Research on the Framework Design of NQI Service Cloud Platform in the Field of Smart Grid Measurement

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Abstract—The quality control of smart meters exists in production enterprises and power grid companies respectively. Their data are not connected, which leads to the lack of comprehensive control in the whole life cycle of smart meter design, manufacturing and operation scrap, which results in the overall quality level of smart meter industry is limited. The NQI service cloud platform in the field of smart grid measurement takes cloud computing technology as the core and NQI quality service as the process to mine and analyze the quality data of smart meters in the whole life cycle, so as to achieve the overall quality improvement of smart meter industry. In this paper, the service cloud platform architecture is designed by analyzing the service scenario, the quality evaluation index system and the data model of intelligent power meter.

1. INTRODUCTION
At present, the quality control and management of smart meters exist in production enterprises and power grid companies respectively. There are some problems, such as weak systematization, lack of coordination, lack of overall technical solution ability and so on. In order to give full play to the basic role of National Quality Infrastructure (NQI) in the overall quality improvement of intelligent energy meter industry, around the overall quality improvement, with the idea of quality collaboration between upstream and downstream enterprises in the supply chain of intelligent energy meter, carry out the design of NQI service cloud platform to support the quality improvement of intelligent energy meter, so as to realize the multi factor, multi-dimensional, whole process quality data collection and Quality monitoring, providing all-round services for the government, the public, power companies, production enterprises, etc., and promoting the overall improvement of the quality level of smart meters. [1-3]

The NQI service cloud platform in the field of smart grid measurement (hereinafter referred to as "NQI service cloud platform") adopts the concept of platform, integrates cloud computing and intelligent power meter quality service business, takes cloud computing technology as the core and NQI quality service as the process, realizes the storage and processing of massive quality data of intelligent power meter, improves the efficiency of quality data mining and utilization, and realizes the Overall
quality improvement. Based on the analysis and research of service scenario, intelligent power meter quality evaluation index system and intelligent power meter data model, this paper proposes the design requirements of the cloud platform, and designs the cloud platform architecture design scheme, data storage design and data processing scheme. [4-8]

2. NQI SERVICES CLOUD PLATFORM SERVICES AND DATA ANALYSIS

Through the analysis of service scenario, evaluation index and data model, the quality big data of intelligent power meter has the characteristics of diverse data services, high data quality requirements, wide data association and many business types. Data service objects are diverse, and different application scenarios have different requirements for data content and processing methods. The NQI service cloud platform is built based on the cloud computing platform, and uses big data related technologies to manage quality data in a unified way, realize unified data access, storage, management and sharing functions, and realize quality data sharing supporting multiple services. NQI service cloud platform mainly includes cloud platform, data sharing platform, data processing support platform, etc. [9-10].

2.1. Service scenario analysis

The application scenario design of NQI service cloud platform should fully consider the needs of grid companies, production enterprises and government departments, and carry out overall planning and design of NQI service cloud platform service scenario. The main purpose of service grid company: to promote the improvement of quality system construction, improve the quality control level of power companies, and support the sound and orderly development of business. The main purpose of service production enterprises: to promote product quality improvement, enhance the level of enterprise capacity, enhance the innovation and competitiveness of enterprises, and the main purpose of service government: to assist the government in industry supervision and management and policy-making, and guide the industry to develop better.

![Figure 1. Technical framework of NQI capability index system for smart meters.](image)

2.2. Evaluation index of quality technology basic ability

Considering the common characteristics of NQI and the characteristics of each link, when designing the technical framework of the indicator system, the design of the NQI capability indicator system in the intelligent meter industry is carried out from the horizontal and vertical dimensions. Among them, the five elements of standardization ability, measurement ability, certification and approval ability, inspection and testing ability and quality management ability interact and support each other, forming the horizontal dimension of the indicator system, and the key quality in the whole life cycle of smart meters, such as R & D design, material procurement, production and manufacturing, ex factory supply, acceptance and testing, storage and distribution, installation and operation, demolition and scrap. The control points interact with each other to form the vertical dimension of the indicator system, and the horizontal and vertical dimensions form a complete system, which comprehensively affects the development of the smart meter industry and affects the entire value chain of the industry. All dimensions and elements are interdependent and inseparable. The technical framework of indicator system is shown in Figure 2:
The NQI capability index system of intelligent meters is a hierarchical organic whole composed of several first level indexes, several second level indexes and several third level indexes. Among them, NQI elements such as measurement, standard, certification and inspection are the basis and means to ensure the high-quality and efficient completion of the eight links of smart meters, and the eight links of smart meters are the concrete embodiment of the application and implementation of NQI elements. The factors in each level also interact with each other, forming a complete technical chain.

2.3. Analysis of the data model of NQI service cloud platform intelligent electricity meter
Based on the evaluation index system of basic quality and technology capabilities, starting from the business processes of R & D and design, material procurement, production and manufacturing, delivery, acceptance and testing, storage and distribution, installation and operation, demolition and scrapping of smart meters, research and analyze, sort out key quality control points and relevant data in business links, and carry out product design quality, production quality, operation quality and inspection analysis and research on quality measurement, equipment health status diagnosis, performance evaluation, fault prediction, etc. to find the key data affecting product quality. On this basis, the quality data model of intelligent power meter is constructed, which is mainly composed of infrastructure layer objects, data layer objects and business layer objects. Through the data model based on NQI, the NQI system is extended to design, manufacturing, operation and other process links, as shown in Figure 3.

