Big Data Platform for Smart Substation Monitoring System

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Keywords: power, dispatching, distribution, big data, application, smart grid, architecture

Abstract. Due to new energy resources, including wind energy storage has been well into the grid, power dispatch and distribution of the operation process involves large-scale, multi type, highly complex data, which contains real-time data, planned data, early warning and monitoring data, environmental data. At present, the application of large data mainly focuses on the single analysis of structured and semi-structured data. And in-depth study of the analysis has not been concerned about the transformation of power grid data into knowledge, is the inevitable trend of the development of smart grid. In this paper, the data source, data characteristics and application trends are analyzed. According to the new requirements of the smart grid, the potential applications of large data technology are studied in the field of smart grid. Finally, to meeting requirement of the power dispatching & distribution data analysis, smart substation monitoring data system architecture was designed which is an integrated software/hardware, storage, computation, communication trinity. And it is proved that the system structure of smart substation monitoring data system has strong support, service and security.

Introduction

With the construction of smart grid, a large amount of information acquisition and management system for production, can provide different services, and generate electricity big data [1-3]. At the same time, there are more and more equipment collection points, and the sampling frequency is improved, which is the real time sampling. Therefore, the rapid development of grid data, so that the power industry to enter the big data era.

In the Chinese electric power industry, the research of big data has just started, and the basic theory of the research [4]. Some major international companies such as Siemens, Alston, ABB, GE and IBM are studying power data as a key breakthrough, many companies have been established in the United States of America. And some application developers such as general electric development of big data platform, you can do the two development.

In the era of big data, like natural or human resource data is an important strategic resource. This paper studies and analyzes the characteristics and applications of large data in electric power dispatch and distribution. And the architecture of the data is designed, which provides a useful reference for the application of the smart grid data.

Material and Methods

Analysis of Smart Substation monitoring data

Based on the traditional power grid, the big data source, type, size has been greatly expanded in power dispatch & distribution system. The data include four kinds as follows: basic data, real-time measuring data, quasi real-time data of application and environmental data.

The data has three characters as following:

1) Large amount of data, real-time and short cycle of data acquisition such as millisecond, second, minutes;
2) Structured data and semi- structured data;
3) Scattered data in various center.

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Application of Smart Substation monitoring data

Because more and more related systems of power dispatching &distribution have been developed which produce more and more data, the relevance of systems is stronger and systems are integrated. Application of Big Data in Smart substation monitoring are illustrated in Table.1.

New application	Grid: Online parameter identification, Situation awareness	Life cycle management, cascading outage model	Grid economy: Wide optimized dispatching; Load Forecasting	
Requirement of grid	Horizontal integration, Vertical integration	Integrated, High real-time Interactive, Data fusion	Automatic, Intelligent, unmanned	Low-energy, Economic, Low-carbon protection
Big data	Basic data	Real-time measuring data	Quasi real-time data of application	Environmental data
Information system	Basic platform: Smart substation monitoring system	Sub-system: SCADA, WAMS, AMI	Monitoring alarm, Power plan, Dispatching management	External system: GIS, Weather forecast, Economic policy

Table.1 Application of Big Data in Smart Substation monitoring

Based on big data technology, application of big data in Smart Substation monitoring will be drawn for new requirement of smart grid as following.

Online analysis of multi time scale load features

Data acquisition from the power grid is carried out by the SCADA system and the dynamic data of the WAMS system. Use big data technology to analyze these 2 kinds of data, in order to determine the on-line load dynamic model. Therefore, the grid control framework will be established for real-time measurement, real-time distinction, real-time simulation and online control.

Wide area optimized dispatching of interactive load range

Whole grid load information and controlled resource information of requirement were analyzed using big data technology. way this In decision were and from done to real-time time different according scale optimized to of optimizing maximum resource controlled the It range. Can overall situation enhance perception of grid accurate fast analysis and decision. Controlled unit Meanwhile not it meets only protection safety economy but grid in environmental also optimized satisfy of resource maximum and range energy renewable of sources maximum the dispatching degree.

