Research on data structure of intelligent watt hour meter quality data service platform

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Abstract. This article introduces the basic situation of smart meter quality data, and designs the overall architecture of the smart meter quality data service platform based on the information requirements of the quality data of the entire chain of smart meters. And the data flow direction of each link is explained in detail. Finally, it looks forward to the further development of the platform and its application in actual business.

1. Introduction

After the comprehensive promotion of smart meters, the number continues to increase. Therefore, State Grid Corporation of China started the research on smart meter sorting in April 2017, and gradually carried out fault analysis of disassembly and inspection business according to the disassembly and inspection business. At present, the content of the fault database is not complete, and it is not included in the fault data of electric energy meter verification and detection business and field investigation. At the same time, the reliability and robustness of the software are not considered in the preparation of the watt hour meter software. The data between the meter manufacturer and the power company is not shared, and the quality of each link in the whole life cycle of the design is not the same. The manufacturing and operation of the intelligent watt hour meter lacks the comprehensive control of the control points. There are many unexpected failures in the operation of the smart meter, and the company is faced with greater operational risk and operation maintenance cost and public opinion pressure.

Taking smart watt hour meter as the breakthrough point, it is necessary to establish an ecological environment with global coverage, data fusion, resource sharing, safety and credibility, and win-win situation from all parties, and form a hub for gathering all kinds of resources, so as to realize the collection and sharing of quality data of all categories and links. Through the business process, data flow and information flow between relevant parties, the quality development direction of the electric energy meter industry can be led, and the construction of the energy meter industry can be promoted The quality ecological system covering the whole industry chain of electric energy meter industry has laid a solid foundation. Improve the quality of smart meters, improve the technical quality level of the industry, promote international cooperation, establish the international quality credit of China's smart meter products, and gradually narrow the gap with international high-end products.
2. Technical architecture of quality data Service Platform for intelligent electricity meters

The intelligent watt hour meter quality data service platform includes information management area part and Internet area part, which are deployed in information intranet and information extranet respectively. The information intranet includes big data platform, which is used to store the whole chain quality data and conduct big data analysis and processing. The external information network includes quality data credible acquisition system, digital factory system, intelligent watt hour meter quality data service system, operation management system, etc., which stores the calculation result data after desensitization of production enterprise side and power company side. The security of data interaction is ensured by the security isolation gateway between the information management area and the Internet area. Quality data edge acquisition terminal is deployed in production enterprises. The technical architecture of the platform is shown in Figure 1.

![Figure 1. Technical architecture of the platform](image)

3. Data architecture of smart meter quality data service platform

The overall data structure of the platform is shown in the figure below. The data is divided into production enterprise side data and power company side data. Data flow on the production enterprise side: The raw data on the production enterprise side is uploaded by the quality data collection device to the equipment quality data credible collection system, and is provided to the smart power meter quality data service system and the digital factory service system, and passes through the isolation gatekeeper Big data platform transmitted to the information intranet. The data flow direction of power company side is from sg-mds system and the management and control platform of headquarters acquisition master station to big data platform. The analysis and processing results of the whole chain quality data are transmitted from the big data platform of the information intranet through the isolation gate to the information external network. The operation management system is based on the data of intelligent watt hour meter quality data service system and digital factory service system. As shown in Figure 2.
3.1. Data flow direction from equipment / system of production enterprise to quality data acquisition device

The master node device interacts with the sub node device through HTTP protocol data. The sub node device communicates with the equipment through the standard Modbus protocol data. MES system of production enterprise uses JSON format data to exchange data through the open interface of master node device. As shown in Figure 3.

3.2. Data flow direction from quality data acquisition device to equipment quality data credible acquisition system

The terminal application of quality data acquisition device converts the incremental data (timing: a period of time) of production enterprises into object model data and uploads them to the equipment quality data credible acquisition system. As shown in Figure 4.
3.3. Data flow direction from equipment quality data credible acquisition system to intelligent watt hour meter quality data service system

The cloud product flow rules are configured on the Internet of things platform, and the specified fields of the specified topic messages are transferred to the destination for storage and calculation. Based on the IOT platform, the device provides IOT SDK, connects to the IOT platform, and reports data to the IOT platform. According to the data flow rules, the IOT platform processes the data in the topic through SQL and forwards it to the message queue (Kafka). Data service platform consumes message queue to realize high reliable consumption of data. As shown in Figure 5.

