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Communication networks and systems for power utility automation – Part 4: System and project management

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 4: System and project management

FOREWORD

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 61850-4 edition 2.1 contains the second edition (2011-04) [documents 57/1103/FDIS and 57/1122/RVD] and its amendment 1 (2020-11) [documents 57/2256/FDIS and 57/2271/RVD].

International Standard IEC 61850-4 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This edition aligns the document more closely with the other parts of the IEC 61850 series, in addition to enlarging the scope from substation automation systems to all utility automation systems.

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://web-store.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- withdrawn,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.

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 4: System and project management

1 Scope

This part of IEC 61850 applies to projects associated with processes near automation systems of power utilities (UAS, utility automation system), such as substation automation systems (SAS). It defines the system and project management for UAS with communication between intelligent electronic devices (IEDs) in the substation respective plant and the related system requirements.

The specifications of this part pertain to the system and project management with respect to:

– the engineering process and its supporting tools;
– the life cycle of the overall system and its IEDs;
– the quality assurance beginning with the development stage and ending with discontinuation and decommissioning of the UAS and its IEDs.

The requirements of the system and project management process and of special supporting tools for engineering and testing are described.

2 Normative references

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

IEC 60848, *GRAFCET specification language for sequential function charts*

IEC 61082 (all parts), *Preparation of documents used in electrotechnology*

IEC 61175, *Industrial systems, installations and equipment and industrial products – Designation of signals*

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

IEC 61850-7 (all parts), *Communication networks and systems for power utility automation – Part 7: Basic communication structure*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
supporting tools
those tools that support the user in the engineering, the operation and the management of the UAS and its IEDs

NOTE These tools are usually a part of the UAS.

3.2
engineering tools
tools that support the creation and documentation of the conditions for adapting an automation system to the specific plant (substation) and customer requirements

NOTE Engineering tools are divided into project management, configuration and documentation tools.

3.3
system specification tools
tools used to create a system requirement specification including the relation of system functions to the plant/substation to be managed; especially a tool creating a specification in a formally defined, standardized format for evaluation by other tools

3.4
system configuration tools
tools handling the communication between the IEDs in the system, configuration of issues common for several IEDs, and the logical association of the IED's functions to the process to be controlled and supervised

NOTE See also "system parameters".

3.5
IED configuration tools
tools handling the specific configuration and download of configuration data to a specific IED of a specific type

3.6
expandability
criteria for the efficient extension of an automation system (hardware and functional) by use of the engineering tools

3.7
flexibility
criteria for the fast and efficient implementation of functional changes including hardware

3.8
scalability
criteria for a cost effective system while recognizing various functionalities, various IEDs, substation sizes and substation voltage ranges

3.9
parameters
variables which define the behaviour of functions of the automation system and its IEDs within a given range of values

3.10
system parameters
data which define the interaction of IEDs in the system

NOTE System parameters are especially important in the:

– configuration of the system;
– communication between IEDs;
– marshalling of data between IEDs;
– processing and visualization of data from other IEDs (for example, at the station level).

3.11
IED parameters
parameters defining the behaviour of an IED and its relation to the process

3.12
IED-parameter set
all parameter values and configuration data needed for the definition of the behaviour of the IED and its adaptation to the substation conditions

NOTE Where the IED has to operate autonomously, the parameter-set can be generated without system parameters using an IED-specific parameterization tool. Where the IED is a part of the system, the parameter set may include the IED related or complete set of system parameters, which should be coordinated by a general parameterization tool at the system level.

3.13
UAS-parameter set
all parameter values and configuration data needed for the definition of the behaviour of the overall UAS and its adaptation to the substation conditions

NOTE The parameter set includes the IED-parameter sets of all participating IEDs.

3.14
remote terminal unit (RTU)
used as an outstation in a supervisory control and data acquisition (SCADA) system

NOTE An RTU may act as an interface between the communication network to the SCADA system and the substation equipment. The function of an RTU may reside in one IED or may be distributed.

