Research on Real-Time Database Recovery Method of Smart Grid System Based on IEC61970 Standard

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Abstract. Real-time database management system plays an important role in power grid system. With the increasing development of smart grid, the problem of data integrity security in real-time database has attracted more and more attention. Research on real-time database recovery Method of Smart Grid system is based on IEC61970 standard using RFID algorithm. After the data integrity is destroyed, it takes only a rollback malicious transaction, without having to roll back all transactions, the transaction conflict caused by the transaction revocation can be avoided, that can improve the survivability of real-time databases, protect the integrity of the real-time database of smart grids, and improve power grid dispatching system. Therefore, real-time database recovery Method plays an important role in power grid dispatching system.

1. Introduction

IEC6197O standards are in continuous improvement and development. IEC61970 standard has been used by ABB, ALSTON, Siemens and other developers for over 30 applications such as SCADA, the development of SCADA system scheduling structure has gone through centralized scheduling automation system, open scheduling automation system, and gradually mature distributed scheduling automation system. Common centralized dispatch system schemes are single system scheme, dual system scheme and bus scheme. The centralized dispatching system is the main structure of the first- and second- SCADA systems generation. This kind of structure generally sets up one or two computers to make up a system in whole substation, uses a dedicated operating system for a device. The disadvantages of this structure are not interoperable, the disadvantages of this structure it is not interoperable, difficult to maintain, difficult to expand, and highly dependent on software and hardware. With the increase of substation monitoring system equipment, the increase of complexity, and the reduction of computer price, the centralized dispatch is gradually eliminated.

2.Purpose and significance

Smart grid is a complete enterprise information architecture and infrastructure system. With the increase of openness, "non-disclosure is security" cannot be the choice of a security policy. The safe operation of power system under smart grid also forms the dependence on the security of information system. The essential elements of information security include confidentiality, integrity, availability, controllability and non-repudiation. Among them, integrity means to guarantee the consistency of data and prevent data from being tampered by illegal users. The information of smart grid should be vertically integrated with industry chain information and grid information, and horizontally integrated with the internal business of grid enterprises at all levels. Therefore, information integration is the core of smart grid

information management. The 57th technical committee of the international electro technical committee (IEC), which is responsible for standards related to power system control and communication, has developed the public information model (CIM) and component interface specification (CIS) standards related to the energy management system (EMS) profession, which is the IEC61970 series. To understand the role of IEC61970 standard in scheduling automation, Data recovery algorithm based on IEC61970 standard is applied in scheduling automation system.

3.IEC61970 Standard

The work of IEC61970 standard is to form a set of guidelines and standards to integrate different applications and realize data exchange with other systems. According to the IEC61970 standard, the support platform and application software of the grid dispatch automation system should be modified according to the CIM and CIS standards. Real-time database management is the core content of the support platform and even the whole system, including topology analysis, power flow calculation, state estimation, security analysis and other data, which can fully reflect the current operating state of the grid. These data are integrated through IEC61970 standard and connected to smart grid through data exchange platform. At present, the construction of power grid information system is strictly divided into strict zones:

