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IEC 61850을 이용한 새로운 결합 극복형 시스템 응용

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The application of IEC61850 in a new anti-fault substation system

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Abstract - The compatibility between different automation devices hasn't been difficult any longer while the new standard IEC61850 is imposed which provides efficient implementation on both embedded and non-embedded system. While implementing the substation automation, different devices from different company may be an obstacle to system designing. However, with the help of IEC61850 this problem can be neglected. In this paper the newest development of the demo system based on IEC61850 will be introduced.

1. Introduction

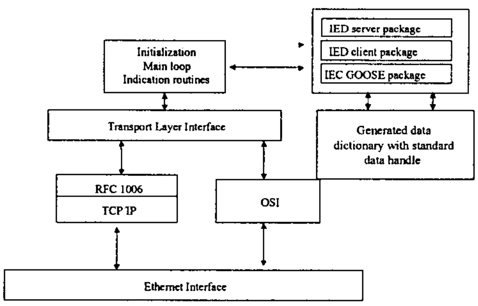
While implementing the power system, the compatibility of assembling IEDs from different manufactures cannot be guaranteed. The research to the substation automation standard began in USA and in Europe at the beginning of 1990s. In USA, UCA 2.0 was imposed, while in Europe IEC61850 was created. These two standards united into the IEC61850, in which the data model and service of UCA was still reserved to ensure the compatibility of the two standards[1].

In power system, if the fault cannot be affirmed and corrected in time, the whole power supply will come to the paralysis. Therefore the protective IED of detecting the fault is necessary. Meanwhile, even if the IED meets a hardware or software disability the system must be sure of working on. So the redundant IED is referred to. This backup IED must include all the features of the IEDs used in power system. In the second part of the paper, the software method will be introduced to implement the IED.

2. Related Work

2.1 Architecture

The architecture of the routine is shown as follows:



<Fig 1> The architecture of the routine in IED

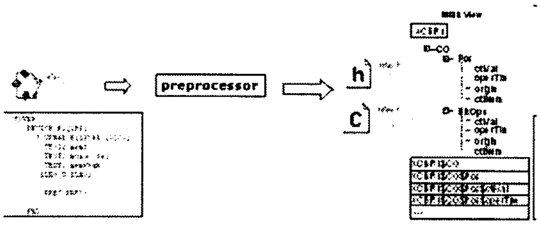
It can be concluded into three parts: dictionary generation, network connection and functional user package.

2.2 Data structure of power system

The initialization and operation of data structure in this software scheme presented use the scheme offered by Tamarack, named ObjectPrep, which is a preprocessor to generate the dictionaries using the object models derived from those standardized in IEC61850.[2]

The ObjectPrep tool generates 'C' source code considered as a dictionary representing the server. This dictionary can be compiled into small-embedded systems and served on the network. The run-time generation mechanism uses the ObjectPrep tool to generate a 'C' language file encoding the object class hierarchy to be supported in the device. This object class hierarchy can contain (for example) the entire set of IEC 61850 class definitions, or it may be contain a user-selectable subclass, according to the feature of this tool, it can satisfy the demand of a backup IED which includes all the information of the whole system.

The input of ObjectPrep takes in the form of a text file containing descriptions of class structures as defined in IEC 61850 PART 7-2, 7-3, and 7-4 using a specified language. The output "C" source dictionary is used as a common format to maintain the linking between the real data of the device and the abstract objects.

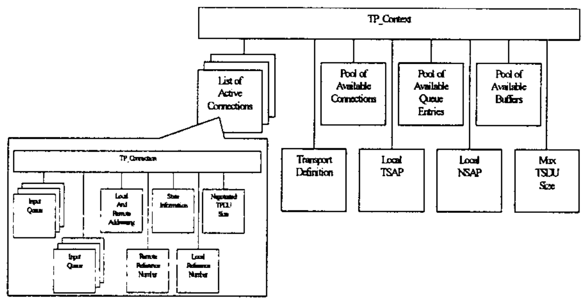


<Fig 2> The process of abstract data structure creation

In figure 2 shown above, an example is imposed. modify the file "relay" to select whatever you want to implement in this IED. this design will convenience the user while initializing the IED and provide a friendly interface to the user.

2.3 Network configuration

The following figure 3 shows the connection handle definition. the TP_Connection defines some pools and buffers for storing the potential "connection", if the connection event occurs, TP_Connection, the handle of this connection with details, will be added into relevant pool area. The main loop will enquire the handle of TP_Context for the network information.



<Fig 3> The structure for network configuration

TP_Connection contains information specific to a connection. The input and output queues are maintained per connection, including send and receive sequence numbers. Addressing information (local/remote TSAP and NSAP, remote MAC address) are stored within the connection record. State information maintained consists of the actual connection state, as well as a count of the number of TSDUs waiting to be delivered to the user application.[3]

2.3.1 Input management

the routine will be triggered to scan input using the socket select function on the data socket created for the connection while the list of active connection is called to refresh. If data is available to be read, the following actions are performed based on the state of the input parse:

① Parsing RFC1006 length.
② Parsing TPO length.
③ Parsing TPO header.
④ Allocating TPO body.
⑤ Parsing TPO body.

