

A Method of General Data Interface's Design And Implementation Based On IEC 61850

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Abstract: this article describes a method of general data interface's design and implementation based on IEC 61850. This method puts interface data of communication and other function components in real-time database of the equipment, which also sets up a mapping method of the correlation of IEC 61850 and real-time database storage. And the method uses shared memory as the cushion space of data information exchange by the chain management technology of message blocks and subscribing/publishing distribution mechanism, and it provides a unified interface function for each application function module call. It is easy to implement the unified management of data interface, which can be more effective to complete the information exchange between IEC61850 data and a variety of advanced applications. It reduces the difficulty and complexity of the system integration, and improves the reusability of software.

1 Introduction

IEC61850 is the unified standard for intelligent substation communication, and it is the basis for intelligent substation related standards. This standard establishes the abstract model of the application layer, and describes the data exchange between different interfaces, using object-oriented modeling method, whose data based on the IEC61850 model and the traditional equipment real-time data interface must deal with the mapping between different models and processing. In the past, the substation automation equipment organizes data according to its different function, and communication software processing part has a clear boundary with the application of the function which two parts can interact through the common data area. Communication software doesn't need to converse these data. The data classification method based on IEC61850 is essentially different with this, which also caused difficulties in accessing real-time data based on IEC61850 communication services. Therefore, the design of efficient data interface based on IEC61850, fast access real-time data, improving the independence and reusability of software modules, reducing the coupling degree are particularly important.

Now most of the manufacturers' data models, data interface, the underlying architecture and other standards are not unified. Software and hardware resources' investments are duplicate from the collection data to the data system provided to the station side. large consumption of system resources, slow update of data, data inconsistencies, etc..can bring lots of inconvenience to practical applications.

Based on this situation, this paper presents an efficient and real-time data interface method which can make it easy to achieve unified management. It can complete the interface between IEC61850 data and database, and a variety of advanced application data processing more effectively and directly. There is important practical significance not only for large power grid and intelligent station's development needs, but also for the access of existing equipment.

This design method is applied in many existing engineering examples. The practicality, reusability and stability of the design method are verified by testing feedback.

2 Association and design method of IEC61850 model data and user data

2.1 Application model's mapping module

Application model's mapping module is used to complete the conversion of IEC 61850 communication model and application model. IEC 61850 communication model is a tree structure information. The application function model is usually a table structure. In order to implement the interfacing and mapping, file localIOMap.xml and gseIOMap.xml that are based on the XML format, which are mainly used to configure the mapping relation between IEC61850 model data and user data area. The main contents of these two files are shown in Table 1.

Table 1 the configuration contents of mapping files

local2svrMap.xml	IEC61850 reference and the correlation relationship between shared memory rtdb/localIO. Data (AI, DI) location and RTDB sequence are consistent (both storage structures are not the same) ⁽¹⁾ .	Configure the corresponding relationship between DI and rtdb
		Configure the corresponding relationship between AI and rtdb
		Configure the corresponding relationship between DO and rtdb
		the configuration of constant value
		the configuration of parameters
gseIOMap.xml	GOOSE transceiver functions with configuration files. dynamic configuration of the GOCB transmit-receive control block. IEC61850 reference and shared memory gseIO	Configure gocb to send control blocks
		Configure gocb to receive control blocks
		Configure goose control blocks
		configure logical nodes

Program initialization parsing the files, gseIOMap.xml and Local2svrMap.xml. Write the data received and dispatched by GOOSE and MMS according to the function and configuration in the AI, DI, DO, ST, TR, and IL blocks of files. Configure AI/DI/constant value/ parameter serial numbers to be consistent with the number in RTDB and corresponding to the defining sequence of STRU_DATA_AI/DI/SET/PARA data in the local public variable region.

Other interface application data' mapping relations with IEC61850 data are defined in the localIOMap.xml. interface mapping information includes telemetry, remote signaling, remote control, constant values and parameters, which are shown in figure 1.

