Research on Data Analysis Method Based on Open Sharing

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Abstract: Through real-time forwarding of source messages at control system and entire network collection, real-time data platform for grid control truly realizes single-point data collection and network-wide sharing of real-time data under automatic synchronization and maintenance-free based on entire network model, which improves real-time performance as well as operation and maintenance efficiency of entire network in real-time data collection, provides real-time, comprehensive and accurate cross-network real-time data and state estimation data sections for advanced analysis and application of control cloud and new generation control system, and offers strong data support for improving accuracy of application-level analysis results.

1 Introduction

With overall acceleration on construction of large power grids in which UHV AC and DC interconnected, further advancement of electricity marketization reform, and centralized access to large-scale new energy, integrated operation characteristics of large power grids are becoming more and more obvious, and grid dispatching operations are entering a new era. Therefore, grid architecture real-time data platform architecture based on distributed and parallel framework is proposed in this paper, which realizes synchronous collection and processing of grid real-time data, and is applied in Guofen Control Center. Practice has shown that solution proposed in this paper can improve real-time performance of data collection among multi-level regulatory agencies, and meet requirements of entire network on real-time cross-section data analysis and decision-making applications[1-2].

2 System Overall Structure

2.1 Two-level Deployment Method of Real-time Data Platform

As shown in Figure 1, real-time data platform is designed according to overall architecture of regulatory cloud, which adopts two-level deployment method at national and provincial levels.

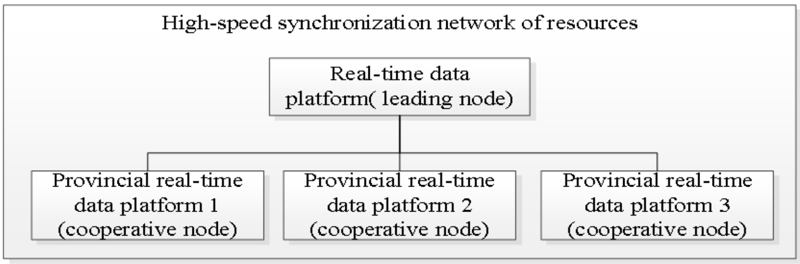
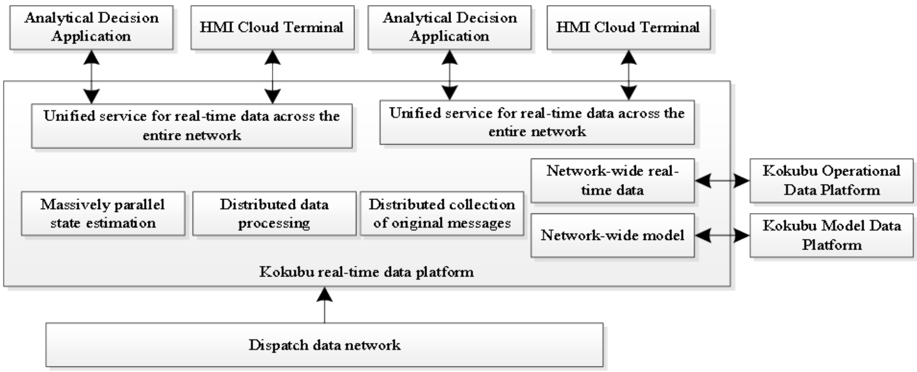


Fig.1 Deployment Diagram of Real-time Data Platform

Among them, leading node in Guofen Real-time Data Platform deploys at least 220kV main network model data to implement corresponding real-time data collection and processing, which focuses on supporting real-time business of main branch in Guofen province, while cooperative node in provincial real-time data platform deploys a least 35kV provincial grid model data to implement corresponding real-time data collection and processing, which focuses on supporting real-time business of local power grids in provinces and counties. Therefore, high-speed synchronous network of resources is used by two-level real-time data platform to deploy unified service of real-time data and achieve real-time data sharing at different voltage levels so that real-time data of entire network and full voltage level can be obtained at leading or coordinating node[3].

2.2 Platform Architecture of Real-time Data

Technical route of real-time data platform leading and cooperating nodes is the same, and technical route of system is focused in this paper from the perspective of Guofen real-time data platform. Real-time data platform architecture is shown in Figure 2.



