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Intelligent power service and improvement analysis of communication network based on SDN

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Abstract. As the carrying network of electric energy, the power grid is the foundation of the national industry. For the implementation of the "Internet plus" strategy, there is an urgent need for a new network communication technology to improve the traditional power communication network, and to make up for the original defects. This paper mainly analyzes the new demands of new intelligent power business of communication network. Then, the limitations of existing power communication network and power distribution equipment are explored. At last, It put forward the basic scheme of using SDN technology to improve the existing power communication network, which provides a train of thought for the design of intelligent power distribution system based on SDN Technology.

1. Introduction[1]

Power communication network is the basis for the development of strong smart grid. In recent years, the new power business has many characteristics, such as a variety of services, high flexibility and strong interactivity. It requires that the power communication network not only has a powerful core network, but also has a high flexibility, high scalability edge access network. But the current power communication network is mainly SDH/MSTP backbone network, which network flexibility and business scheduling ability is insufficient. It is difficult to meet the demand for intelligent distribution and electricity business[1].Therefore, this paper uses the SDN technology to improve the existing power communication network, and establish an open, active intelligent power communication network, which will create favorable conditions for the future development of intelligent power business.

2. Research on new intelligent power service

Smart power service is a new generation of power business with high intelligence, real-time interaction and informatization, relying on advanced measurement technology, mobile Internet, artificial

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intelligence, big data, cloud computing and other emerging technologies. In recent years, with the rapid development of new energy technology and Internet technology, the new network communication technology is rapidly integrated into the grid, resulting in a variety of new power distribution business [2], as shown in the Figure 1.

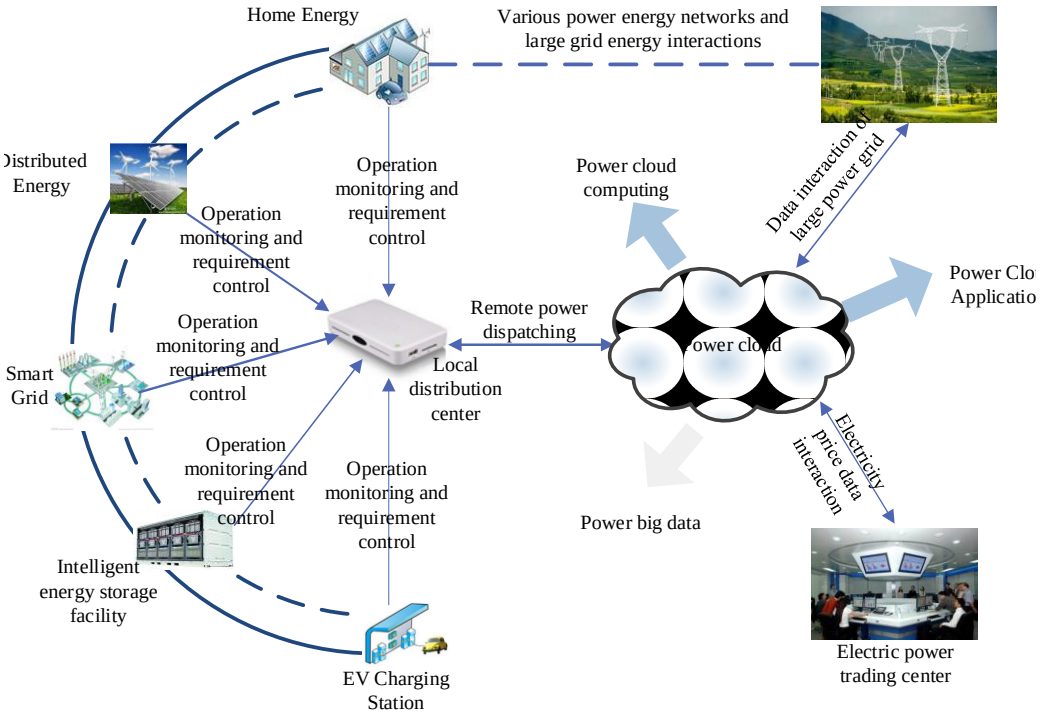

Figure 1. New intelligent power business.