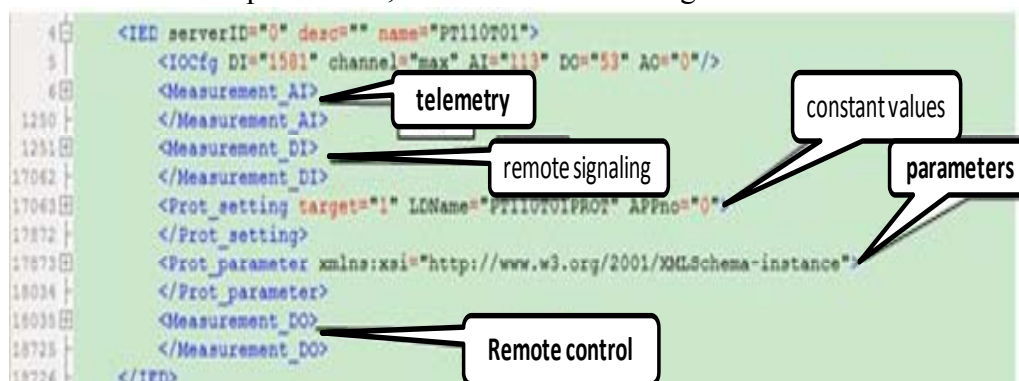


Figure. 1 mapping relations defining in the file localIOMap.xml

2.2 Real-time library interface module

Independently developed real-time database interface module provides a lightweight real-time database and access interface between processes. The real-time database RTDB is located in shared memory, designing the specific interface protocol, and achieving the specific application by using various types of interface functions. The system provides the functions of writing functions or the format and database interaction data, which can be very convenient to update the database. In the library, it can realize the transformation of the object, parameters' boundary check, quality state change, and concurrent coordination, which ensures the safety of database.

Real-time database is mainly divided into two parts, real-time database and extended area. Real-time library's memory size has been compiled with the definition of the macro, but the number of devices and the analog quantity and the switching value of each device are configurable. The database is created dynamically.

Extended area is passed in when the library is set up or applied by the parameters in the the configuring file rtdb.conf. It is a memory area, which is connected to the database, and can be freely used by the database.

2.3 Real-time library configuration file

The two configuring files are real-time library configuration file rtdb.conf and device configuration file stnXX.conf.

These two files are both text files, which can be revised conveniently.

Real-time library configuration file: rtdb.conf

Rtdb.conf is mainly used to describe the amount, names, and coefficients of devices and the amount of each device such as remote signaling and remote communication data.

rtdb.conf text files

stnxx=name, the amount of remote signaling, remote communication, remote controlling, and electric power

extend_size=256 the amount of extended shared memory pages, the unit of which is 4K

station_sum=2 the amount of configure connection devices

#[station]

stn01="local main device",24,48,24,0

stn02="fiber temperature detecting",16,16,0,0

stn03="monitoring main IED ",128,256,32,0

stn04="capacity equipment 1 ",128,256,32,0

.....

Device configurationfile: stnXX.conf

It is a text file, defining the properties of each device such as the analog quantity and the switching value.

For example: stn02.conf

#####

fiber temperature detecting

#####

#[the describing of telemetering]

#=names, types, units, coefficients, null points, control words

AI001=fiber measured point 1,0,0,0.1,0.0,1

AI002=fiber measured point 2,0,0,0.1,0.0,1

AI003=fiber measured point 3,0,0,0.1,0.0,1

.....

#[the describing of remote signaling]

#=names, types, properties, control words

DI001=on-off input 1,0,0,1

DI002=on-off input 2,0,0,1

DI003=on-off input 3,0,0,1

.....

2.4 Message block management

Short and urgent information uses message blocks management, message block chain management and delivery technology to avoid duplication of data when exchanging, which acts quick and saves resources.

The mechanism of message subscribing/ publishing make it possible for each program module to receive the data information which they themselves subscribe, avoiding the disturbing from other data information, which improves the efficiency. Dispatching data information is sent to other information automatically distributed to other procedures to subscribe to the data information of the program module simply and flexibly

The division of message area:

(1)message buffer

It is composed of 512 message block structures, which are used to save the context of

exchanged data information. The message block structure, which is the basic unit of data information of program module exchanging, includes types, the sources, the length, of messages, as well as survival time scale and message data.

(2)message port area

It is composed of 32 message ports used to save registered states and names, subscribed message types, and received message chains.

(3)message chains' index area

It is used to save the chain conditions of message blocks.

(4)free message management area

Record the number of free message blocks and its starting position and end position, realizing centralized and unified management of the free message chain.

(5)the dividing process of messages is shown as Figure.2.

