Design for Communication Network of Internet in On-line Monitoring System for Power Transmission and Transformation Equipment

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Abstract. The Internet of things (iot) for power transmission and transformation equipment is a systematic process that extends from smart grid to intelligent grid, which can guarantee the safe operation of power grid. However, due to various types of power transmission and transformation equipment and complex information composition, the Internet of things will be a network with high relevance and promiscuity in the physical and information space. The Internet of things of power transmission and transformation equipment is based on information model and communication network. It is necessary to deeply discuss the Internet of things of power transmission and transformation equipment based on intelligent detection and life cycle management. In this paper, IEC61850, an advanced Internet of things technology, is used for online monitoring system of power transmission and transformation equipment, and hierarchical structure is used for equipment transportation state. This system has good reliability and flexible extensibility, and can realize the free distribution of functions and the knowledge of system expansion. Moreover, it can use substation configuration description language.

1. Introduction
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\[ c_2 = a_2 + b_2 \] (1)
2. architecture design of Internet of things (IOTTE) for power transmission and transformation equipment

Along with the construction of the smart grid power transmission and transformation equipment condition monitoring requirements subsequently heighten, but because of the power transmission and transformation equipment condition monitoring is still monitoring device performance is not high, data acquisition and data transfer is not enough, the specification information communication network access ability is limited, so from the perspective of physical space and space information and establish the architecture. In the vertical level of "power flow", the Internet of things for power transmission and transformation equipment includes primary equipment of transmission lines and substations, communication and network system, substation monitoring integrated system, sub-station platform of prefectural and municipal power supply bureau, main station platform of provincial network monitoring and main station platform of state grid/south network. See figure 2 for details. Transmission and transformation equipment adopts the horizontal range of information flow through the substation production management system, financial system and network dispatching automation system, energy management system, meteorological system, geographic information acquisition system and other application systems. Its physical structure is mainly the use of power structure in the information network fusion in the power network. According to the energy flow level, substation level, power supply bureau level, provincial network level, etc. Its power transmission and transformation equipment iot have more intelligent and more comprehensive state of equipment, can help realize the fault of power transmission and transformation equipment maintenance based on the advanced Internet technology, analyzing the attributes of the resources integration of the power transmission and transformation equipment as a whole, the promotion of power transmission and transformation equipment is safe and effective, to further improve the enterprise benefit and service quality, so as to realize the effective construction of the smart grid.

Table 1. Three Scheme comparing.

| Numble | Scheme 1 | Scheme 2 | Scheme 3 | Scheme 4 | Scheme 5 |
|--------|----------|----------|----------|----------|----------|
| 1      | 456      | 456      | 123      | 123      | 123      |
| 2      | 789      | 213      | 644      | 644      | 644      |
| 3      | 213      | 654      | 649      | 649      | 649      |
Fig. 2 Design of (IOTTE) architecture for transmission and transformation equipment Internet of things

3. Analysis of IEC61850 information communication model
The IEC61850 is operable, its operability is different from the simple exchange of information refers to the communication function between ieds based on the communication protocol stack, play the role of execution procedures as well as information semantics. Moreover, the system functions can be diversified and supported by flexibility. Its functions can be coordinated by more intelligent electronic devices. It can realize the freedom to break the space limit and distribute arbitrarily on the intelligent electronic devices. It allows users and devices to freely allocate functions of electronic devices according to requirements, and provides communication rules and constraints between electronic devices. It is also an open architecture that can extend the field of substation automation to the condition monitoring of power transmission and transformation equipment.

