Intelligent Operation and Maintenance Control Platform for Energy Internet Analysis

Guzainuer · aizaizi*, Liang Bai, Zhijie Liu, Pan Xudong, Yedeli · bolati

State Grid Xinjiang Electric Power Co., LTD. Information and Communication Co., Urumqi, Xinjiang ,830000, China

*Corresponding author's e-mail: g185994333262@163.com

Abstract. This paper deeply analyzes the application of intelligent operation and maintenance management and control platform in the energy Internet, and discusses its technical level composition and development mode. Firstly, the concept and development trend of energy Internet are introduced, and then the hierarchy composition of intelligent operation and maintenance control platform is introduced in detail, including equipment level, subsystem level and total system level. Then, the paper focuses on the technology application of energy Internet in the intelligent control platform, including heterogeneous terminal data access technology, portrait technology, container-based cloud platform technology and component release method supporting multi-transmission protocol. Finally, the development mode of the distribution network operation analysis platform is discussed. Through the research of this paper, the importance and application value of intelligent operation and maintenance control platform in the energy Internet can be better understood.

Keywords: Intelligent; operation and maintenance control platform; energy Internet

1 INTRODUCTION

With the rapid development of the energy Internet, the traditional energy supply and consumption mode are facing great challenges and changes. In order to better realize the efficient utilization and sustainable development of energy, the intelligent operation and maintenance control platform has become one of the key technologies in the construction of energy Internet.[1] By collecting, processing and analyzing big data, the intelligent operation and maintenance control platform realizes the real-time monitoring and fine management of the energy system, so as to improve the energy supply efficiency and use effect.

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A. Haldorai et al. (eds.), *Proceedings of the 2024 3rd International Conference on Artificial Intelligence, Internet and Digital Economy (ICAID 2024)*, Atlantis Highlights in Intelligent Systems 11,
https://doi.org/10.2991/978-94-6463-490-7_55

2 ENERGY INTERNET OVERVIEW

The development of the energy Internet is to deal with the challenges and changes of the traditional energy supply mode. The traditional energy supply mode mainly relies on centralized energy production and large-scale energy transmission, which has problems such as energy waste and environmental pollution. Through the application of information and communication technology, the energy Internet has realized the comprehensive interconnection between energy production, transmission, storage and consumption, and optimized the allocation and coordinated management of energy resources, so as to realize the efficient utilization and sustainable development of energy.[2]

The key features of the energy Internet include the following aspects:

(1) Clean: The Energy Internet encourages the development and utilization of clean energy and reduces the dependence on traditional fossil energy. By the integration of renewable energy such as solar energy, wind energy, water energy, etc., to achieve the efficient use of clean energy.

(2) Low carbonization: The Energy Internet promotes the low-carbon transformation of the energy system and reduces the emission of greenhouse gases such as carbon dioxide. Reduce carbon emissions by improving the energy efficiency of energy systems and using clean energy.

(3) Intelligence: With the help of advanced information and communication technology, the energy Internet realizes the real-time monitoring and fine management of the energy system. Through big data analysis, artificial intelligence and other technical means, to predict energy demand, optimize energy scheduling, and improve the operation efficiency of the energy system.

(4) Security and reliability: The energy Internet reduces the vulnerability and risk of the energy system through the construction of a multi-source and diversified energy supply system. At the same time, the intelligent operation and maintenance control platform can monitor the operation status of the energy system in real time, find and solve potential problems in time, and ensure the safety and reliability of energy supply.

3 THE HIERARCHICAL COMPOSITION OF THE INTELLIGENT OPERATION AND MAINTENANCE CONTROL PLATFORM

3.1 Equipment Level

As the basic layer of the intelligent operation and maintenance control platform, the equipment level includes all kinds of equipment in the distribution network, mainly including distribution lines, transformers, metering terminals, etc. This level mainly carries out real-time monitoring and management of various equipment in the distribution network through data sharing and communication between equipment.[3] The data collection and analysis capability at the equipment level can reasonably coordinate various services according to the actual needs of the distribution network, so as to ensure

the normal operation of the distribution network. Through data collection and processing, the equipment level can also find the abnormal situation of the equipment in time to provide support for preventive maintenance.

3.2 Subsystem hierarchy

As an important part of the intelligent distribution network operation and maintenance control platform, the subsystem level mainly involves substations and other facilities at all levels. This level is mainly responsible for the monitoring and management of the subordinate distribution system, while providing real-time data and operational status information to the superior system. The subsystem level will screen and integrate all kinds of the data received, and conduct scientific control based on its own operating state, so as to improve the stability and reliability of the system. In addition, the subsystem level will also send decision information to the associated equipment to ensure the coordination and efficiency of the distribution network operation.