Fig． 2 Architecture of Real-time Data Platform

3 Key Technologies of Grid Control Real-time Data Platform Architecture

Key technologies of grid control real-time data platform architecture include online grid model synchronization technology, distributed data collection technology, distributed real-time processing technology, large-scale parallel state estimation technology, and real-time data unified service technology.

3.1 On-line Synchronization Technology of Power Grid Model

Grid model online synchronization mainly completes maintenance-free real-time synchronization of grid model and collection point table model on real-time data platform. Meanwhile, control cloud common data object ID coding [10] is adopted to achieve a set of models across the network. In addition, key technologies include RT_ID coding, grid model and collection point table model synchronization technology [4-5].

3.1.1 RT_ID Encoding

Since real-time data platform uses the control cloud general data object ID which is character type to access grid model data on model data platform, RT_ID encoding method is proposed in this paper to meet requirements of efficient processing and real-time data retrieval.

Coding rule of regulating cloud object ID, abbreviated as "SG_ID", adopts "four-segment" method which consists of data objects "large class code", "small class code", "data management agency code" and "serial number". If it is not more than 18 decimal digits, it will be stored in character type. Besides it, real-time data platform RT_ID is designed as two long integer numbers. Type code in SG_ID is removed, and remaining data management agency code and serial number are 14 digits which will be stored in a long integer data after being converted to integers. In addition four-digit type code is converted into 4-digit integer and stored in the second long integer. In order to ensure data scalability, type code is extended to 6-digit storage. For example, a general data object device SG_ID: 110132010000000005 is divided into two parts 1101 and 32010000000005, which will be respectively stored in two unsigned long integers[6-7].

In order to improve efficiency of database access, when RT_ID represents measurement of object, field number of data table will be used to identify measurement, and field number will be stored in lower 4 digits of the second long integer data. Conversion relationship between RT_ID and SG_ID is shown in Figure 3.

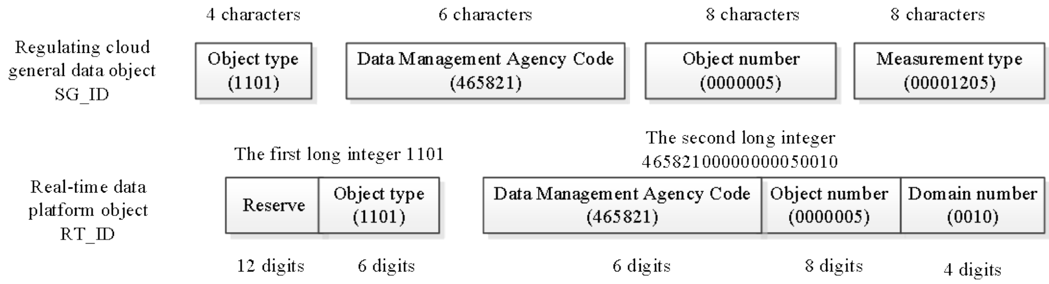


Fig.3 Schematic Diagram of Conversion Relationship between RT_ID and SG_ID

RT_ID of real-time data platform and SG_ID of control cloud can be quickly converted to each other, which can intuitively represent data at the same time, and data processing efficiency is high. Meanwhile, two long integer data used at the same time leave a certain amount of redundant space, and takes into account scalability of data. Moreover, real-time data platform model comes from model data platform, and consistency of model object ID between model object ID and source control system model object ID is solved through SG_ID mapping table. In other words, when extracting objects on control cloud from source control system, mapping relationship table between control system object ID and SG_ID is automatically formed, which provides unified object basis for real-time data platform to collect data from source control system.

3.1.2 Grid Model Synchronization

Real-time data platform obtains grid model from model data platform by means of inventory download and incremental automatic update. Synchronization process is shown in Figure 4.

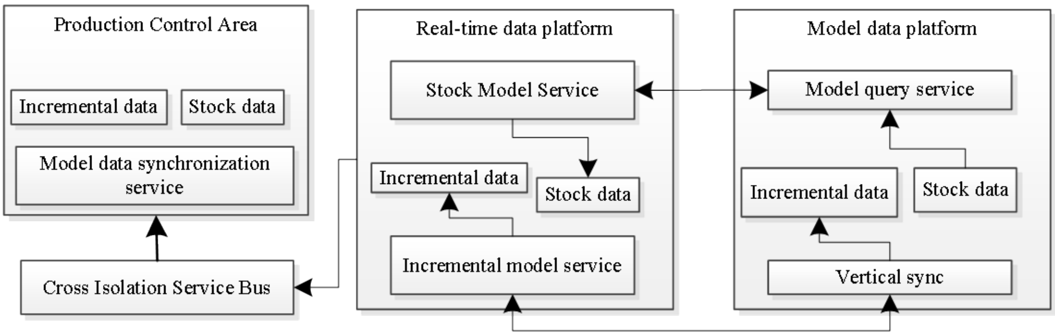


Fig.4 Flow Chart of Power Grid Model Synchronization on Real-time Data Platform

Based on model data platform model tailoring service, full model structured query language (SQL) information is used by stock model download to obtain full power grid model required by real-time data platform through specifying model range, voltage level and other information.