3.1. IEC61850 hierarchical information modeling
As shown in figure 3, IEC61850 USES unified description of information devices and hierarchical modeling of servers, logical devices, logical points and data objects. In the hierarchical information model, each intelligent electronic device is equipped with a relevant server. Logical nodes are named according to common data classes in data attribute composition. When accessing the system, the data is accessed through the abstract communication service interface and the server. The idea of intelligent electronic equipment modeling is to conduct abstract analysis of actual equipment functions, analyze its logic composition according to object-oriented thought, and analyze its process functions, including logical nodes, logical nodes and logical parameter attributes.
3.2. **IEC61850 hierarchical data communication model**

As shown in figure 4, iec61850-5 is logically divided into station control layer, interval layer and process layer through the substation system. The hierarchical distributed data communication model of the substation is carried out by using the hierarchical thinking.

As shown in the above model, it is divided into process layer, interval layer and station control layer for functional differentiation. In the process layer, simulation data acquisition, equipment running state detection, control command transmission and other functions. The interval layer summarizes the information of the data in its layer for protection and control. The automatic communication function of the substation is developed into a connection channel, which can ensure the communication speed in the substation layer and improve the safety and reliability. The station control layer can effectively control the primary equipment of the interval layer in the station, and connect the communication functions from the aspects of remote control, engineer station and man-machine interface.
3.3. Communication service mapping of substation functions in IEC61850

Abstract communication service refers to the service which is independent of the application layer of the communication system. It can realize the functions between its abstract services through data. In order to meet the requirements of different types of communication, it can map the communication services of messages that need to be exchanged within the substation according to their message performance. The system is as follows.

![Diagram of Communication Service Mapping]

Figure 5 Communication Service Mapping

Above describes the different abstract communication service mapping of specific communication architecture and transmission protocol, IEC61850 USES more than one communication protocol, a kind of communication service there was only one map, the process of sending and receiving the same information transmit information through the same protocol set, there is no protocol conversion, to ensure the interoperability of equipment. The Manufacturing Message Specification (MMS), which implements the IEC61850 core services, is a communication protocol developed by ISO/IEC to regulate the communication behavior of intelligent sensors, ieds and intelligent control devices with communication capabilities in the industrial field, enabling interoperability between devices from different manufacturers and making system integration easier. MMS adopts the method of abstract modeling and object-oriented data description, standardizes the communication between multiple manufacturers, and provides convenience for manufacturing equipment to enter the network.
In IEC61850, the mapping between server, logical device, logical node, data, association and file model and object model of MMS, such as VMD, domain, named variable, application association and file, etc. The mapping relationship between objects in IEC61860 and objects in MMS is shown in the following table.

Table 2. MMS mapping of IEC61850

| IEC61850 object model | MMS object model |
|-----------------------|------------------|
| Association           | Content          |
| Server                | VMD              |
| Logical Devices       | The domain model |
| Logical Node          | Named Variable   |
| Data Class            |                  |
| RCB                   |                  |
| LCB                   |                  |
| SGCB                  |                  |
| CONTROL               |                  |
| Data Set              | Named Variable List |
| Log                   | Journal          |
| File                  | File             |

3.4. Specific test items

By analyzing the specific monitoring items of main intelligent electronic devices for online monitoring of power transmission and transformation equipment, the online monitoring information types of Internet of things for power transmission and transformation equipment can be divided into IEC61850 information and non-iec61850 information. Among them, IEC61850 class information refers to the information type defined in iec61850-5, and non-iec61850 class information refers to the information type not defined in iec61850-5. The information transmission type supported by the Internet of things for power transmission and transformation equipment is shown in table 3.
Table 3. Specific test items

| Information types         | State parameter                                                                 |
|---------------------------|----------------------------------------------------------------------------------|
| IEC61850 information      |                                                                                   |
| Substation equipment      |                                                                                   |
| Transformer/reactor       | Dissolved gas in oil, casing medium, partial discharge,                            |
|                           | leakage current, Moisture in oil, core grounding                                  |
|                           | current, temperature in oil, noise                                                |
|                           | Partial discharge, gas composition, moisture                                       |
|                           | Capacitance, dielectric, partial discharge                                        |
|                           | The circuit breaker                                                                |
|                           | transformer                                                                       |
|                           | Surge arrester                                                                    |
|                           | High voltage bus                                                                  |
|                           | Dc transformer                                                                    |
| Converter station equipment|                                                                                   |
|                           | Inverter/advection reactor                                                         |
|                           | Dc arrester                                                                       |
|                           |                                                                                   |