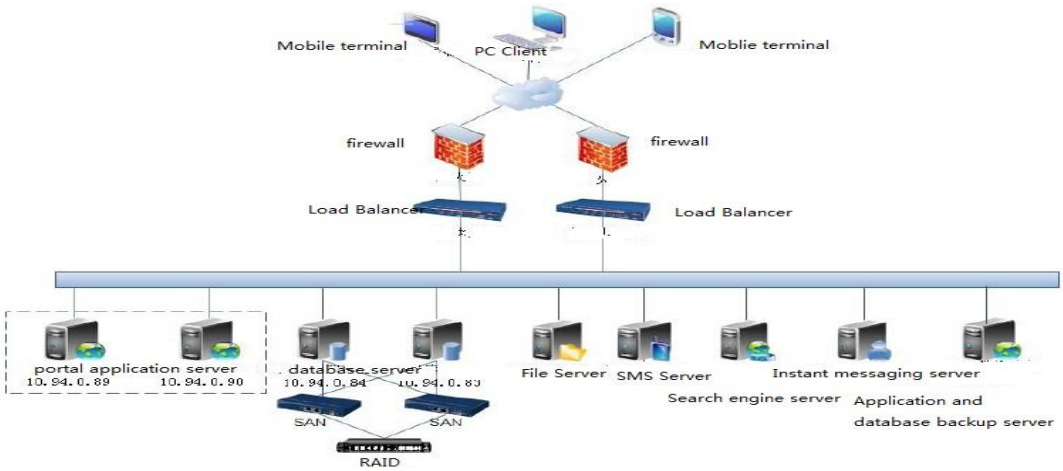

Figure 1. The server hardware for data structure

Safety zone 1 is the real-time control zone, safety zone 2 is the non-control business zone, safety zone 3 is the production management zone, and safety zone 4 is the information management zone. The logical or physical isolation device is applied horizontally between different security zones, the authentication is carried out vertically, the IP authentication encryption device is deployed along the vertical boundary of security zone 1 and 2, and the hardware firewall is required for the vertical boundary of security zone 3 and 4.In this way, the data in the high security zone can be spit out in one direction through physical isolation to the data of the operating system in the low security zone. After extracting the data required by smart grid from security zone 1 and 2, the data is transformed to meet the IEC61970 standard and stored in the database, which can be used for query statistics, online analysis and processing, data mining and auxiliary decision-making in this security zone and its low-security region, and can also be transmitted to smart grid integration platform. The characteristics of the smart grid increases the user participation, such as electrical energy in a safe zone 2 billing system, need every once in a while from the user to the data acquisition of electricity, due to the direct contact with the outside world, some security threats such as illegal invasion, a security region makes real-time data in the database security is difficult to guarantee, may bring harm to the safe operation of the whole system. Therefore, this paper carried out a study on the rapid recovery method of real-time database integrity based on IEC61970.

4.Data integrity recovery

On the basis of understanding the database type and characteristics of scheduling automation real-time

system, this paper studies the recovery method of data in database after data is destroyed or lost. The data recovery algorithm of grid dispatch automation system based on 61970 standards is studied, to understand the role of the 61970 standards in power grid dispatch, refer to the multiple log models and credible recovery mechanism proposed by the traditional database field, and study the data integrity recovery method based on the 61970 standard integrated real-time databases. When the database is attacked and the intrusion detection system detects the malicious user behavior that violates the security policy, it must first isolate the database and use the relevant repair algorithm to roll back the malicious transaction and the infected transaction. The RDIR algorithm is built according to the known malicious transaction location and execution sequence H.

5. Data recovery algorithm

To understand the role of IEC61970 standard in scheduling automation, Data recovery algorithm based on IEC61970 standard is applied in scheduling automation system. Data recovery algorithm selection: how to select the appropriate data recovery algorithm according to the needs of scheduling automation system. RDIR algorithm is applied to database, this algorithm is applied to real-time database recovery in scheduling automation real-time system.

In a real-time library centered on table structure, object information is stored in the Shared memory to be parsed into basic data types and arrays, and arranged according to the specified array form and layout. The organization, inheritance and association information between the object itself and the object is lost, and Pointers and object containers cannot be used. This approach limits the application of object-oriented programming techniques and fails to use some efficient and practical excellent libraries, such as object containers and algorithms for the standard template library (STL). When implementing CIM access, this inadequacy is inconvenient for development.

The goals are to find optimal transmission strategy for each link (i.e., either direct or cooperative transmission), the optimal power allocation for the chosen strategy, and the link flow to route data generated by source nodes to the corresponding destination node. This is a cross-layer design problem for both physical layer (i.e., relay selection, power allocation) and network layer (i.e., routing of traffic flows). The problem can be stated as follows:

minimize $\sum_{(i,j)\epsilon L)} p(i,j)$ (1)

Subject to $\sum_{j\epsilon o(i)} x(i,j)\text{-}\sum_{j\epsilon I(i)} x(i,j)=Si\ \epsilon V$ (2)

$x(\ i,j) \leq r(\ i,j\ ),(\ i,j) \in L$

$x \geq o$

The data integration platform of smart grid realizes the data interoperation between various databases through CIM mapping. Its architecture is shown in the following figure. It can be seen that the CIM database corresponds to various databases, real-time databases and data warehouses in the power system.

