IEC 61850-5

Edition 2.0 2022-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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AMENDMENT 1
AMENDEMENT 1

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 fonctions et les modèles d'appareils

IEC 61850-5:2013-01/AMD1:2022-03(en-fr)

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

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 5: Communication requirements for functions and device models

AMENDMENT 1

FOREWORD

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Amendment 1 to IEC 61850-5:2013 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

Draft	Report on voting
57/2448/FDIS	57/2467/RVD

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

The language used for the development of this Amendment is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications/.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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FOREWORD

In the FOREWORD, below item 9), replace the first paragraph through the third paragraph including its bullet points with the following new paragraphs:

International Standard IEC 61850-5 Edition 2 and its Amendment 1 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

DISCLAIMER

This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This consolidated version of IEC 61850-5:2013 bears the edition number 2.1. It replaces the second edition (2013-01) and its amendment (2021-XX). The technical content is identical to the base edition and its Amendment.

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

The changes, corrections and updates have been made mainly according to the comments received.

The major changes of this consolidated version with regard to Edition 2 are as follows:

a) extensions of the requirements with some Logical Nodes;
b) errors and typos have been corrected;
c) harmonization of all Logical Node descriptions (impact on all Logical Node tables);
d) re-organization of selected clause structures;
e) updating of headlines;
f) re-ordering subclauses in the chapter about performances.

to provide

– ease of reading and understanding of the requirements for the IEC 61850 series
– consistent and updated requirement references for the data model and communication service parts

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INTRODUCTION

Delete the existing fourth paragraph of the Introduction. Replace the existing text of the fifth paragraph of the Introduction with the following new text:

The IEC 61850 series shall be long living but allow following the fast changes in communication technology by both its technical approach and its document structure. The IEC 61850 series 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 IEC 61850-5 will not change the requirements defined in IEC 61850-5. 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.

Replace the existing text of the sixth paragraph of the Introduction with the following new text:

This consolidated version of IEC 61850-5:2013 and its Amendment 1 defines the communication requirements for functions and device models for power utility automation systems.

Replace the existing text of the seventh paragraph and the Note of the Introduction with the following new text:

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 IEC 61850-7 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 IEC 61850-8 and IEC 61850-9. A System configuration language (IEC 61850-6) for strong formal description of the system usable for software tools and a standardized conformance testing (IEC 61850-10) complement the standard.

NOTE 1 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 IEC 61850-5 (requirements). In IEC 61850-7 (modelling), -8 and -9 (specific communication service mapping) terms belonging to application requirements like PICOM are normally not used.

NOTE 2 Specific requirements concerning extensions of part 8 are covered in separate technical reports, e.g. IEC TR 61850-80-3.

Figure 1 – Relative position of this part of the standard

Delete existing Figure 1.

1 Scope

Replace the existing text of Clause 1 by the following new text:

The specifications of this document refer to general, respectively core, communication requirements of the application functions in all domains of power utility automation systems. Dedicated communication requirements and most examples of application functions in this document are from the domain substation automation but may be reused in or extended to other domains within power utility automation systems. 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) are regarded.

The description of the application functions is not used to standardize these functions, but to identify communication requirements between Intelligent Electronic Devices (IEDs) hosting these functions within plants and substations in the power system, between such stations (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. In addition 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. Another prerequisite for interoperability is a commonly defined method for time synchronization.

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

The same or similar IEDs from substations like protective and control devices are found in other domains like power plants also. Using this document 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 the IEC 61850 series have been already defined and published.

2 Normative references

Replace the existing text of Clause 2 by the following new text:

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 60617, *Graphical symbols for diagrams – 12-month subscription to regularly updated online database comprising parts 2 to 13 of IEC 60617*

IEC 60834-1:1999, *Teleprotection equipment of power systems – Performance and testing – Part 1: Command systems*

IEC 60834-2:1993, *Performance and testing of teleprotection equipment of power systems – Part 2: Analogue comparison systems*

IEC 60870-4:1990, *Telecontrol equipment and systems. Part 4: Performance requirements*

IEC 60870-5 (all parts), *Telecontrol equipment and systems – Part 5: Transmission protocols*

IEC 61000-4-15:2010, *Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications*

IEC 61000-4-30:2015, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC TR 61850-1:2013, *Communication networks and systems for power utility automation – Part 1: Introduction and overview*

IEC TS 61850-2:2019, *Communication networks and systems for power utility automation – Part 2: Glossary*

