Research on Data Processing Architecture of NQI Service Platform in Intelligent Measurement Domain

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Abstract. 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 system, lack of coordination, and lack of overall technical solution ability. By carrying out the design of NQI service platform to support the quality improvement of smart meters, the quality data collection and quality monitoring of smart meters in multiple factors, dimensions and the whole process are realized, and the quality level of smart meters is promoted comprehensively. The NQI service platform focuses on the storage and processing of massive quality data of smart meters, improving the efficiency of quality data mining and utilization, and achieving the overall quality improvement of smart meter industry. In this paper, through the analysis and research of service scenario, the massive quality data analysis and processing mechanism of intelligent power meter is designed.

1. Introduction
Under the current power grid operation management system, the reliability data of smart energy meter mainly exists in the production and manufacturing process inspection (including R & D, debugging, testing, type test), acceptance inspection, on-site operation monitoring, operation process sampling inspection, maintenance and other major links. At present, these data are not centralized and channeled uniformly, and the data that can be used for reliability analysis are mixed in all kinds of pseudo data sets, and there are also some key elements for reliability analysis lacking, which will undoubtedly be the biggest obstacle for the in-depth reliability analysis of intelligent watt hour meter. [1-3]

The NQI service platform adopts advanced cloud computing and big data technology, through information technology, establishes an effective communication mechanism among manufacturers, users, certification and accreditation agencies, provides quality related data in the design and production process to users and certification and accreditation agencies, and provides manufacturers with quality related data of product life cycle closed-loop management and quality spiral rise in the user's testing process and operation process. The power company release the product faults and related reasons in time, form the access and elimination mechanism of products and components, and then form the access and elimination mechanism of suppliers in combination with the certification and approval of each link of development and production. Based on the demand of business application, this paper proposes the data analysis and processing mechanism of NQI service platform to support the continuous improvement and improvement of the quality of smart meters. [4-5]
2. Business application requirements

Based on the four elements of NQI (measurement, standard, inspection and testing, certification and approval), combined with the eight links of measurement equipment (R & D and design, material procurement, production and manufacturing, ex factory supply, acceptance and testing, logistics distribution, installation and operation, demolition and scrapping, etc.) and a certification evaluation system, relevant application requirements are proposed, mainly including measurement index management, standard management, inspection and testing Management, certification and accreditation management.

Measurement index management is used to manage all quality control points in the whole business process, including measurement index library management, indicator definition, indicator iterative update management, etc.

Standard management includes standard library management, including different attributes (technical standards, management standards and working standards) of different levels (international standards, national standards, industrial standards and enterprise standards). Standard revision management includes standard version management, cross reference management, difference management and benchmarking management.

In order to make the relevant business processes and links meet the requirements of relevant standards and specifications, inspection and testing Management manages all kinds of inspection and detection. Including inspection and testing content, method, process, equipment, etc.

Certification and accreditation management includes certification and accreditation institutions and organization management, certification type and content management, certification process management, etc.

3. Data demand analysis

NQI service platform is based on distributed big data model. Data has obvious big data characteristics. If we want to fully mine the value content of data and provide more extensive business support and interactive query support, we can't rely too much on traditional relational database technology, because the horizontal expansion ability of such technology is poor, as well as the unified management ability and fault tolerance ability after distributed processing. The new distributed big data model and related technologies become the best choice to deal with this kind of data. Through the data distributed storage and distributed processing, the data storage with high performance and reliability, and relatively simple and efficient distributed query and processing are realized.

According to the application requirements of NQI service platform, a quality data model based on NQI system is established. As the data model of the system, it 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 the figure 1.

![Figure 1. Structure of NQI based quality data model.](image)
4. Data analysis and processing mechanism
Based on business analysis and data model, the data analysis and processing mechanism of NQI service platform is established, including data storage management, data model processing, data preprocessing, as shown in the figure 2.

4.1 Mixed management of data
Because the data storage and sharing service need to deal with many types of data, it needs to design a mixed storage mode, and choose flexibly according to the business characteristics and data characteristics.

Based on the hybrid storage of quality information in cloud computing, the original data frame is converted into semi-structured business data through protocol analysis. According to the file data provided by the big data management engine, the semi-structured data is semantically associated with the business to form the basic business data. The basic business data is stored in the file according to the type, which is then handed over to the big data management engine for processing. Big data management engine is responsible for loading, writing, querying and processing massive data, including job tracker, business model, metadata manager, query plan generator, query execution engine, data writer, data source connector, MapReduce big data set parallel processing unit, etc.