3.15
UAS product family
different IEDs of one manufacturer with various functionalities and with the ability to perform within utility automation systems

NOTE The IEDs of a product family are unified in relation to the design, the operational handling, the mounting and wiring conditions, and they use common or coordinated supporting tools.

3.16
UAS installation
the concrete instance of a substation automation system consisting of multiple interoperable and connected IEDs of one or more manufacturers

3.17
configuration list
overview of all instances of IEDs and other installed products of a system, their hardware and software versions including the software versions of relevant supporting tools

NOTE The configuration list also contains the configured communication connections and addresses.

3.18
configuration compatibility list
overview of all compatible hardware and software versions of components and IEDs, including the software versions of relevant supporting tools operating together in an UAS-product family

NOTE The configuration compatibility list also contains the supported transmission protocols and protocol versions for communication with other IEDs.

3.19
manufacturer
the producer of IEDs and/or supporting tools

NOTE A manufacturer may be able to deliver an UAS solely by use of his own IEDs and supporting tools (UAS product family).

3.20
system integrator
a turnkey deliverer of UAS installations

NOTE The responsibility of system integration includes the engineering, the delivery and mounting of all participating IEDs, the factory and site acceptance tests and the trial operation. The quality assurance, the maintenance and spare delivery obligations and the warranty are agreed in the contract between the system integrator and the customer. A system integrator may use IEDs from several different manufacturers.

3.21
system life cycle
the term has two specific meanings:

a) for the manufacturer, the time period between the start of the production of a newly developed UAS product family and the discontinuation of support for the relevant IEDs;

b) for the customer, the time period between the commissioning of the system installation and the decommissioning of the last IED of the system installation

3.22
test equipment
all tools and instruments which simulate and verify the input/outputs of the operating environment of the automation system such as switchgear, transformers, network control centres or connected telecommunication units on one side, and the communication channels between the IEDs of the UAS on the other side

3.23
conformance test
verification of data flow on communication channels in accordance with the standard conditions concerning access organization, formats and bit sequences, time synchronization, timing, signal form and level, reaction to errors

NOTE The conformance test can be carried out and certified for the standard or specially described parts of the standard. The conformance test should be carried out by an ISO 9001 certified and by the UCA International User Group Subgroup testing qualified organization.

3.24
system test
validation of correct behaviour of the IEDs and of the overall automation system under various application conditions

NOTE The system test marks the final stage of the development of IEDs as part of a UAS product family.

3.25
type test
verification of correct behaviour of the IEDs of the automation system by use of the system tested software under the environmental test conditions corresponding with the technical data

NOTE This test marks the final stage of the hardware development and is the precondition for the start of the production. This test is carried out with IEDs that have been manufactured through the normal production cycle, and not with prototype HW.

3.26
factory acceptance test
FAT
customer agreed functional tests of the specifically manufactured system or its parts, using the parameter set for the planned application

NOTE This test is typically performed in the factory of the system integrator by the use of process simulating test equipment.

3.27
site acceptance test
SAT
verification of each data and control point and the correct functionality inside the automation system and between the automation system and its operating environment at the whole installed plant by use of the final parameter set

NOTE The SAT is a precondition for the automation system being put into operation.

3.28
system requirements specification
the specification of all requirements including functions, technical quality, and interfaces to the surrounding world

NOTE The requirement specification is typically supplied by the customer.

3.29
system design specification
a description of a system design showing how a system requirement specification is fulfilled with selected products, and how the required functions are implemented on them

NOTE The system design specification is typically provided by the system integrator.