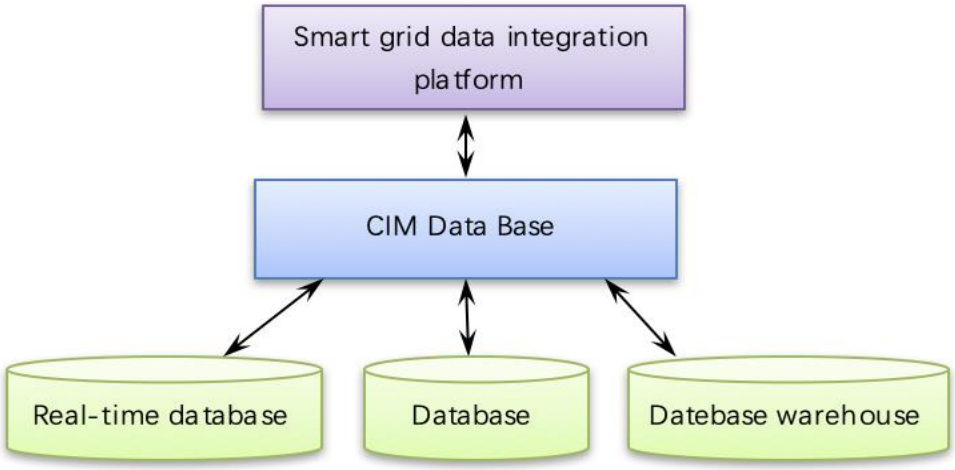

Figure .2 Smart Grid Data Integration Platform

CIM database is established according to CIM, in which CIM depicts all the main objects in the power enterprise contained in a typical EMS information system, including the public classes, attributes and relationships among these objects. CIM database is the key technology to establish intelligent grid information integration platform. State estimation is an important part of real-time database application, which is used for power system scheduling, control and safety evaluation. For example, the online evaluation of nodes and branches in smart grid collects real-time data information and grid model data of nodes and branches on the grid model, where the grid model refers to the grid information related to the state estimation calculation of all equipment objects and measuring objects in the grid system. The output data is mainly the result after the state estimation runs. In the information description of the node, the necessary information for calculating such as active power injected by the node, reactive power injected by the node, maximum voltage, and observability state of the node is defined as the inherent attribute of the CIM node class. In the information description of the branch, the information necessary for the calculation of transformer ratio, branch power flow and whether the current branch is connected is defined as the inherent attribute of the CIM branch class.

When the system inquires the data, information related to the branch, the branch data should be extracted from the real-time database and stored directly in the CIM database. To effectively shield communication protocols and data formats, data in CIM databases is stored as extensible markup language (XML) files. The XML is generated and transformed according to CIM.

6.Conclusion:

This paper solves the problem of security hidden trouble in smart grid system (SGS), recovers lost data quickly based on IEC61970. Data recovery algorithm based on IEC61970 standard is applied in smart grid system to improve the survivability of real-time databases and the automation level of grid dispatching. According to the data security hidden trouble in the SG system the algorithm is adopted to quickly restore the data damaged in the scheduling automation system.

Acknowledgments

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References

[1] Forster C, Pizzoli M, Scaramuzza D. SVO: fast semi-direct monocular visual odometry[C] //Proceedings of IEEE International Conference on Robotics and Automation. Los Alamitos: IEEE Computer Society Press, 2014: 15-22 .

[2] Zhang F. The Schur Complement and Its Applications [J]. Springer-Verlag, New York, 2005, 4(2): xvi

[3] Mur-Artal R, Montiel J M M, Tardos J D. ORB-SLAM: a versatile and accurate monocular SLAM system [J]. IEEE Transactions on Robotics, 2015, 31(5): 1147-1163.

[4] Maalla A, Zhou C, Guang-Yu W U. The Construction of Heterogeneous Platform of Unified Service System Based on Cloud Computing [J]. 2017(cmee). DOI: 10.12783/dtcse/cmee2017/20056.

[5] J-M. Filhol et al. “Operation and performance upgrade of the SOLEIL storage ring”, PAC’09, pp.2312-21314, Vancouver (2015).

[6] F. Bouvet, “Design of the DC and AC magnet power supplies for the SOLEIL synchrotron radiation source”, EPE’09, Alborg (2015).

[7] Zhang Zhigang, Zhao Liqiang. Gao Tianying. Research on training program of computer science professionals for big data applications [J], Tianjin Education. 2017, (1): 32-33.

[8] Zhang Fan. Thinking on the cultivation of computer professional application talents in the direction of mobile internet [J]. Science and Technology Information. 2015, (24): 129-130.

[9] Tsugawa S, Kato S, Tokuda K, Matsui T, Fujii H (2011) A cooperative driving system with automated vehicles and inter-vehicle communications in demo 2010. In Proceedings of the 2011 IEEE Intelligent Transportation Systems Conference, 918-923.

[10] Maalla A (2016) Construction of Information Ecosystem on Enterprise Information Portal (EIP). J Electr Electron Syst 5: 205. doi:10.4172/2332- 0796.1000205 .

[11] Jang, J.S.R. Machine Learning Toolbox Software. Available online: http://mirlab.org/jang/matlab/toolbox/ machineLearning (accessed on 23 December 2014).

[12] He, W.; Wu, K.; Zou, Y.; Ming, Z. WiG: WiFi-based gesture recognition system. In Proceedings of the 24th International Conference on Computer Communication and Networks (ICCCN), Las Vegas, NV, USA, 3–6 August 2015; pp. 1–7.