In the future, the communication network is essential for efficient, centralized management of a large number of intelligent power business and unified coordination of multiple energy sources.The flexible and open features of intelligent power services have brought severe challenges to the existing power communication networks.

3. Demand analysis of communication technology for smart power services

3.1. Network real time requirement

In the expanding and increasingly complex smart grid and energy Internet, to ensure the transmission delay of the power communication network is crucial for the reliability of the distribution automation and the experience of intelligent power distribution service. Intelligent transmission delay requirements for different power services are shown in Table 1 and table 2.

Table 1. Real time index of intelligent power power businesses.

Businesses	Index
Feeder automation service	Time delay ≤60s
Monitoring of intelligent energy storage station	<1s
Distributed new energy station control	<1s
Load forecasting of new energy station	<60s
Smart electricity meter	<60s
Operation state measurement of power equipment	<3s

Table 2. Ductility index of power monitoring system.

Communication protocols	Packet loss rate	Network delay（ms）	Delay jitter（ms）
TCP	≤1/100	≤200	≤50
UDP	≤1/1000	≤500	≤100

Different power distribution services have different requirements on the delay size. Therefore, the intelligent power distribution service needs the communication network to configure the delay of the network link according to the real-time requirements of different business[3], so as to ensure the service quality of the intelligent power business.

3.2. Network reliability requirements

Most of the outdoor communication facilities need to ensure stable operation in severe weather, so as to provide high reliability information transmission channels. Especially, the development of smart power distribution business depends entirely on the communication network, Once the communication network fails, all services will be paralyzed. Therefore, the intelligent power distribution service requires that the communication network has the ability of flexible migration and fault isolation. Once a part of the physical network fails, the network can intelligently isolate the fault area and quickly restore the network service.

3.3. Network scalability requirements

Communication network is the foundation of intelligent power business, and the existing communication network of distribution automation and power service is constructed separately. Once the business is increasing or changing, it is necessary to re-establish the physical network and configure the network devices one by one. With the explosive growth of the types of smart power services, the original mode can not meet the demand, which requires the communication network architecture and function can be flexibly extended to shorten the new power business deployment cycle [4].

3.4. Network compatibility requirements

Intelligent power distribution including power grid operation, power marketing, network maintenance and other services, including data communications, business monitoring, customer interaction and other diverse functions. At present, all kinds of power business and application come from independent and scattered platforms. The communication protocols and information interaction

methods of each system are different, which leads to the difficulty of joint operation between various services and functions, and increases the difficulty of the unified implementation of intelligent power business [5-7].Therefore, it is very important to establish a new type of power distribution communication network which is compatible with protocol and bidirectional interaction.

4. Analysis of the limitations of power communication network for intelligent business

The current electric power communication system in the construction of backbone communication network management and maintenance system has been perfect, and all the 10kV communication access network has EPON, carrier, wireless and many other ways. There are many equipment manufacturers and different communication systems[8]. In supporting the future of the energy Internet in the smart power distribution business development, the limitations of the existing power communication network include the following aspects:

In architecture, the existing communication network contains a huge number of dedicated network nodes and equipment functions, many network vendors have their own hardware and software gateway platform unique, can only realize data exchange, but difficult to achieve unified control network and equipment, resulting in complex network, poor flexibility[9].

In terms of technology, the current power communication network formed a block of hardware and software integration tightly coupled structure, resulting in new business development for a long time, new technology development is complex, network scalability is insufficient.

In the network construction and operation maintenance, network managers face a large number of equipment, their time, manufacturers, models are different, leading to subsequent deployment, configuration, operation, maintenance and transformation and upgrading can not be centralized and unified, resulting in network construction and operation and maintenance is very complex

In terms of power distribution business support, there is a big difference in the business service quality requirements of various power services, and the existing power communication network is difficult to configure flexibly, which can not meet the personalized requirements of various services [6].

The traditional communication network is difficult to effectively solve the intelligent electric business deployment requirements. Therefore, an innovative power communication network is needed to overcome the shortcomings of the existing communication network that can not be centralized control, lack of openness and flexibility, and create good network conditions for the development of intelligent power services.

