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IEC 61850 Implementation Aspects in Research Centre «BRESLER» Devices

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1 INTRODUCTION

Ability to use digital communication interfaces is one of the most important advantages of modern intelligent protection equipment. During the last years such interfaces were developed from highly specialized protocols to international standards DNP3, IEC 60870 etc.

Today the most attention is attracted to IEC 61850. Developing of this standard was required because of increasing amount of intelligent electronic devices (IEDs) on substations, increasing of communication capacity, requirements to simplify and systematize of substation engineering. Use of this standard instead of the classical SCADA-standards affects not only SCADA processes. There is a lot of aspects influenced by this standard, such as IED's cooperation, self-diagnostics, testing of IEDs and whole system.

At present in Russia the introduction of the standard depends primarily on economic reasons. In short-term perspective using of this standard is in scope of SCADA system functions. First of all, it depends on protection IED's responsibility, as well as technological challenges related to using IEC 61850. But potentially the useability of this standard is much wider.

2 IEC 61850 COMPLIANT IED DEVELOPMENT AND USAGE ASPECTS

2.1 Features of IEC 61850

There are a lot of unique features of IEC 61850. One of the main improvements is the ability to organize horizontal exchange between protection, control and measuring IEDs. It is achieved by using special high-speed peer-to-peer or multicast GOOSE and sampled analog values data transfer. Standardization and simplification of configuration of substation exchange system is the goal for application modeling principles and self-description.

Using of SCL, based on widely known Extensible Markup Language (XML), to describe and configure IEC 61850 based systems, makes it possible to elaborate a system at a first stage, without focus on any specific devices and manufacturers.

Features of new standard are well-described and considered in articles [1-5].

Most protection IEDs allow to change behavior of devices, to add or remove some functions. This feature is called "flexible logic". Usually customer can reorganize interconnection between basic functional blocks using some basic logic or mathematics functions. This feature helps consumer to easily adapt protection algorithms to specific conditions and allows the manufacturer to reduce the range of products.

Devices based on “flexible logics” are much more complicated for integration in a SCADA system, because of dynamic data and function structure of device. The same devices may have different amount and purpose of data sets.

IEC61850 solves this problem using self-description principle. IED reports its structure to substation configuration system. The object hierarchy consists of information about the set of functions, parameters, data sets, permissions (fig. 1).

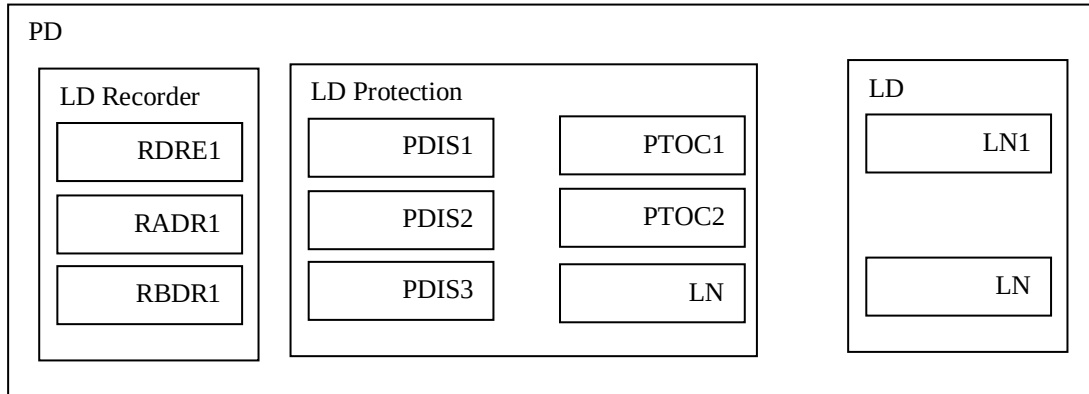


Fig. 1: Functional hierarchy example

Due to the ability of fast exchange between devices provided by IEC61850, IEDs can communicate not only with SCADA, but also between themselves via process or station bus. There is a lot of data transferred through communication cables, therefore using of this standard depends on high-speed and highly reliable communication system. However, this is not the only problem. Important issue for substation is configuring IEDs interaction for distributed protection functions, sampled data transfer and interlocking. To achieve the goal one needs some IEC61850 design CAD system, which is based on well-known principles and does not require deep knowledge of standard. This system should organize interoperability between IEDs using Substation Configuration Language (SCL) defined in IEC 61850.