3.3 Total system level

In the intelligent distribution network operation and maintenance management and control platform, the total system level has the highest level and has the highest control right.[4] This level is responsible for the comprehensive evaluation and processing of all the information in the intelligent system. Through data analysis and mining, the total system level can put forward the final decision instructions. These decision instructions will serve as the guidance basis for the business processing of the operation and maintenance personnel to help them better manage the distribution network operation and maintenance. Through the centralized management and control at the total system level, the comprehensive optimization and efficient operation of the distribution network can be realized.

Table 1. Hierarchical composition of the intelligent operation and maintenance control platform.

levels and ranks	function
Device level	Responsible for data collection and equipment monitoring, including sensors, data collectors and other equipment
Subsystem hierarchy	Responsible for the monitoring and management of each subsystem, such as power system, gas energy system, hydropower system, etc
Total system level	Responsible for the comprehensive control and optimal scheduling of the entire energy Internet

4 THE APPLICATION OF ENERGY INTERNET TECHNOLOGY IN THE INTELLIGENT MANAGEMENT AND CONTROL PLATFORM

4.1 Heterogeneous terminal data access technology of energy Internet

The heterogeneous terminal data access technology of energy Internet, through the principle of "four unified" —— unified Internet of things information model, communication protocol, data transmission and storage standardization, to achieve the unified access of all kinds of data. This technology uses IEC61850 communication architecture to realize the remote control of the control room and the equipment in the station, and is compatible with communication rules such as 103 and 104, integrates field communication, private network, agent network, etc., to solve the access problems caused by the diversity of equipment. This technology eliminates the difference of the underlying communication protocol, improves the efficiency and accuracy of data calculation, and provides a solid foundation for the functions of online monitoring, equipment control, temperature and humidity management, and power quality evaluation.

4.2 Portrait technology

Portrait technology is a powerful tool to integrate customer needs and platform guidance. Relying on the big data of the distribution network, we have built an accurate customer portrait algorithm architecture. With the help of big data technology and machine learning models, we deeply analyze the characteristics of user energy data and digitize user characteristics. At the same time, multi-dimensional label integration technology is used to integrate 34 categories and 218 sub-categories of customer labels to build a "label cloud" and form a three-dimensional customer image.[5] This helps the platform to fully display the characteristics of customer behavior, provide customized and differentiated energy service solutions for different customers, and realize intelligent services. Applying portrait technology, we first obtain customer information, including documents, electronic data, etc., to lay the foundation for the follow-up accurate services.

4.3 Cloud platform technology based on container technology

The container-based cloud platform technology takes the minimum container as the scheduling unit. Through the coordination and arrangement of each single container, the compilation and processing of the third-party application package is realized, so that the containers can be isolated and run. In terms of external data access, the load equalizer is used to control the permission verification of business access requests. Through the application of container cloud platform technology, we can solve the system server slow operation, low resource utilization, large memory required for mirror storage, and long running instance migration and adjustment time. The application of

this technology improves the flexibility and scalability of the system, enabling the distribution network system to better respond to various business needs and changes.

4.4 Component release method supporting multiple transport protocol

In the field of remote service calling technology, the platform is compatible with multiple technology protocols. Using the component release and containerization technology, release the simple components of the platform, while isolating the components and transmission protocols, to ensure the independence. The process of publishing the multiple transmission protocol components is shown in Figure 1. Specific steps: ① Store qualified components: check and coexist in the corresponding directory.② Unload the container subthread: decompress the third-party package stored in the peer directory.③ Add file path: the component name, user name, and call path are added to the configuration file.④ Update instance: Update the thread to add a new service instance as per the protocol. Through these operations, the platform can achieve an efficient operation.

