Construction and Application of an Panoramic Data Information Platform on Intelligent Substation Information Integration System

Tongwei Yu
State Grid Electric Power Research Institute of Liaoning Provincial Power Company
Shenyang, China
e-mail: yu_twei@hotmail.com

Juyong Cui
Shenyang University of Technology
Shenyang, China
e-mail: cuijuyong_sy@126.com

Yundong Cao
Shenyang University of Technology
Shenyang, China
e-mail: ydcaosyut@163.com

Abstract—The formation of intelligent substation is the inevitable rule that substation develops. Substation intelligence is realized by the devices' data collection, transmission, analysis, and processing, etc. Considering data information as one of the media for substation intelligence, multifarious senior applications would need exhaustive equipment information. This article introduces an enterprise-level panoramic data analysis platform, based on the existed intelligent substation information integration system. Department staff could access and analysis on either real time or historical data from substation devices by means of web services. The feasibility and availability of this platform has been tested and verified in a certain intelligent substation. The experimental result of this article could be a valuable reference for substation information system construction.

Keywords-component; intelligent substation; information integration; panoramic data

I. SUMMARY

The smart grid is the common choice of the international power industry to tackle global warming, energy crisis and the deterioration of the environment, is the trend of development of electric power industry[1-4]. As an important part of energy strategy, building a strong smart grid in order to improve the integrated transport system in our country, solve the problem of energy resources and energy requirements of reverse distribution problem, and use it to industry and society with power and influence, the implementation of green production, promote the upgrading of industrial technology[5-7]. As the technology of digital substation intelligent substation transition form is relatively mature, and some have been built in the digital substation is implemented in ahierarchical distributed structure accords with the standard of IEC61850, and the application of non conventional instrument transformer, fiber and intelligent electronic devices IED (Intelligent Electronic Device) and other intelligent devices, to be built in substation have and implement the station control layer bus plan the process bus.

There are six steps in the smart grid power generation .They are transmission, substation, distribution, utilization and scheduling. In six steps of smart grid power generation, construction substation part is the core of intelligent substation[8]. As an important node of the smart grid, intelligent substation is the continuation and development of digital substation The main features of intelligent substation is "intelligent primary equipment, the total information digitization, information sharing standards, advanced application interaction". The State Grid released Technical guidelines for Smart Substation in 2009 on the basis of them. This paper presents a unified information platform of intelligent station panoramic data. It also standardized the data transmission between subsystems, the data interaction between the substation and station data interaction and so on. With the demand increasing, the use data is no longer confined to the substation and dispatching in the substation. It's also necessary to make the data transmission be available between substations and substations or between substations and other functional departments of enterprises. But the description of this part is not perfect in the guidelines. There have been no successful case reports of transcendental in China or abroad[9]. In view of this situation, this scheme is proposed for panoramic data processing between substation and other functions. Such as transmission, access, analysis, processing, applications and so on. And we conducted a more systematic design and development[10].

Compared with the way that the relevant functional departments obtain the raw data directly from the scheduling at this stage, this scheme has several following advantages.

①There are no direct access to dispatch the master station and sub-station in order to avoid a large number of

network resources among master and sub-station for maintaining the operational efficiency of scheduling.

② Compared with the original data, the data after normalization is easier to understand.

③ The use of panorama data can get rid of the dependence on structured data in the past. And the access of videos, documents, charts and other unstructured data brings a more intuitive feel for human-computer interaction.

④This scheme can achieve data transfer and access to multiple intelligent substation. This provides favorable conditions for regional integrated data analysis and processing.

II. INFORMATION INTEGRATION PLATFORM

Intelligent substation information integration platform mainly consists of real-time interfaces to the host system and the lower end of the adapter gateway and non real time interface adapter gateway form. As an information transmission platform for a comprehensive, the station control layer information of each subsystem upload were collected and analyzed, according to the requirement of real time information and the power failure handling priority processing to achieve information. At the same time, the station control layer in accordance with the IEC61850 standard to integrate these data and information, and the unified modeling of its, for no standard definition of logical node, data objects and common data class, according to the prescribed standards for expansion planning. Through the electric power communication network integration platform of information can be sent to the upper control center. "Background presentation" is a IEC61850 client that can run on a PC machine, used to visually display the IEC61850 information model and service information integration platform in substation.

The spacer layer is divided into the protection and control system integration unit, monitoring and five prevention integration unit, the centralized fault recording unit and the electric energy acquisition equipment, but also for the future of the new device access and substation legacy device is provided with a reserved interface. The respective functions of these devices is relatively independent, in fact, when the effective operation to ensure safe and reliable and stable operation of power grid. At the same time, the device can also be carried out between the information sharing and interoperability, the implementation of some comprehensive application, such as accurate judgement of accident handling, played a great role. The process layer adopts transformer first intelligent electrical equipment to replace the traditional and a device, in order to achieve the operation of the electrical quantity detecting, operation of equipment state detection and operation control command execution. The merging unit is an important part to realize the information interaction between process level and bay level, its main function is to multi channel synchronous acquisition of electronic current and voltage transformer of ECT / EVT (Electronic Current / Voltage Transformer) (maximum of 12) digital signal output, and according to the measurement and control, according to the prescribed format to send spacer protection equipment.