5. The characteristics of SDN technology and its application advantages in power communication

SDN is an innovative network model based on software. The most obvious feature is that it separates the management and control part of the network and the data forwarding layer, and supports the centralized control of the network. It can be transparent to the application of the underlying physical facilities relative to the upper layer network. The software defined network architecture based on OpenFlow consists of three layers, as shown in Figure 2.

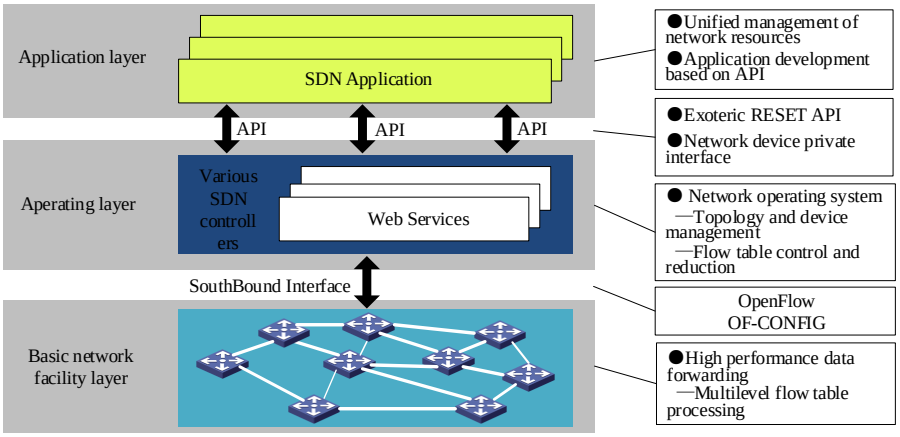

Figure . 2 Software defined network three layer model.

One of the key technologies of SDN is the OpenFlow protocol. It is a protocol of device specification, defines the components and functional requirements of the OpenFlow standard switch in the basic network facilities layer, and the OpenFlow protocol used to accomplish the remote controller's control and management of the switch.

6. Improved scheme of intelligent communication network for electric power service based on SDN

According to the needs of the new electric business, through the analysis of the previous sections, you can use the SDN network architecture model to replace the existing electric power communication network, So that the network operator can control the network resources from the overall situation, can dynamically configure the network delay, software configuration network equipment parameters, real-time expansion of network scale and so on. Therefore, the use of SDN technology to improve the current power distribution communication network, can achieve centralized control of the network, unified deployment of resources. At the same time, its programmable features can also enhance the openness and flexibility of the network, accelerate business innovation.. The improvement idea of power communication network is shown in Figure 3.

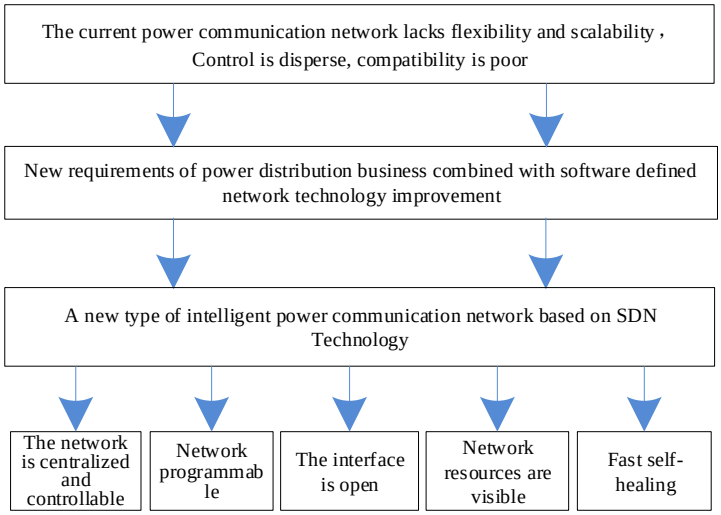

Figure 3. Basic idea of improving power communication network by SDN Technology.

7. conclusion

This paper first explored the intelligent electric business in new energy Internet demand for electric power communication network. Then, analyzed the limitations of the existing power communication systems on the development of intelligent power services. Combined with the characteristics and advantages of SDN technology, this paper put forward the basic scheme to improve the current communication network to adapt to the development of intelligent power business by using SDN technology, and created favorable conditions for the future development of intelligent power business.

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