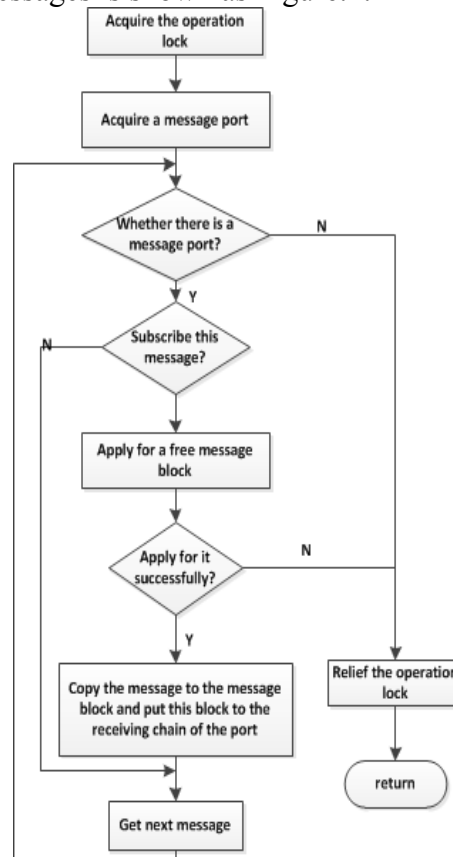


Figure. 2 the dividing process of messages

3 Implementatal method of system data interface based on IEC61850

3.1 Example of protection device interface

Protection device interface example is shown in Figure 3. Protection device accesses in the CPU device based on 61850 through the RS485 interface and 103 protocol access. Related information, telemetry AI, remote DI, remote DO, etc, of the 103 protocol of communication exchange is relevant with real-time database RTDB through real-time database interface function, and short messages or urgent information are managed by message blocks. IEC61850Server is initialized to parse the CID configuration file and the internal mapping file, which accesses real-time database interface function or message access database through real-time database interface functions, so that the relevance of the data based on the IEC61850 and other application function achieves.

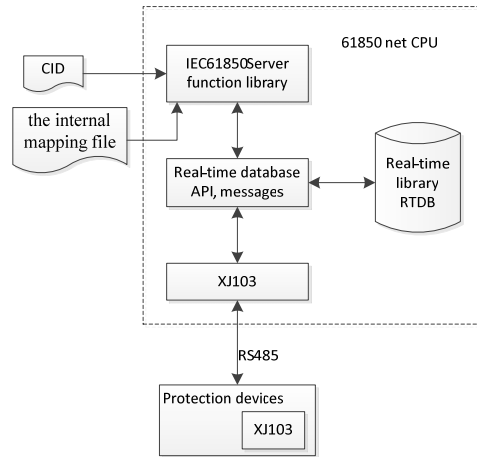


Figure. 3 “And” protection device interface example

3.2 The process of telemetry, remote signal interface functions

Through the opening-inserting received by GOOSE, the warning state, the local switching input, SV sampling values and local device’s analog, through the AI/DI computing, they are written into real-time database or shared memory according to different functions and the database interface function format. IEC61850 communication library read the database according to the internal mapping file and relevant the data to IEC 61850 database. IEC61850Server packages the data into data packets according to the MMS protocol format after reading the data, and send the report to the IEC61850Client side according to the form of data set. The changed data can be sent to the IEC61850Client terminal through the corresponding port, and IEC61850Client terminal read the report to show AI/DI and other information.

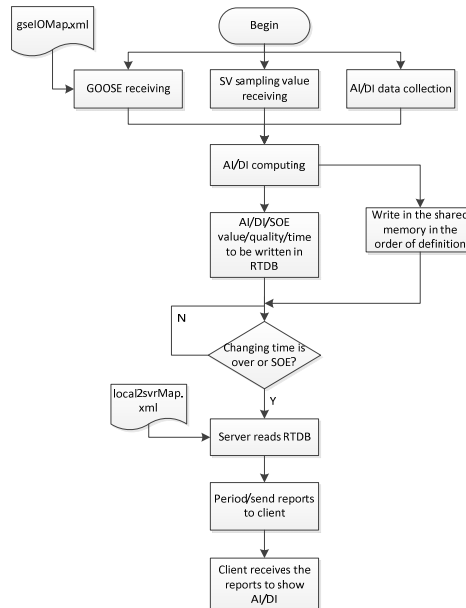


Figure. 4 the process of AI, DI interface functions

4 Conclusions

In this paper, the method is that the IEC61850 communication modules collaborate other application interface module real-time library, message bus and shared memory to exchange information and avoid the information island, which is also suitable for the implementation of interface processing after the protocol conversion. The design and implementation of general interface based on IEC61850 standard make different applications, such as protection, measurement-control and intelligent components, exchange data conveniently. And the data information of existing intelligent equipment of data can be supplied with a fixed integrated management to protect the system data’ integrity and to reduce the cost of system integration, which

has important significance on the upgrading and rebuilding of current smart grids.

The real-time database is fully developed, and it is simple and efficient, and it can guarantee the real-time performance of data. The real-time database RTDB is located in shared memory. Bidirectional real-time interaction between routine and conventional power protocol and IEC61850 protocol can be realized.

The method has solved the IEC61850 based model data and other application data interface implementation method, proposing the overall solution, and improving the data access speed. The design is based on the existing basis, considering both the matching of IEC61850 model and service, and the compatibility with the traditional data interface.

The interface method described in this paper is applied in Linux and VxWorks operating system. The key technology research and preparation of IEC61850 communication and data interaction tests are conducted on the basis of IEC61850 standard. The independence, reusability and stability of the interface can meet the application requirements and achieve the expected goal, and the development of the IEC61850 standard in the power system is promoted.

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