Load forecasting

At present, the traditional grid data is not such as atmosphere, geography, population, economy and other data, which is applied in the traditional load forecasting. In the future, the power supply will be diversified, the supply and demand sides will interact, and control will be smart. Therefore, the accuracy of the algorithm and load forecasting of large data technology will be greatly improved.

Life cycle management of monitoring equipment

The big data technology these, massive distributed,, non-structured, data were analyzed to control

equipment comprehensive evolution of real-time monitoring and trend. So it the online running state can power master equipment of improve of support, repair work grid smart timeliness of accuracy or equipment state reduce, costs of repair and finally improve efficiency of grid assets.

Research on cascading outage model

The big data technology based on grid real-time data can find grid fault quickly, prevent fault effectively and eliminate fault to improve reliability of power grid.

Situation awareness

Large data technology based on grid real time data can quickly discover the power grid fault, effectively prevent the failure, troubleshooting, improve the reliability of the power grid.

Smart Substation monitoring data system architecture

In order to meet requirement of smart substation monitoring, smart substation monitoring system was designed. The bottom hardware/software was designed and three key parts such as computing storage, communication, were studied. Finally three, aspects including application support application, service and, system security were resolved. So system architecture is illustrated in Fig.1.

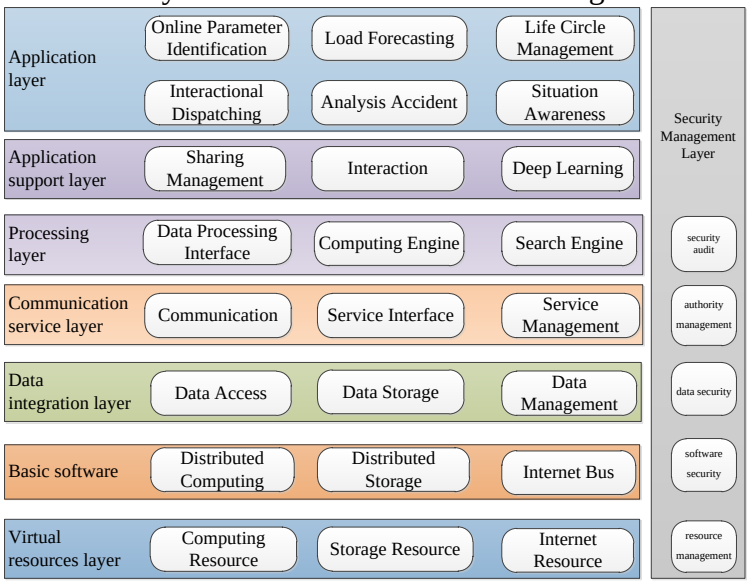

Fig.1 Smart substation monitoring data system architecture

From Figure 1, the system hardware virtualization to the virtual resources, including hardware computing resources, storage resources and network resources of the virtual resource layer. Therefore, it can manage all the hardware to better meet the large data applications. Resources can be flexible scheduling and recycling to save resources;

Software includes distributed processing of computing environment distributed, storage of structured/unstructured data and efficient communication bus between different systems and modules Basic;

Access and management of system data can be concerned in data integration layer storage;

Communication and service interface can be managed in communication service layer Data;

Of data processing computing, engine and search engine were provided in processing layer Interface;

Management of data interface, and deep learning were supported in application support layer sharing;

The top layer application, such as online identification of parameter load, forecasting was applied. In

Addition resource, management, security software, security data, management and so authority all on were designed every layer of system from the beginning.

Summary

Data is the core value of the smart grid, in the power grid operation analysis, scheduling decisions, equipment monitoring, accident analysis and other aspects of the analysis of large data technology in the power dispatch and allocation of applications.

In this paper, to meeting requirement of the power dispatching distribution & data analysis power, smart substation monitoring data system architecture was designed which integrated software/hardware is an storage, computation, communication, trinity. It was proved that smart substation monitoring data system architecture have strong supporting service, and safety ability.

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