According to Intelligent substation integrated monitoring system functional specifications which was released by the State Grid Corporation in 2012, intelligent substation information integration platform got its own framework map as shown in Fig .1.

A) In the security zone Ⅰ, the monitoring host collects the real-time data of Power grid operation and working condition of equipment and then the data will be stored in the data server.

B) In the security zone II, integrated application server communicate with the condition monitoring of transmission and distribution equipment and auxiliary equipment. It collects the communication of the power supply, metering, fire, security, environmental monitoring and so on. The gateway machine of Ⅱ area data communications collect the information of Ⅱ area data and model from data server through firewall.

C) Integrated application server posts information to gateway machine of Ⅲ / Ⅳ area data communication through the forward and backward isolation device. And then it transfers to other master systems by the gateway machine of Ⅲ / Ⅳ area data communications.

There is no clear plan to the transmission and access of information Ⅲ / Ⅳ zone in State Grid Corporation. Currently data of substation side is transmitted to CAC by comprehensive monitoring unit through I1 interface. Then it is transmitted from CAC to Substation CAG of state evaluation system side through I2 interface. At least, authorities access to the substation through the system server. Considering the secure of network data transmission and confidentiality of business critical data, we increased security isolation device between II and III district. Data could not be successfully sent to the master terminal by the existing data transfer mode. So we must upgrade the original system.

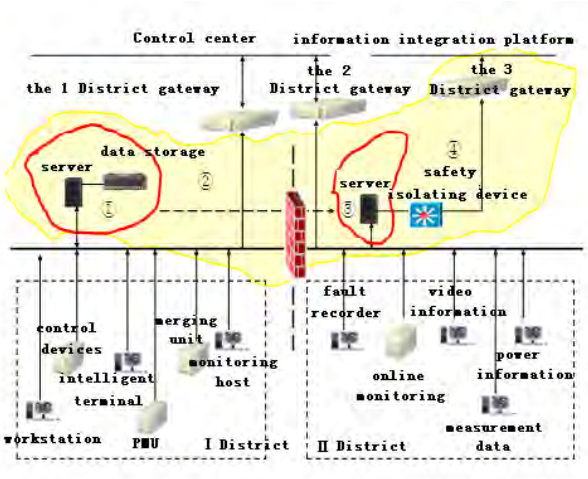

Figure 1. The physical structure of intelligent substation information integration platform.

To solve the problems above, this scheme adds the integrated information platform station device in Zone III and deploys data synchronization protocol in the station device and district II integrated application server to integrate the data on the integrated application server in a

specific format so that it can achieve the purpose passing forward isolation device and sending synchronous data to the devices in Zone III. Fig .2 is a schematic diagram of data transmission system which is transformed.

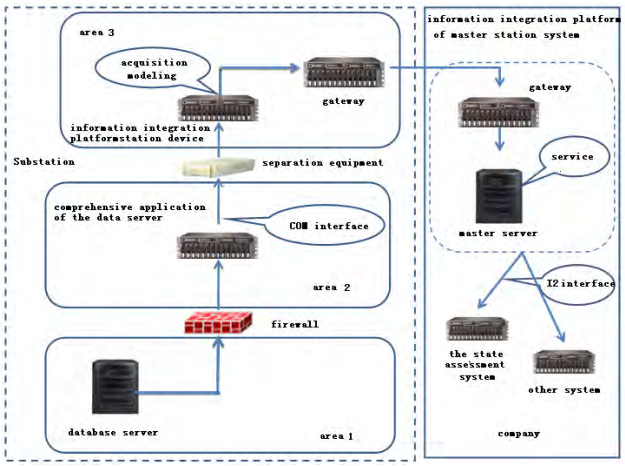

Figure 2. Structure diagram of data transmission system which is transformed.

The operating system of new station device keep in touch with the master. In this scenario, the system is Kylin system. But the system of Information Integration Platform in Zone I and Zone II is So1aris10.Data which is integrated into an XML file format in a specific format sent to the isolation device on the integrated application server. XML has gradually become an international standard of network data transmission and exchange. It has its own advantage that any system can read XML data through XML parser without worrying about unsupported system . Master server models the panoramic data of Transformer substation unified and provide data services to all relevant departments in the form of web service. It does visual display of the steady-state and dynamic data at the user end. Such as active power, reactive power, voltage, current, frequency, synchronized phasor and other data. It is always using forms tables, graphs, pie charts, bar graphs, contour, etc. For data files, images and other formats, users can query access.