2.2 IEC 61850 implementation aspects

Working with SCADA based on IEC 61850 without using of horizontal communication and process bus, IED acting just as IEC 61850 MMS server, and does not require high performance. For applications used distributed functions, IEDs interacting, and samples from intelligent measuring devices, requirements on communication throughput and IEDs packet processing increases significantly [6]. In such circumstances it becomes important to minimize the time processing of incoming fast packets, such as GOOSE and Sampled Values. Use of communication controllers and protocol converters is not good solution because of additional delay in transfer and processing data. Therefore, IEDs with such functionality must be specifically focused on the rapid processing of the fast packets.

To achieve the goal of using IED in substation distributed functions, organized on the basis of IEC61850, manufacturers must pay special attention to the problems of time synchronization and self-diagnostics. It is very important to provide precise time synchronization between the devices to work properly. IED's self-diagnostics should also move to a new level of high integration. The application of IEDs interaction makes it necessary to use self-diagnostic information of data supplier in dependent functions. This information may be used to build smart reasonable algorithm downgrade in distributed functions.

Note that despite the high communication capacity of Ethernet, it is necessary to separate the process bus from the station bus. It makes requirements to IED's Ethernet ports number – at least two. Experience of working with Ethernet for the needs of IEC 61850 shows that it is very suitable for using in auxiliary functions. Ability to synchronize the device from time servers SNTP/NTP and PTP is a good alternative to system based on receivers of GPS/GLONASS. Such a method is recommended in IEC 61850 [7,8].

Another usable feature is FTP file server which provides possibility to easy and fast downloads from IED data files like disturbance records, event logs, and more. And, last but not least, one can use any modern file-manager with built-in FTP-client.

Implementation of HTTP-server in device allows you to organize independent personal monitoring and control system without the need to use specialized service software. One can use it with any popular internet browser.

Despite the wide range of benefits and convenient features of IEC 61850, there are some negative aspects:

- the complexity of the standard leads to long time of implementation, greatly complicates the debugging and testing of software;
- the standard is not complete yet, is not so far off the official publication of the second version of the standard and this may lead to increasing troubles of interoperability between different vendors;
- IEC 61850 compatible IED today is more expensive, more complicated, requires high competent service, more advanced software;
- using of the standard on substations requires additional trainings for personnel;
- there is also some concern about reliability of data transfer and information security.

3 CONCLUSION

IEC 61850 takes a strong position in SCADA integration, in spite of serious difficulties encountered in industrial application and development of this standard in Russia. Using a standard for transmission of instant data is a reason for doubting of domestic experts. Process bus and distributed functions are the tasks for the nearest future. In a short time the second edition of the standard will be issued, supplemented and modified. It shows the serious intentions of research group and their focus on future.

REFERENCES

- [1] Apostolov.A.P. Communications in IEC61850 Based Substation Automation Systems, 2006 Power Systems Conference Advanced Metering Protection Control Communication and Distributed Resources, 51-56.
- [2] Mackiewicz R.E. Technical Overview and Benefits of the IEC61850 Standard for Substation Automation, Transmission and Distribution Conference and Exhibition, 2005/2006 IEEE PES, 2006.
- [3] Golubev S.V., Golikov I.N. Building of SCADA based on IEC 61850 from Research Centre “Bresler”, Relay protection and automation in power systems-2008: Transactions of XVIII scientific and technical conference, M.,2008.
- [4] Orlov L.L., Egorov D.V. IEC 61850 – the new standard for substation automatisisation systems, *Electrichestkie stancii*. 2009.№ 11.
- [5] Ivanov U.V., Borodin O.S., Lesnov A.E., Aprosin K.I. Practical experience of IEC 61850 using and development in power system protection. Actual status and prospects, Relay protection and automation in power systems-2010: Transactions of XX scientific and technical conference. M.,2010.
- [6] IEC 61850. Part 5: Communication requirements for functions and device models.
- [7] IEC 61850. Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI).
- [8] IEC 61850. Part 8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3.