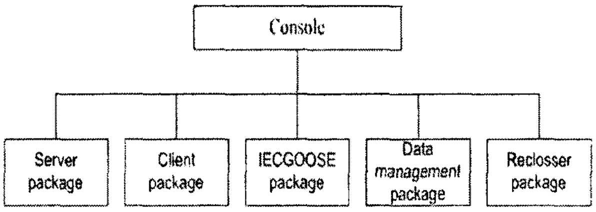
2.3.2 Output management

the output routine will be triggered when it receive a sending command. First the TSDU should be partitioned according to the defined buffer size in transport context. And the segment will be placed on a output queue and sent into the output socket stream. After the process ,empty the buffer and the pool, then enter into the next circle.

2.4 Functional user package

The functional user package is the kernel of a IED, It determined the property and functionality of the IED. If we implement the circuit breaker algorithm in it ,it turns to be a circuit breaker. Of course ,the backup IED should include all algorithms available and management function to control the algorithms.

In the demo IED, server package, client package, IECGOOSE package, data management package and recloser package have been implemented to test the feasibility, as well as only two LNs implemented. Fig 4 shows that.



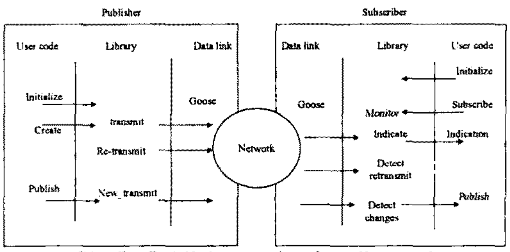
<Fig 4> The components of demo IED

In server and client package, MMS services (read, write, status, file, delete service) are implemented. So the console can directly switch the working mode between client and server. In this way it is very convenient while administrator wants to access the data located in other IED, and there is no need to reboot the IED to transfer the role of it. Data management package is a special design for local data initialization, acquirement and modification. the functions are listed below:

<Table 1> Data package functions

Function	Description
Read	Read the variable
Write	Write variable
ReadNVL	Read MMS Named Variable List
WriteNVL	Write MMS Named Variable List
ListNV	List variable
Include	Include commands from file

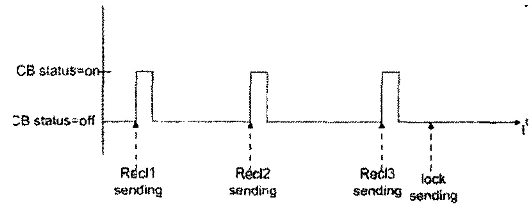
The IECGOOSE package includes two parts: subscriber and publisher.



<Fig 5> Publisher and subscriber pair

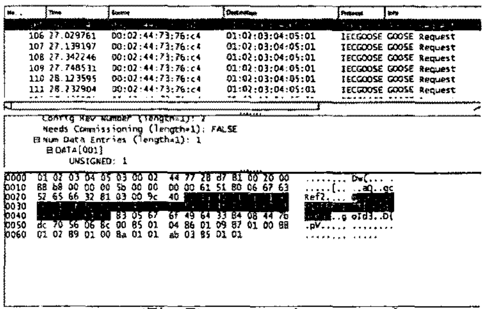
As it is shown in fig 5, the subscriber first initialize the goose handle and begin the loop of monitoring the input active goose pool. If there is a input goose corresponding to the handle, the subscriber start to decode the goose message and offer the data to up layer services. In the other peer, the publisher will first fill in the GOOSEPDU with the information administrator defined, then, send the PDU to data link layer and broadcast out, Meanwhile startup the retransmit mechanism and trance the retransmit response. Certainly, the routine goose package supply a user interface for high level development, for example, the recloser package.

The recloser package not only include the recloser algorithm but also support the interface for goose. This algorithm monitors the incoming status goose message from circuit breaker, distills and identifies the data, if needed, broadcast the reclose message to inform the circuit breaker to close the circuit. the concrete process is shown in fig 6.



<Fig 6> Recloser course

3 The result of messages' sending



<Fig 7> captured goose pdu

Figure 7 shows the content of the goose pdu which is sent when goose control block detect the value of the named variable "E1Q1BP1/RRECSTOp$general" turns from "false" to "true" the goose mechanism produce a new goose message to inform the circuit breaker to open the circuit.

3. Conclusion

In this paper, a new software architecture frame for implementing IEC 61850 is imposed, which provides for a simple, modular approach to build high performance embedded implementations of IEC 61850. The further development based on this architecture typically requires very little custom, device-specific code. A demo IED has been already achieved and tested conforming to the architecture. The maneuverability and practicability very adapt to the demand of future power system implementation.

Acknowledge

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Reference

[1] http://www.61970.com/data/2006/0115/article_4826.htm
[2] tamarack document ObjectPrep Reference Manual pages: 4-5
[3] tamarack document RFC1006 transport interface pages: 4-6