Incremental model synchronization receives incremental model change message of model data platform through wide area service bus, which will be filtered according to subscription scope so that incremental model required on real-time data platform can be formed. Meanwhile, power grid and equipment models on two platforms are periodically compared to realize complement of difference model and ensure consistency of model data platform and real-time data platform model. Therefore, entire process of maintenance and update in power grid model from model data platform to real-time data platform is automated and maintenance-free without human intervention, which truly implements a set of models for entire network.

3.1.3 Collection Point Table Model Synchronization

Collection point table model is used to analyze original message of control system on real-time data platform so that real-time data of corresponding device can be obtained, and collection point table model synchronization adopts incremental synchronization and full synchronization. Moreover, incremental part is triggered synchronization. When control system maintains collection point table model, changed collection point table model will be synchronized to real-time data platform immediately. Besides it, full amount is periodically synchronized, and control system periodically synchronizes all collection point table models to real-time data platform as a supplementary means of consistency verification.

During synchronization of point table model, version number of collected point table model is used to ensure consistency of point table and data message. What's more, control system updates version number when collection point table model changes, and forwards version number in original message. Meanwhile, data on real-time data platform will verify consistency between version number of collection point table model and version number in message. If it is not consistent, real-time data platform does not process the message. Additionally, through automatic generation of collection model files and real-time wide-area transmission of files, synchronization of entire collection point table model is maintenance-free.

3.2 Distributed Gathering Technology of Original Messages

Distributed collection of original messages mainly completes collection of original messages for control systems and plants of national, divided, and provincial systems, where multi-link load balancing and the same protocol link pooling technology are used to ensure efficiency and reliability of data collection so that single point collection of plant data can be realized in control system and shared across entire network. In addition, key technologies include forwarding mechanism, communication link load balancing, and aggregation.

3.2.1 Forwarding Mechanism

Forwarding mechanism of current real-time data among subordinate regulatory agencies is shown in Figure 5. Moreover, multi-level control system is used to forward mature data transmission layer by layer. Taking 220kV plant station data forwarding as an example, it arrives at national survey collection point after being forwarded by multi-level control agency. In addition, data delay exceeds 10s.

Real-time data platform adopts original message aggregation method with control system as a bridge to establish logical direct mining channel between real-time data platform and plant. What's more, control system forwards original message of direct mining channel to real-time data platform, where delay of data transmission network can be reduced to millisecond level, and delay from plant to real-time data platform collection point can be reduced to less than 1 s.

Meanwhile, when forwarding original message on station side, control system adds time stamp information to message end to support subsequent provision of the same time stamp data section for analysis business applications.

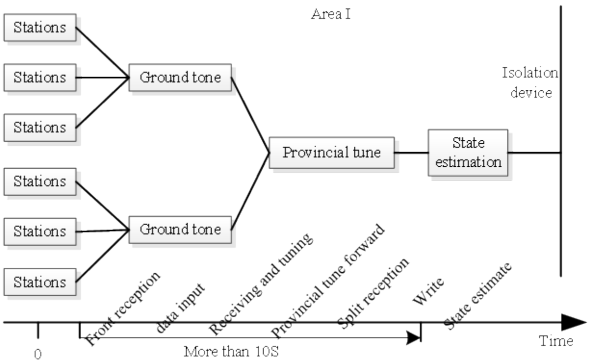


Fig.5 Schematic Diagram of Data Delay Time in Traditional Multi-level Transferring Mode

4 Conclusion

Nowadays, platform is in pilot construction stage, and data of each branch or provincial control system is fully accessed. It will be content that needs to be studied in next step that how to actively explore and discover innovative real-time data business applications based on real-time data collected on platform as well as provide real-time data sharing services for new formats and scenarios.

Acknowledgement

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