4 Abbreviations

ASDU	application service data unit
CD ROM	compact disc read only memory
CAD	computer aided design
CT	current transformer
FAT	factory acceptance test
HMI	human machine Interface
.icd	IED capability description file
ICT	IED configuration tool
.iid	instantiated IED description file
IED	intelligent electronic device
PE	process environment
RTU	remote terminal unit
SAS	substation automation system
SAT	site acceptance test
SCADA	supervisory control and data acquisition
.scd	substation configuration description file
SCT	system configuration tool
.sed	system exchange description file
.ssd	system specification description file
TE	telecommunication environment
UAS	utility automation system
VT	voltage transformer

5 Engineering requirements

5.1 Overview

The engineering of a utility automation system is based on a system requirement specification, which defines the scope, functions, boundaries and additional restrictions and requirements for the system, and includes:

– the definition of the necessary hardware configuration of the UAS: i.e. the definition of the IEDs and their interfaces with one another and to the environment as shown in Figure 1;

– the adaptation of functionality and signal quantities to the specific operational requirements by use of parameters;

– the documentation of all specific definitions (i.e. parameter set, terminal connections, etc.).

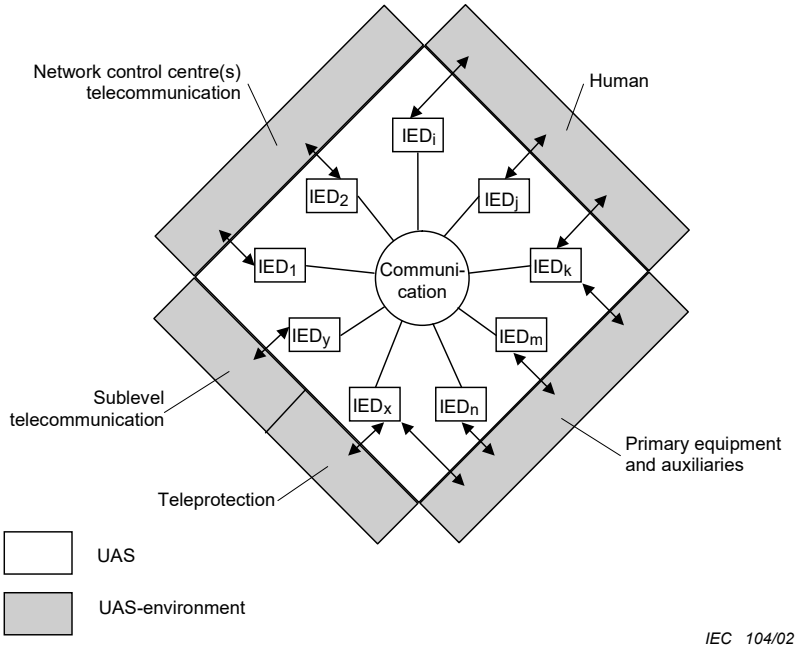

Figure 1 - Structure of the UAS and its environment

As shown in Figure 1, the UAS consists of different IEDs which communicate with each other via communication channels and which execute tasks concerning interactions with the environment of the automation system, such as:

– telecommunication environment (TE);
  - network control centre(s);
  - subordinate systems;
  - teleprotection;
– the human as a local operator;
– process environment (PE) like switchgear, transformer, auxiliaries.

Typical IEDs may be:

– for the telecommunication environment:
  - gateways;
  - converters;
  - RTUs (telecommunication side);
  - protection relays (teleprotection side);
– for the human machine interface (HMI):
  - gateways;
  - personal computers;
  - workstations;
  - other IEDs with integrated HMIs;
– for the process environment (PE):
  - bay control units;
  - protection relays;
  - RTUs (process side);
  - meters;

- autonomous controllers (i.e. voltage controllers);
- transducers;
- digital switchgear interface;
- digital power transformer interface;
- digital VTs and CTs.

5.2 Categories and types of parameters

5.2.1 Classification

Parameters are data, which control and support the operation of:

– hardware configuration (composition of IEDs);
– software of IEDs;
– process environment (primary equipment and auxiliaries);
– HMI with different supporting tools; and
– telecommunication environment

in an automation system and its IEDs in such a way that the operations of the plant and customer specific requirements are fulfilled.

The total set of parameters and configuration data of an UAS is termed the UAS-parameter set. It consists of the used parts of the parameter sets of all participating IEDs.