IEC 61850-3:2013, *Communication networks and systems for power utility automation – Part 3: General requirements*

IEC 61850-4:2011, *Communication networks and systems for power utility automation – Part 4: System and project management*

IEC 61850-6:2009, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs*
IEC 61850-6:2009/AMD1:2018

IEC 61850-7-1:2011, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and models*
IEC 61850-7-1:2011/AMD1:2020

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*
IEC 61850-7-2:2010/AMD1:2020

IEC 61850-7-3:2010, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*
IEC 61850-7-3:2010/AMD1:2020

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*
IEC 61850-7-4:2010/AMD1:2020

IEC TR 61850-7-5, *Communication networks and systems for power utility automation – Part 7-5: IEC 61850 modelling concepts*

IEC TR 61850-7-500:2017, *Communication networks and systems for power utility automation – Part 7-500: Basic information and communication structure – Use of logical nodes for modeling application functions and related concepts and guidelines for substations*

IEC TR 61850-7-510:2012, *Communication networks and systems for power utility automation – Part 7-510: Basic communication structure – Hydroelectric power plants – Modelling concepts and guidelines*

IEC TR 61850-7-6:2019, *Communication networks and systems for power utility automation – Part 7-6: Guideline for definition of Basic Application Profiles (BAPs) using IEC 61850*

IEC TS 61850-7-7:2018, *Communication networks and systems for power utility automation – Part 7-7: Machine-processable format of IEC 61850-related data models for tools*

IEC 61850-8-1:2011, *Communication networks and systems for power utility automation – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*
IEC 61850-8-1:2011/AMD1:2020

IEC 61850-8-2:2018, *Communication networks and systems for power utility automation – Part 8-2: Specific communication service mapping (SCSM) – Mapping to Extensible Messaging Presence Protocol (XMPP)*

IEC 61850-9-2:2011, *Communication networks and systems for power utility automation – Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3*
IEC 61850-9-2:2011/AMD1:2020

IEC/IEEE 61850-9-3:2016, *Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation*

IEC 61850-10:2012, *Communication networks and systems for power utility automation – Part 10: Conformance testing*

IEC TR 61850-80-3:2015, *Communication networks and systems for power utility automation – Part 80-3: Mapping to web protocols – Requirements and technical choices*

IEC TR 61850-90-1:2010, *Communication networks and systems for power utility automation – Part 90-1: Use of IEC 61850 for the communication between substations*

IEC TR 61850-90-2:2016, *Communication networks and systems for power utility automation – Part 90-2: Using IEC 61850 for communication between substations and control centres*

IEC TR 61850-90-4:2020, *Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines*

IEC TR 61850-90-5:2012, *Communication networks and systems for power utility automation – Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118*

IEC TR 61850-90-12:2020, *Communication networks and systems for power utility automation – Part 90-12: Wide area network engineering guidelines*

IEC 61869 (all parts), *Instrument transformers*

IEC TR 62357-1:2016, *Power systems management and associated information exchange – Part 1: Reference architecture*

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

IEEE Std C37.2-2008, *Electrical Power System Device Function Numbers, Acronyms and Contact Designations*

3 Terms and definitions

Replace the existing text of the first two paragraphs of Clause 3 by the following new text:

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 General

Replace the existing text of terms and definitions 3.1.1 to 3.1.4 with the following new text:

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

Note 1 to entry: Generally, an application 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
application 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
application 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.

3.1.16
logical node (LN)

Replace the existing text of term 3.1.16 with the following new text:

3.1.16
Logical Node (LN)

3.2 Connections

3.2.1
logical connection

Replace the existing text of definition 3.2.1 by the following new text:

communication link between application functions represented by Logical Nodes

3.2.2
physical connection

Replace the existing text of definition 3.2.2 by the following new text:

communication link between intelligent electronic devices (IEDs) and is providing all logical connections for the implemented application functions represented by Logical Nodes

3.2.4
hidden connection

Replace the existing text of the note to 3.2.4 by the following new text:

Note 1 to entry: This data exchange is not visible and cannot be used by other IEDs therefore not requesting interoperability. It should be noted that by distributing combined application functions in one IED to more than one IED hidden connections may get exposed ones which shall be standardized.