III. PANORAMIC DATA PLATFORM

Although the focus point of each application system in substation substation is different, but the object of concern within the substation equipment are the same, the only difference is that access to information types, fineness, level, angle and real time etc.. In the intelligent substation, function and data for all devices by IEC61850 modeling, using the mapping to the manufacturing message specification (MMS)Abstract communication service interface (ACSI), generic object oriented substation event (GOOSE), sampling value (SAV), simple network time protocol (SNTP) to achieve a variety of communication functions such as communication protocol. Service description object oriented IEC61850 based data, bus voltage, current, active power, reactive power, frequency and other electrical quantities and the oil temperature of the transformer, circuit breaker intelligent devices will be synchronous acquisition in SF6 pressure and isolation switch opening and closing position of non electric quantity conversion digital signal output to the standard, and then according to the Ethernet data transmission format upload specified in the IEC61850-9-1 to the spacer layer network, call for each system in the. The technology to ensure the authenticity, integrity and consistency of data, make substation truly "one side entry, multi use" data exchange. Process of network transmission of data information, value and protection unit sent to the scene to switch equipment protection signal transmission time information demand the most urgent sampling to real-time voltage, voltage transformer and current data protection and control unit, the highest priority. In the sampling process, fault recording system for data sampling frequency is highest, protection and control of required data sampling frequency is lower than the measurement data. Thus, in the premise of ensuring network transmission smooth, ensure the accuracy of different application uploads to the data in the system, which laid the foundation for the safe and stable operation of substation under normal and accident.

Panoramic is a collection of data which is used to reflect steady state, transient, dynamic data, equipment status and image, models and other data in substation running. Definition contains both structured data, such as data by two-dimensional table in database, also contains documents, graphics, images, XML, audio and video information and other unstructured data. Panoramic data platform of this program will provide structured data and unstructured data web services the relevant departments. As shown in Fig .3.

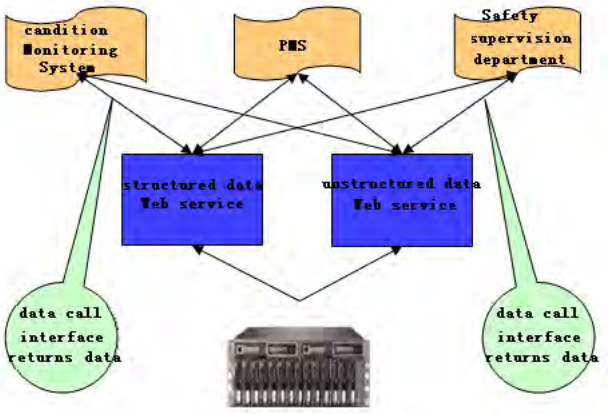

Figure 3. Two data structures schematic of web service.

The State Grid Corporation publish Unstructured Data Platform Management Measures and Unstructured data management platform business applications access specification and built enterprise-class platform of unstructured data management. This has guiding significance for the construction of unstructured data management and query applications. The logical deployment of management platform is as shown in Fig .4.

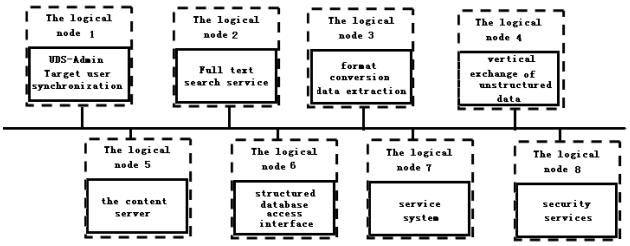

Figure 4. The logical deployment of management platform data.

The main forms of unstructured data within the enterprise stage are contracts, cases, power of attorney, certificates, laws and regulations, document, notice, sign newspaper, attachments, files, knowledge, special, editing, etc. Application of unstructured data mainly classifies various forms of data. And then do full text retrieval on this basis and find key information of interest to the user. Classification of unstructured data is currently more popular keyword-based classification method. Such as TF-IDF method which was put forward by Salton.

IV. CONCLUSION

This paper presents an intelligent substation information integration platform for providing the data of panoramic substation for the enterprise other (non-manufacturing) sector by Technical guidelines for Smart Substation and intelligent substation integrated monitoring system functional specifications which was released by the State Grid Corporation. The paper also proposes the related mechanisms of use of ART1 neural network to classify and retrieve unstructured data to serve panoramic Data Platform in management and retrieval applications of unstructured data .Overall platform design has been field testing in Hejia (Chaoyang City, Liaoning Province) Intelligent 220KV substation and it has achieved satisfactory results. This provides a valuable reference sample for constructions of other intelligent substation information integration platform in China.

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