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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Communication networks and systems for power utility automation – Part 5: Communication requirements for functions and device models

Réseaux et systèmes de communication pour l'automatisation des systèmes électriques – Partie 5: Exigences de communication pour les modèles de fonctions et d'appareils

IEC 61850-5:2013

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Réseaux et systèmes de communication pour l'automatisation des systèmes électriques – Partie 5: Exigences de communication pour les modèles de fonctions et d'appareils

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 5: Communication requirements for functions and device models

FOREWORD

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International Standard IEC 61850-5 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2003. It constitutes a technical revision.

The major technical changes with regard to the previous edition are as follows:

– extension from substation automation systems to utility automation systems;
– including the interfaces for communication between substations (interfaces 2 and 11);
– requirements from communication beyond the boundary of the substation.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/1286/FDIS	57/1309/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 61850 series, published under the general title *Communication networks and systems for power utility automation,* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 61850 is part of set of standards, the IEC 61850 series. The IEC 61850 series is intended to provide interoperability between all devices in power utility automation systems. Therefore, it defines communication networks and systems for power utility automation, and more specially the communication architecture for subsystems like substation automation systems. The sum of all subsystems may result also in the description of the communication architecture for the overall power system management.

Communication between these devices in subsystems and between the subsystems within the overall power utility automation system fulfils a lot of requirements imposed by all the functions to be performed in power utility automation systems starting from the core requirements in substations. These requirements are stated both for the data to be organized in a data model and for the data exchange resulting in services. Performance of the data exchange means not only transfer times but also the quality of the data exchange avoiding losses of information in the communication.

Depending on the philosophy both of the vendor and the user and on the state-of-the-art in technology, the allocation of functions to devices and control levels is not commonly fixed. Therefore, the standard shall support any allocation of functions. This results in different requirements for the different communication interfaces within the substation or plant, at its border and beyond.

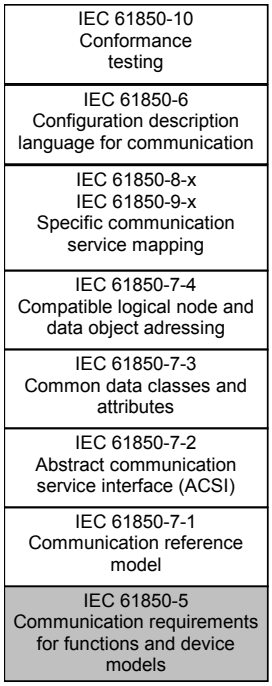
The standard series shall be long living but allow following the fast changes in communication technology by both its technical approach and its document structure. Figure 1 shows the relationship of Part 5 to subsequent parts of IEC 61850 series.

The standard series IEC 61850 has been organized so that at least minor changes to one part do not require a significant rewriting of another part. For example, the derived data models in subsequent parts (IEC 61850-7-x) and mappings to dedicated stacks (IEC 61850-8-x and IEC 61850-9-x) based on the communication requirements in Part 5 will not change the requirements defined in Part 5. In addition, the general parts, the requirement specification and the modelling parts are independent from any implementation. The implementation needed for the use of the standard is defined in some few dedicated parts referring to main stream communication means thus supporting the long living of the standard and its potential for later technical changes.

This Part 5 of the standard IEC 61850 defines the communication requirements for functions and device models for power utility automation systems.

The modelling of communication requires the definition of objects (e.g., data objects, data sets, report control, log control) and services accessing the objects (e.g., get, set, report, create, delete). This is defined in Part 7 with a clear interface to implementation. To use the benefits of communication technology, in this standard no new protocol stacks are defined but a standardized mapping on existing stacks is given in Part 8 and Part 9. A System configuration language (Part 6) for strong formal description of the system usable for software tools and a standardized conformance testing (Part 10) complement the standard. Figure 1 shows the general structure of the documents of IEC 61850 as well as the position of the clauses defined in this document.

NOTE To keep the layered approach of the standard not mixing application and implementation requirements, terms like client, server, data objects, etc. are normally not used in Part 5 (requirements). In Parts 7 (modelling), 8 and 9 (specific communication service mapping) terms belonging to application requirements like PICOM are normally not used.



IEC 2379/12

Figure 1 – Relative position of this part of the standard

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 5: Communication requirements for functions and device models

1 Scope

This part of IEC 61850 applies to power utility automation systems with the core part of substation automation systems (SAS). It standardizes the communication between intelligent electronic devices (IEDs) and defines the related system requirements to be supported.

The specifications of this part refer to the communication requirements of the functions in power automation systems. Most examples of functions and their communication requirements in this part are originated primarily from the substation automation domain and may be reused or extended for other domains within power utility automation if applicable. Note that sometimes instead of the term substation automation domain the term substation domain is used, especially if both the switchyard devices (primary system) and the automation system (secondary system) is regarded.