3.5 Power utility automation functions at different levels

3.5.2
station level functions

Replace the existing text (not including the note) of definition 3.5.2 with the following new text:

power system application functions referring to the substation or plant as whole

3.5.3
bay level functions

Replace the existing text of definition 3.5.3 with the following new text:

application functions using mainly the data of one bay and acting mainly on the primary equipment of one bay

3.5.4
process level functions

Replace the existing text of definition 3.5.4 and Note 1 with the following new text:

application functions interfacing to the process, i.e. basically binary and analogue I/O functions like data acquisition (including sampling) and issuing of commands related to one primary object (e.g. circuit breaker)

Note 1 to entry: These functions communicate via the logical interfaces IF4 and IF5 to the bay level. The process level functions may be implemented in the bay level IEDs together with the bay level functions if no process bus is applied. If a process bus is applied the process level functions are implemented in process level IEDs.

3.5.5
process related station level functions

Replace the existing text of definition 3.5.5 and Note 1 with the following new text:

application functions using the data of more than one bay or of the complete substation and acting on the primary equipment of more than one bay or of the complete substation

Note 1 to entry: Examples of such functions are station wide interlocking, automatic sequencers or busbar protection. These functions communicate mainly via the logical interface IF8.

3.5.6
interface related station level functions

Replace the existing text of definition 3.5.6 and Note 1 with the following new text:

application functions representing the interface of the power automation system to the local station operator named HMI (human machine interface), to a remote control centre named TCI (telecontrol interface) or to the remote engineering workplace for monitoring and maintenance named TMI (telemonitoring interface)

Note 1 to entry: These functions communicate in substations via the logical interfaces IF1 and IF6 with the bay level and via the logical interface IF7 and the remote control interface to the outside world. Logically, there is no difference if the HMI is local or remote. In the context of the substation there exists at least one logical interface for the substation automation system at the boundary of the substation. Same holds both for the TCI and TMI. These logical interfaces may be realized in some implementations as proxy servers.

3.6 Miscellaneous

3.6.1
local issue

Replace the existing text of definition 3.6.1 (not including the note) with the following new text:

some functionality which is performed only inside an IED without communication to other IEDs which is outside the scope of IEC 61850 series

3.6.2
granularity

Replace the existing text of definition 3.6.2 (not including the note) with the following new text:

extent to that the application function and their allocated data are split in sub-functions and subgroups respectively

4 Abbreviations

Add the following new terms to the existing list of abbreviations:

CT	Current Transformer
FACTS	Flexible AC Transmission Systems
SGAM	Smart Grid Architecture Model
VT	Voltage Transformer

5 Power utility automation functions

5.1 General

Replace "utility power automation system" *by* "power utility automation system".

Replace "connecting nodes" *by* "connecting node".

Add, at the end of Subclause 5.1, the following new paragraph:

How the domains and application functions are grouped is outside the scope of this document which is requirement focused. However it should be noted that a structured bridge between requirements and implementation exists by the Smart Grid Architecture Model (SGAM) as referenced in the IEC reference architecture (IEC 62357-1).

5.2 Example substation automation system

5.2.1 General

Replace "functions" *by* "application functions".

5.2.2 Logical allocation of application functions and interfaces

Replace, in the first paragraph of 5.2.2, "functions" *by* "application functions".

Replace, in the first paragraph of 5.2.2, "1 to 11" *by* "1 to 12".

Replace, in the second paragraph of 5.2.2, "Process level functions" *by* "Process level application functions".

Replace, in the third paragraph of 5.2.2, "Bay level functions" *by* "Bay level application functions".

Replace, in the third paragraph of 5.2.2, "are functions" *by* "are all functions".

Replace, in the third paragraph of 5.2.2, "primary equipment of one bay" *by* "primary equipment of this one bay".