3. NQI PLATFORM DESIGN
Through the analysis of service scenario, evaluation index and data model, the quality big data of intelligent power meter has the characteristics of diverse data services, high data quality requirements, wide data association and many business types. Data service objects are diverse, and different application scenarios have different requirements for data content and processing methods. The NQI service cloud platform is built based on the cloud computing platform, and uses big data related technologies to manage quality data in a unified way, realize unified data access, storage, management and sharing functions, and realize quality data sharing supporting multiple services. NQI service cloud platform mainly includes cloud platform, data sharing platform, data processing support platform, etc.
3.1. Cloud infrastructure platform design

The cloud platform is responsible for providing unified resource support and management for the upper layer. The cloud platform forms a resource pool with powerful storage, computing and communication capabilities through the unified management of computing resources, storage resources and network resources. And through virtualization and other technologies, the rapid allocation, deployment, adjustment, upgrading and recycling of resources are realized.

As the overall resource providing layer of data services and data services, the service cloud platform realizes different types of resource organization and management according to different requirements of power data services on the premise of centralized management of all computing, storage and network resources. According to the analysis of existing data services and intelligent power consumption services, three available areas, data domain, business domain and interaction domain, are set on the cloud platform, as shown in Figure 4:

- Data domain provides high performance and scalable cluster resources for data storage and processing. In the process of data access, storage and application, distributed data query and processing are needed, so computing resources and storage resources are in the same physical node, that is, computing resources localization.
- The business domain provides the business logic support of the upper specific interaction interface, realizes the complex business logic and smooth network interface, and realizes the access to the lower data service and external interaction interface.
- The interaction domain provides an interface and means for the end users of quality data, such as business people, users or researchers. Users of quality data exist in a variety of network environments, and their security issues are the most critical. According to the characteristics of different users, network environment and access rights, we need to partition the security domain of interactive services and design security protection.

3.2. Shared platform design

The data big data sharing platform of NQI platform is the core module of the whole service architecture. Its main functions are to provide reliable quality data access and preprocessing, preparation and provision of business data of NQI platform, construction and unified management of data warehouse of NQI platform, etc.

The big data sharing platform stores and preprocesses the original collected data reliably, forms the quality business data after preprocessing, supports the distributed storage and management of non relational database, and further arranges and mines the data. The platform also needs to import archive data into relational database for storage and management. It can be seen that different data types have different suitable storage and management mechanisms, but different data contents need to be incorporated into a unified shared storage mechanism to achieve unified management, monitoring, backup and interface management, and realize flexible use and deployment of different types of data according to different businesses. The quality data maintenance requirements of unified management are shown in Figure 5:
3.3. Big data storage model design

Big data storage model from the perspective of data storage stability, processing efficiency optimization and other aspects, according to different business needs, design different storage strategies and data copy strategies, and manage the overall storage status and metadata of data. The ultimate efficiency of the NQI service cloud platform greatly depends on whether the different data in the service business are stored in the right way. The design classification storage mode of this scheme is shown in Figure 6:

The original quality data is the terminal support object in the quality big data service. It should be classified and stored according to the data content, and the quasi real-time query demand of the original data and the demand of distributed batch processing should be considered. For the business that needs to query the original data frequently, the data copy of the business content optimization index should be separately arranged to support.

There are many types of data and large amount of data in the intermediate results, so the distributed and multi copy mode is adopted for unified management. However, the intermediate results will not be directly queried by the business system, but will be further calculated and collated, so there is no need to provide the support of distributed data query.

The business data set usually appears as the final data, so the possibility of further processing is small, or even if further processing, its processing performance and real-time requirements are weak, so the distributed column storage and other mechanisms are preferred to realize the optimization of distributed query.

The file data is generally small data, involving enterprise data, electricity meter data, installation data, etc. the data volume is small and the update is not frequent, but the correlation between the data is strong. Generally, the storage of this kind of data needs to follow the conventional relational database design mode, and uses high-performance relational databases such as Oracle for storage.

3.4. Design of data processing support platform

Big data support platform is mainly responsible for all kinds of business calculation of original data, incremental data, etc., providing different data copies and data tables for different businesses. From the perspective of database, it mainly provides data marts and business data needed by data mining. In general, report and query business are more considered in processing results, so optimization of data index and storage methods should be considered - that is, after data processing, the result data is sorted out for the purpose of query optimization, and returned to the big data sharing and storage platform. The main workflow is shown in Figure 7:
4. CONCLUSION

Based on the scenario requirements and data analysis of NQI service cloud platform, this paper studies the technical architecture of NQI cloud service platform in the field of intelligent measurement using big data related technologies. The NQI cloud service platform in the field of intelligent measurement realizes the access, storage, management and sharing of quality data, so as to achieve the quality data collection and quality monitoring of the intelligent energy meter in multiple factors, dimensions and the whole process, provide all-round services for the government, power grid companies, production enterprises, etc., and ultimately promote the overall improvement of the quality level of the intelligent energy meter.

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