In the process of modeling, unified modeling language (uml) is adopted to establish various classes, relationships between classes, classes and pairs. The interaction of the images completes panoramic information modeling. Among them, the extension of CIM (Common Information Model) should consider three questions: (1) whether to build a new package; (2) which new classes to extend; (3) which existing classes to extend the attributes and attribute values. Refer to IEC61850 logical node modeling extension process, the specific method of information modeling of this subject is shown in figure 7 below.

4. Conclusion
Design of Internet of things information model for transmission and transformation equipment. According to the three-tier architecture model of IEC61850 substation, the layered distributed information model of Internet of things for power transmission and transformation equipment is designed. According to the support of IEC61850 for the free distribution of system functions, the
dynamic mapping between physical devices and virtual devices is analyzed in detail, and the distributed computer fault diagnosis flow of the system is studied on this basis.

References
[1] Visu P., Lakshmanan L., Murugananthan V., Meenaloshini Vimal Cruz. Software-defined forensic framework for malware disaster management in Internet of Thing devices for extreme surveillance[J]. Computer Communications, 2019, 147.
[2] Soulmaz Gheisari, Ehsan Tahavori. CCCLA: A cognitive approach for congestion control in Internet of Things using a game of learning automata[J]. Computer Communications, 2019, 147.
[3] Ahmad Nizar Harun, Norliza Mohamed, Robiah Ahmad, Abd Rahman Abdul Rahim, Nurul Najwa Ani. Improved Internet of Things (IoT) monitoring system for growth optimization of Brassica chinensis[J]. Computers and Electronics in Agriculture, 2019, 164.
[4] Yasmine Harbi, Zibouda Aliouat, Allaoua Refoufi, Saad Harous, Abdelhak Bentaleb. Enhanced authentication and key management scheme for securing data transmission in the internet of things[J]. Ad Hoc Networks, 2019, 94.
[5] Saniya Zafar, Rasheed Hussain, Fatima Hussain, Sobia Jangsher. Interplay between Big Spectrum Data and Mobile Internet of Things: Current solutions and future challenges[J]. Computer Networks, 2019, 163.
[6] Xin, Shen min, cao, Wu, xue, jian, li, yong, lu linshan, zhang Research and application of intelligent online monitoring of power transmission and transformation equipment based on Internet of things technology [J]. China southern power grid technology, 2016, 10(01): 32-41.
[7] Tiancong, Huang, Lili, Deng Wu, Xue Jie, Yu Cao Min, Hu Zhiyuan. Network structure and topology analysis of Internet of things communication for transmission and transformation equipment [J]. High Voltage Technology, 2015, 41(12): 3922-3928.
[8] Xin, Guo Shiwang, Xiong Xing, Zhang Zhang Jinjiang, Cao Min, Xue Wu. Multi-source heterogeneous data aggregation method for panoramic information of transmission and transformation equipment [J]. High Voltage Technology, 2015, 41(12): 3888 ≤ 3894.
[9] Peng, Sun Jian, Li Zhang Jin, Xue Wu. Reliability evaluation of integrated intelligent monitoring device for transmission and transformation equipment based on Markov process [J]. High Voltage Technology, 2015, 41(12): 3952 ≤ 3958.
[10] Zhiyuan, Hu Bingwu, Yang Yongmei, Zhu Yuxiang, Lu Yunmei, Cheng Yang Jiaquan. Design of Communication Network for online Monitoring system of Internet of things for Transmission and Transformation equipment [J]. High Voltage Technology, 2015, 41(07): 2252 ≤ 2258.