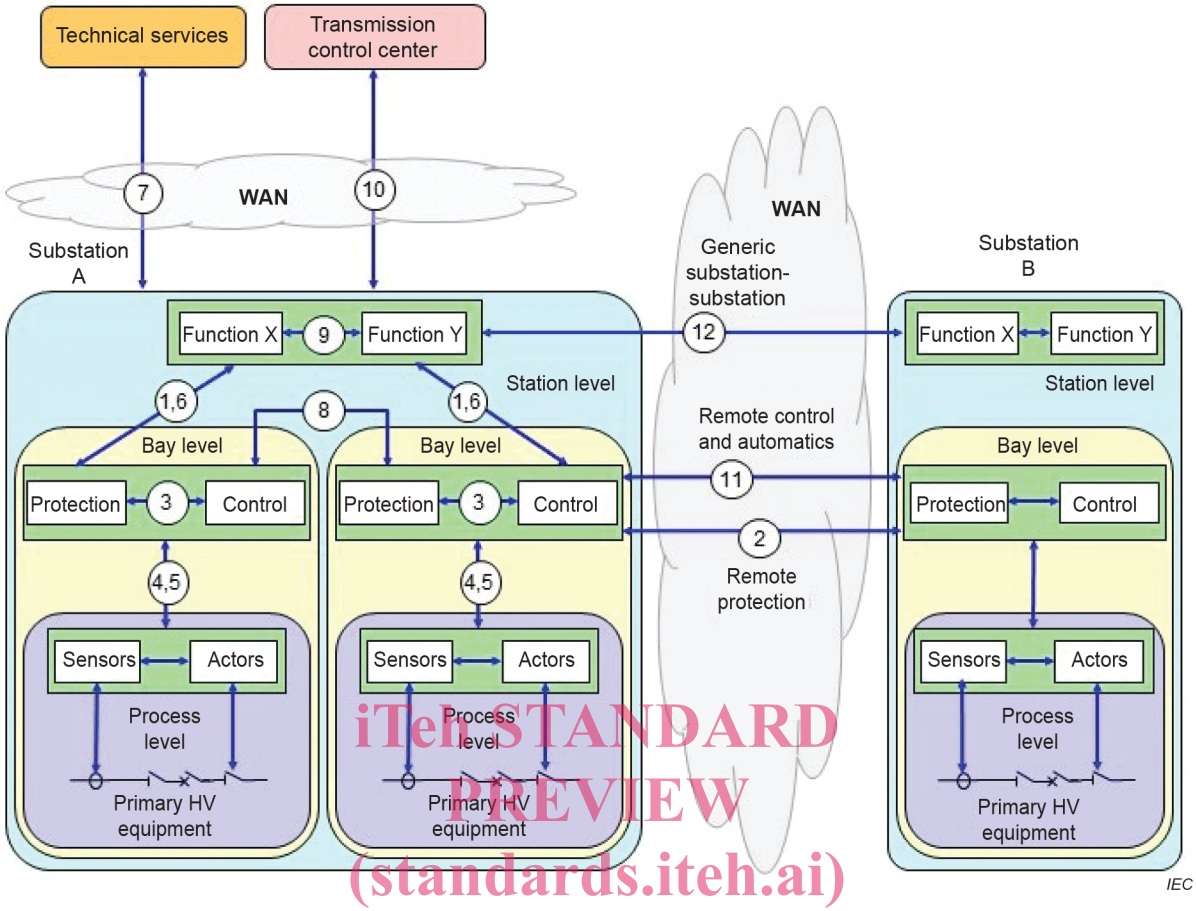
Replace, in the third paragraph of 5.2.2, "the scope of IEC 61850 series" *by* "the scope of the IEC 61850 series".

Replace, in the fifth paragraph of 5.2.2, "station level functions" *by* "station level application functions".

Replace, in the sixth paragraph of 5.2.2, "station level functions" *by* "station level application functions".

Figure 2 – Levels and logical interfaces in substation automation systems

Replace existing Figure 2 by the following new figure:



Replace, in the seventh paragraph of 5.2.2, in line IF10, "control centre(s)" *by* "Network Control Centre(s)".

Add, after line IF11, the following new text:

IF12: generic substation-substation link e.g. for FACTS control

Replace the existing text of 5.2.2, following new item IF12, by the following new text:

Measurements in different kinds e.g. RMS values or synchrophasors, may be part of the different interfaces. Furthermore, requirements for time synchronization to be covered by the different interfaces are depending on the application functions.

The cloud(s) around IF2, IF11 and IF12 indicate(s) that there may be also an external communication system applied for which the requirements as defined in IEC 61850-90-1, IEC 61850-90-2, IEC 61850-90-5, IEC 61850-90-12 or IEC 61850-80-3 may apply. In case of implementation based on external communication systems, which are not in accordance with the data model and services defined in the IEC 61850 series, some kind of protocol conversion is needed.

NOTE The distribution of the functions in a communication environment may occur through the use of Wide Area Network (WAN), Local Area Network (LAN) and Process Bus technologies. At requirement level, the functions are not constrained to be deployed within/over any single communication technology.

The devices of a substation automation system may be installed physically on different functional levels (station, bay, process). This refers to the physical interpretation of Figure 2:

a) process level devices are typically remote process interfaces like I/Os, intelligent sensors and actuators connected by a process bus as indicated in Figure 2;

b) bay level devices consist of control, protection or monitoring units per bay;