With respect to handling methods and input procedure, parameter set contents is divided into two categories:

– configuration parameters;
– operating parameters.

With respect to origin and function, the parameters are divided into types:

– system parameters;
– process parameters;
– functional parameters.

In Figure 2, the overview of the parameter structure is given.

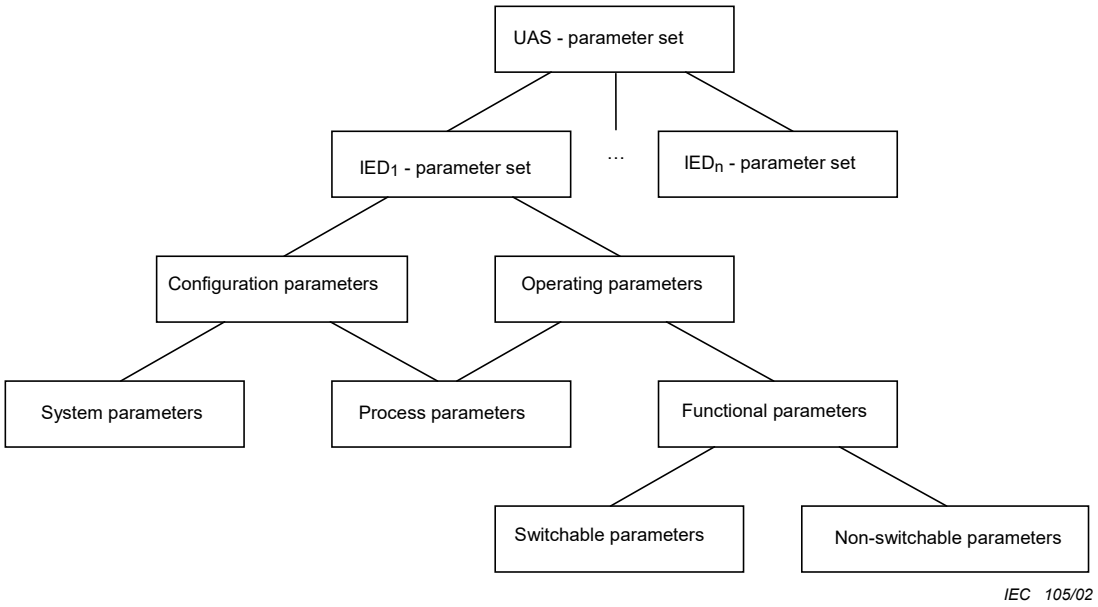

Figure 2 - Structure of UAS and IED parameters

The categories and types of parameters in Figure 2 are described below.

5.2.2 Parameter categories

5.2.2.1 Configuration parameters

The configuration parameters define the global behaviour of the whole UAS and its IEDs. As a rule, they are only assigned a value during the initial parameterization, but they should be updated when extending or functionally changing the UAS.

The generation and modification of the configuration parameters should be carried out off-line, i.e. separately from the operation of the automation system. During the input of configuration parameters, a temporary restriction of the system operation is allowed.

Observe that the term parameter in a more narrow sense means some variables, whose setting defines the wanted behaviour. System and IED configuration needs however often more than just setting of values. If we want to differentiate these different kinds of configuration, we talk about “configuration data” meaning more complex parameterizations, while “configuration parameters” means an adjustment by value setting alone.

The configuration parameters of an IED usually include system and process parameters. Observe that UAS configuration parameters are typically defined at system level. They contain or specify IED related system parameters.

5.2.2.2 Operating parameters

The operating parameters define the behaviour of partial functions of the system. They shall be changeable on-line during the normal operation of the system. The modification is allowed without restricting the system operation and within a framework of ranges of parameter values. Protection functions, as far as combined in IEDs with other functions, shall not be influenced during the parameterization of these functions.

The range and the basic settings of these parameters are determined at the initial parameterization or at a modification stage, separate from the operation of the system. The operating parameters can be put on-line into the system via:

– telecommunication interface;

– HMI;

– integrated service interface of the IEDs.