system has its own special requirements. Each layer needs to be equipped with its own network control system.

### **3. Application of communication technology in integrated automation system of substation**

#### **3.1 Serial communication technology**

In my country's earlier integrated automation systems for substations, serial communication technology is usually used. This technology has exposed many shortcomings in the application process. For example, it is obvious that the rate of real-time transmission of large amounts of information is too low and not enough; The application of star topology structure is difficult to expand system sites and functions; when bus topology structure is adopted, it is difficult to achieve balanced transmission and multi-master network resource sharing; serial communication technology cannot complete the superior performance brought by multi-master settings. In view of this, the application of this technology requires a relatively complex and large-scale communication network to support, which cannot meet the upgrade requirements of substation automation systems. Therefore, various substation equipment manufacturers have adopted field-bus technology instead of serial communication technology.

#### **3.2 Field-bus technology**

Compared with serial communication technology, field-bus technology has much higher communication speed, reliability, real-time performance, and flexibility. So this technology has quickly become the mainstream communication technology in substation automation systems from application to development. However, in the specific application process, field-bus technology also has certain limitations. For example, when the number of communication nodes in a substation exceeds the limit, the performance of the entire network will decline rapidly and cannot meet the communication requirements of a large substation; another example is any failure point in the bus topology will cause the interruption of the entire network communication. This is not conducive to troubleshooting and diagnosis of fault points.

#### **3.3 Ethernet technology**

The intercommunication and sharing of information is the need of the progress of the times. In order to meet this demand, network communication technology has developed rapidly. Among them, Ethernet technology and Internet technology have developed the most momentum and have become the two most important network technologies. In particular, Ethernet has a relatively mature application environment, a relatively advanced network competition mechanism, a relatively low price, and a relatively open user protocol. It has established the leading application network status in the LAN field and has become the current standard for LAN applications. Applying to various fields is also the development trend of local area network communication in the integrated automation system of substation.

#### **3.4 Dual network communication technology**

The topological structure of network communication includes star topology, bus topology, and ring topology. Among them, star topology is used more, mainly because its connection points, access methods and access protocols are relatively simple, and when a single site When a failure occurs, only a single site will be affected, which is convenient for the staff to troubleshoot and repair, and will not cause the interruption of the entire network. However, the star topology has very high requirements for the stability and reliability of the Hub. Once a problem occurs in the Hub, the entire network will stop operating. Therefore, in order to improve safety performance, substations usually use dual-network communication technology.

### **4. Conclusion**

The use of the integrated automation system of the substation not only provides convenience for the daily management of the staff, but also improves the safety index of the operation of the electrical equipment of the entire substation. Communication technology, as a key link of the system, directly affects the transmission performance of the network. Therefore, continuously strengthening the research and development of communication technology is the key to promoting the wider and more in-depth application of the integrated automation system of substations, and has important positive significance for improving the development of my country's grid system.

### **References**

1. Yang Q, Huang J, Shi Y. Current status and development of substation automation communication technology. *Power System Equipment* 2019; (10): 51-52.
2. Ding H, Zhu N, Ren Y. Research on internal network communication technology of substation automation system. *Communication World* 2019; (8): 311-312.