The hybrid storage technology of quality information based on cloud computing adopts the hybrid storage method of cloud storage and relational database in the specific storage. The relational database mainly stores business transaction data with frequent modification operations, such as archive data; the cloud storage architecture adopts distributed file storage for massive data processing, which is powerful and flexible through the construction of segment clusters. Scalable data storage. When the data storage server can not meet the large-scale quality information storage, new data storage nodes can be added directly. By adding nodes, the pressure of existing intelligent power consumption information storage server can be relieved, and dynamic expansion can be realized, so as to ensure the stability and reliability of massive data, and provide good services for other intelligent power application systems Data support.

4.2 Multidimensional metadata modeling and synchronization mechanism
Metadata is the foundation of communication management and maintenance of NQI service platform. There are metadata in NQI service platform database for quality improvement business content, such as production process data and operation failure data. Because different kinds of metadata are difficult to be integrated and shared, in order to achieve unified scheduling and processing of heterogeneous metadata, there needs to be a shared and system free metadata The relational model represents the formal language of metadata to model heterogeneous metadata. According to the characteristics of NQI service platform, this paper develops a unified multi-dimensional meta model definition based on CWM,
including the unified metadata structure definition and the unified metadata semantic definition. Based on the definition of multi-dimensional meta model and plug-in architecture, NQI service platform applies metadata management, ETL, plug and play technologies to build a metadata synchronization and loading engine that meets the requirements of metadata modeling and mapping module plug and play.

The metadata synchronization and loading engine includes three sub engines: class mapping engine, relationship mapping engine and transformation engine. Each sub engine contains a general processing module, which is a general class mapping module, a general relationship mapping module and a general transformation module. The three sub engines of metadata synchronization and loading engine can realize the plug and play deployment and operation of class mapping module, relationship mapping module or transformation module defined by application program through the module interface of power consumption information collection system.

4.3 Data preprocessing based on big data model
The preprocessing process is the process between data collection and data integration into unified shared storage. The preprocessing process has certain flow processing requirements and data quality management requirements. With the development of NQI service in the future, the preprocessing content of big data may have some dynamic changes, so we design a data preprocessing method that can configure policy. As shown in the figure 3:

![Figure 3. Data preprocessing model diagram.](image)

Data processing policies can be configured. As a general data support service, big data support platform needs to support a wider range of data preprocessing and processing methods. At present, the data service is mainly based on the data collection support of the mining system. As more data may be accessed in the future, the processing strategy needs to be dynamically modified and added. Therefore, it needs to support from the aspects of preprocessing code and processing flow. For example, on the big data storage and processing platform based on Hadoop, the above is realized by configuring the MapReduce method and oozie workflow Function.

Data can be recorded separately. The original power consumption data is stored in big data platforms such as HDFS, and the raw data without pretreatment can be backed up again. Log and error records generated by processing shall be recorded in the log storage container.

4.4 Business data processing and support based on big data model
Data processing of NQI service 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.

4.5 Real time analysis of massive data based on dynamic load balancing

NQI service platform will access hundreds of millions of smart meters in production and operation, and the amount of data collected will increase exponentially, which puts forward higher requirements for data processing capacity. In order to maximize the use of system resources (such as system memory, port, processor, etc.) and improve the number of system server access terminals, it is necessary to optimize and reconstruct the internal processing mechanism of the NQI service platform, research the real-time information analysis technology based on dynamic load balancing, and meet the massive quality information brought by the growing scale of smart power meter access. The requirement is parsed.

At the beginning of the analysis, the massive quality information real-time analysis technology based on dynamic load balancing carries out coarse-grained task allocation and data exchange among the nodes of the cluster, and then carries out a single task analysis within each node, using multi-threaded data parallel processing mode to speed up the analysis task, reducing the number of message transmission between nodes as much as possible during the analysis process. Even if data exchange occurs, the processing mode of overlapping analysis and communication should be adopted as much as possible. On the whole, the processing mode of combining task parallel and data parallel should be adopted.

At the same time, the massive information real-time analysis technology based on dynamic load balancing uses load balancing to distribute the tasks of real-time analysis cluster. By selecting appropriate load balancing strategies, such as according to the IO load rate, CPU load rate, memory occupation rate, and the number of tasks being processed of the collection and calculation nodes, the terminal communication and data can be selected. The server resource of processing unit is utilized to the maximum extent, and the performance of data acquisition can be improved linearly when the nodes of acquisition and calculation are added.

5. Conclusion

This chapter focuses on the analysis of the characteristics of quality data and NQI service platform, clarifies the similarity between current quality data and big data from the perspectives of data type and relevance, data quality, data business analysis, and puts forward the processing mechanism of mixed management, pre-processing and real-time analysis of quality data, which meets the requirements of NQI service platform for data processing, and provides data technical support for improving the quality of intelligent energy meter.

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