The description of the functions is not used to standardize the functions, but to identify communication requirements between Intelligent Electronic Devices within plants and substations in the power system, between such stations s (e.g. between substation for line protection) and between the plant or substation and higher-level remote operating places (e.g. network control centres) and maintenance places. Also interfaces to remote technical services (e.g. maintenance centres) are considered. The general scope is the communication requirements for power utility automation systems. The basic goal is interoperability for all interactions providing a seamless communication system for the overall power system management.

Standardizing functions and their implementation is completely outside the scope of this standard. Therefore, it cannot be assumed a single philosophy of allocating functions to devices. To support the resulting request for free allocation of functions, a proper breakdown of functions into parts relevant for communication is defined. The exchanged data and their required performance are defined.

The same or similar intelligent electronic devices from substations like protective and control devices are found in other installations like power plants also. Using this standard for such devices in these plants facilitates the system integration e.g. between the power plant control and the related substation automation system. For some of such other application domains like wind power plants, hydro power plants and distributed energy resources specific standard parts according to IEC 61850 series have been already defined and published.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61000-4-15, *Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications*

IEC/TS 61850-2, *Communication networks and systems in substations – Part 2: Glossary*

IEC 61850-6, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs*

IEC 81346 (all parts), *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations*

Cigre JWG 34./35.11 – *Protection using Telecommunication, Cigre Technical Brochure (TB) 192* (111 pages), 2007

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC/TS 61850-2, as well as the following apply.

3.1 General

3.1.1
application function
task, which is performed in or by power utility automation systems

Note 1 to entry: Generally, a function consists of subparts which may be distributed to different IEDs, which exchange data with each other. More precisely these sub-functions implemented in the IEDs exchange data. Also between different functions data are exchanged. The exchanged data exposed to the communication system shall be standardized based on the semantic content to be understandable by the receiving function. For this purpose the standard groups the exchanged data in objects called Logical Nodes which refer to the name of the allocated functions by their mnemonic name.

3.1.2
local function
function which is performed by sub-functions in one physical device

Note 1 to entry: If the performance of the functions is not depending on functions in other devices no standardized link is needed. Sometimes, functions with a weak dependency only from other ones are also called local functions. The loss of such links should not result in blocking these functions but in worst case to some graceful degradation.

3.1.3
distributed function
function which is performed by sub-functions in two or more different physical devices

Note 1 to entry: The exchanged data is contained in Logical Nodes having a common semantic reference to the distributed function. Since all functions communicate in some way, the definition of a local or a distributed function is not unique but depends on the definition of the functional steps to be performed until the function is defined as complete In case of losing the data of one Logical Node or losing one included communication link the function may be blocked completely or show a graceful degradation if applicable.

3.1.4
system
set of interacting entities which perform a common functionality

Note 1 to entry: The backbone of the system is the data exchange.

3.1.5
logical system
communicating set of all application functions performing some overall task like “management of a substation” or “management of a plant”

Note 1 to entry: The boundary of a logical system is given by its logical interfaces. The backbone of the logical system is the communication relationship between its functions and sub-functions. The exchanged data are grouped in Logical Nodes.

3.1.6
physical system
set of all interacting devices hosting the application functions and the interconnecting physical communication network

Note 1 to entry: The boundary of a physical system is given by its physical interfaces. Examples are industrial systems, management systems, information systems, and within the scope of this standard, substation or power utility automation systems. The backbone of physical system is its communication system together with all implemented data.

3.1.7
substation automation system
system which operates, protects, monitors, etc. the substation, i.e. the primary system

Note 1 to entry: For this purpose it uses fully numerical technology and digital communication links (LAN as communication system).

Note 2 to entry: See 3.1.9 for a definition of primary system.

3.1.8
secondary system
power utility automation system
interacting set of all components and subsystems to operate, to protect and to monitor the primary system

Note 1 to entry: In case of full application of numerical technology, the secondary system is synonymous with the power utility automation system. For this purpose it uses fully numerical technology and digital communication links (WAN as communication system). Substation automation systems are one kind of power utility automation systems responsible for the nodes in the power system or power grid.

Note 2 to entry: See 3.1.9 for a definition of primary system.

3.1.9
primary system
power system
set of all components for generating, transmitting and distributing electrical energy

Note 1 to entry: Parts of the power system are also all consumers of electrical energy.

Note 2 to entry: Examples are generators, power transformers, switchgear in substations, overhead line and cables.

3.1.10
communication system
interconnected set of all communication links

Note 1 to entry: Depending on the size it is called either LAN (local area network) as used in substations or plants, or WAN (wide area network) as used globally in the power utility system.

3.1.11
device
mechanism or piece of equipment designed to serve a purpose or perform a function

Note 1 to entry: Communication relevant properties are described in the related device model.

Note 2 to entry: Examples are a breaker, relay, or the computer of the operator's work place.

3.1.12
intelligent electronic device
IED
device incorporating one or more processors with the capability to execute application functions, store data locally in a memory and exchange data with other IEDs (sources or sinks) over a digital link