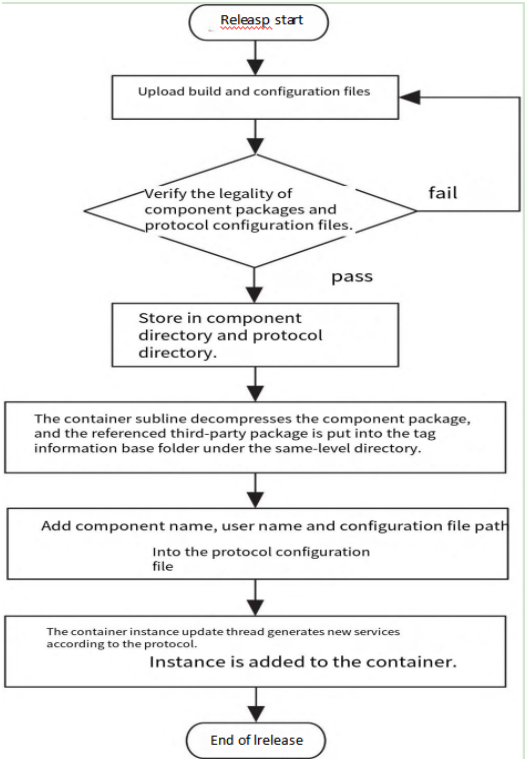

Fig. 1. The component release step.

5 DEVELOPMENT MODE OF POWER DISTRIBUTION NETWORK OPERATION ANALYSIS PLATFORM

The development mode of the operation and maintenance platform system is a mode integrating software and hardware, which aims to realize the operation analysis function of the distribution network by combining the internal server, the network switch, the dispatching communication equipment and the background monitoring system of the substation. This integrated integration can ensure the smooth collaboration between hardware and software, and improve the stability and reliability of the system. The structure of the hardware platform system is shown in Figure Figure 2.

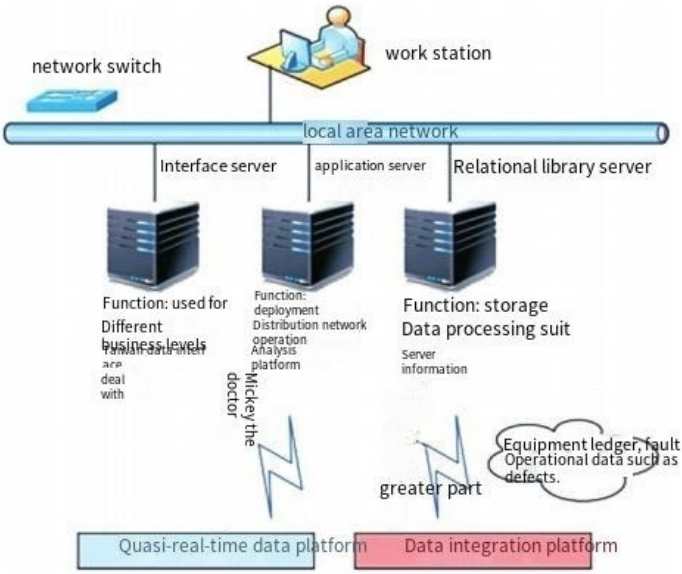

Fig. 2. Hardware platform development.

The software system of the operation and maintenance platform includes four main levels: business layer, application layer, data layer and data bottom layer. In these four levels, the data layer plays a crucial role, providing a matching data interface for various business systems to ensure that the system can obtain the required data. Through the comprehensive processing of data extraction, cleaning, fusion, caching and mining analysis, we are able to build a new database to support the development and utilization of the application layer. The software development mode of this operation and maintenance control platform is shown in Figure 3.

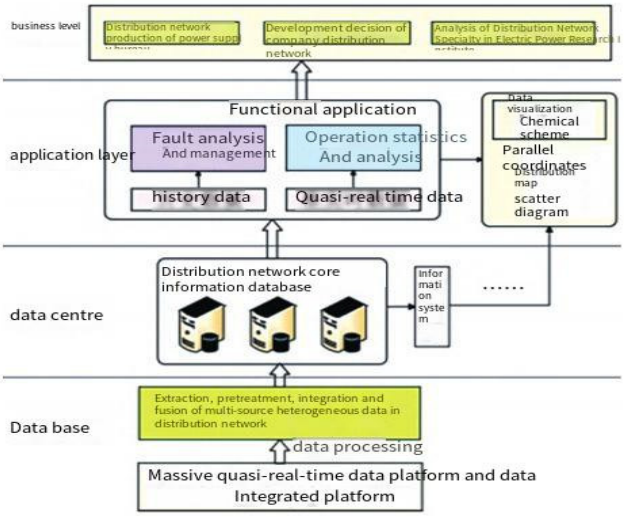

Fig. 3. Software platform development.

6 EPILOGUE

Intelligent operation and maintenance control platform has important application value and promotion prospect in the energy Internet. Through the real-time monitoring and fine management of the energy system, the efficient utilization and sustainable development of energy can be realized. In the future, with the continuous development of artificial intelligence and big data technology, the intelligent operation and maintenance management and control platform will play an increasingly important role in the energy Internet.

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