3.4. Data flow from smart meter quality data service system to intranet big data platform

The integration between smart meter quality data service system is application integration, which uses microservice API to request service; the intelligent watt hour meter quality data service system
integrates with the intranet intermediate database platform in the way of database table replication; the intermediate database and big data display platform are integrated in the way of kettle; the big data platform adopts the storage process Line integration. As shown in Figure 6.

![Figure 6. Data flow from smart meter quality data service system to intranet big data platform](image)

3.5. Data flow from intranet big data platform to smart meter quality data service system

The integration between smart meter quality data service system is application integration, which uses microservice API to request service; the intelligent watt hour meter quality data service system integrates with the intranet intermediate database platform in the way of database table replication; the intermediate database and big data display platform are integrated in the way of kettle; the big data platform adopts the storage process Line integration. As shown in Figure 7.

![Figure 7. Data flow from intranet big data platform to smart meter quality data service system](image)

3.6. Data flow from equipment quality data credible acquisition system to digital factory service system

The cloud product flow rules are configured on the Internet of things platform, and the specified fields of the specified topic messages are transferred to the destination for storage and calculation. Based on the IOT platform, the device provides IOT SDK, connects to the IOT platform, and reports data to the IOT platform. According to the data flow rules, the IOT platform processes the data in the topic through SQL and forwards it to the message queue (Kafka). Digital factory service consumption message queue to achieve high reliable consumption data. As shown in Figure 8.
3.7. Data flow from quality data service system of smart watt hour meter to operation management system

1) Data conversion between end users and Internet regional operation and management platforms; data content includes business request data, operation and maintenance management data, which is generated by user interaction such as app and Internet, and the data is presented to users in real time, with bandwidth requirements of more than 1Mbps;

2) Data conversion between Internet regional operation management system and Internet regional intelligent watt hour meter quality data service system; data content includes service data, business data and message data between applications; data is stored on data service platform for operation management; data interaction between Internet regional operation management platform and Internet regional data service uses cache, message queue, API gateway and so on. The data is transmitted in real time with bandwidth of more than 1Mbps;

3) Data conversion between Internet regional operation management system, smart meter quality data service system and application hosting system; data content includes the whole life cycle data of application service, log data of user operation and data service, monitoring data of application system, and alarm data in case of abnormal occurrence, with data volume of about 2T (calculated by half a year); Internet The data interaction between regional operation management system, smart meter quality data service system and application hosting system adopts Alibaba Cloud Architecture, real-time communication, and bandwidth requirement is more than 10Mbps. As shown in Figure 9.
3.8. Data flow from digital factory service system to operation management system
The operation management system pushes data to the digital factory service system for application on the shelf. Users obtain information from the operation management system through the digital factory service system, such as obtaining the application service list, and subscribing to the service from the application list through restapi. As shown in Figure 10.
4. Conclusion
The smart meter quality data service platform aims to get through the quality data of related parties (power companies, production enterprises, government and regulatory agencies). The quality data not only covers the manufacturing quality data of R & D and design, material procurement, production manufacturing and ex factory supply of production enterprises, but also covers the operation quality data of acceptance testing, storage and distribution, installation and operation, demolition and scrapping of power companies.

The intelligent energy meter quality data service platform takes the entire chain of intelligent energy meter quality data collection, integration, and analysis as the main line, using modern advanced technologies such as cloud computing, big data, Internet of Things, mobile Internet, artificial intelligence and blockchain to collect the quality data of production enterprises, power companies and other parties can open up the business flow, data flow and information flow between all relevant parties to realize the safe and reliable data of smart electric energy meters, efficient coordination of multiple parties, and reasonable value distribution. The government and the public provide information support and quality services, promote the improvement of the quality level of the smart electric energy meter industry, and promote the common development of the upstream and downstream of the industrial chain.

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