



BSI Standards Publication

Communication networks and systems for power utility automation

Part 1-2: Guideline on extending IEC 61850

National foreword

This Published Document is the UK implementation of IEC TS 61850-1-2:2020+A1:2022. It supersedes PD IEC TS 61850-1-2:2020, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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**Communication networks and systems for power utility automation –
Part 1-2: Guidelines on extending IEC 61850**

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ELECTROTECHNICAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMUNICATION NETWORKS AND SYSTEMS
FOR POWER UTILITY AUTOMATION –****Part 1-2: Guidelines on extending IEC 61850**

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

Technical specification IEC TS 61850-1-2 has been prepared by IEC technical committee TC 57: Power systems management and associated information exchange.

The text of this technical specification is based on the following documents:

DTS	Report on voting
57/2084/DTS	57/2145/RVDTS

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

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

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

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 1-2: Guidelines on extending IEC 61850

1 Scope

This part of IEC 61850, which is a technical specification, is intended for any users but primarily for standardization bodies that are considering using IEC 61850 as a base standard within the scope of their work and are willing to extend it as allowed by the IEC 61850 standards. This document identifies the required steps and high-level requirements in achieving such extensions of IEC 61850 and provides guidelines for the individual steps.

Within that scope, this document addresses the following cases:

- The management of product-level standards for products that have an interface based on IEC 61850
- The management of domain-level standards based on IEC 61850
- The management of transitional standards based on IEC 61850
- The management of private namespaces based on IEC 61850
- The development of standards offering the mapping of IEC 61850 data model at CDC level
- The development and management of IEC 61850 profiles for domains (underlying the role of IEC TR 62361-103 and IEC TR 61850-7-6)

This document includes both technical and process aspects:

On the technical side, this document:

- Highlights the main basic requirements (mostly referring to the appropriate parts of the series which host the requirements or recommendations)
- Lists all possible flexibilities offered by the standards
- Defines which flexibilities are allowed/possible per type of extension cases

On the process side, the document covers:

- The initial analysis of how the existing IEC 61850 object models and/or communication services may be applied and what allowed extensions may be required for utilizing them in new or specific domains (including private ones). The results of that step are expected to be documented
- The extension of the IEC 61850 object models for new domains. The typical associated work is to identify existing logical nodes which can be reused "as is", to determine if existing logical nodes can be extended, or to define new logical nodes
- The purpose and process to use transitional namespaces, which are expected to be merged eventually into an existing standard namespace
- The management of standard namespaces
- The development of private namespaces

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 61400-25 (all parts), *Wind energy generation systems – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models*

IEC 61850-8 (all parts), *Communication networks and systems for power utility automation*

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

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

IEC 61850-5, *Communication networks and systems for power utility automation – Part 5: Communication requirements for functions and device models*

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

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

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

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 TR 61850-7-6, *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, *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, *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 TS 61850-80-1, *Communication networks and systems for power utility automation – Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104*

IEC TS 61850-80-4, *Communication networks and systems for power utility automation – Part 80-4: Translation from the COSEM object model (IEC 62056) to the IEC 61850 data model*

IEC 61850-9 (all parts), *Communication networks and systems for power utility automation*

IEC 62271-3:2015, *High-voltage switchgear and controlgear – Part 3: Digital interfaces based on IEC 61850*

IEC 61869-9, *Instrument transformers – Part 9: Digital interface for instrument transformers*

IEC TR 62361-103, *Power systems management and associated information exchange – Interoperability in the long term – Part 103: Standard profiling*

IEC 62351 (all parts), *Power systems management and associated information exchange – Data and communications security*

IEEE 1815.1, *Standard for Exchanging Information between networks Implementing IEC 61850 and IEEE Std 1815™ (Distributed Network Protocol – DNP3)*

"Guidelines for code components" document accessible at:

 <https://www.iec.ch/tc57/supportdocuments> 

3 Terms and definitions

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

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

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

3.1

code component

part of a standard document which has to be copied/modified from the IEC publication by any potential users of the standards.

Note 1 to entry: Code Components are components included in IEC standards that are intended to be directly processed by a computer and also includes any text found between the markers <CODE BEGINS> and <CODE ENDS>, or otherwise clearly labelled in this standard as a Code Component.

3.14

deprecation (of an element of a given model)

action consisting in tagging this element specifically in order to discourage future usage of this element

Note 1 to entry: The deprecation of an element implies the deprecation of all included sub-elements.

Note 2 to entry: A deprecation is often the latest stage before withdrawing a given element.

Note 3 to entry: Once deprecation has applied to an element, this element is tagged as "deprecated".

Note 4 to entry: Deprecation may apply to any types of element of the model, including (but not restricted to) attribute, class, object, abbreviation, enumerated element, package, namespace. 

3.2

namespace

domain in which any name and its related information is univocal

3.3

IEC 61850 basic namespace

data model namespace hosted in the IEC 61850 core standard (namely related to IEC 61850-7-2, IEC 61850-7-3, IEC 61850-7-4 parts)

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

Note 2 to entry: The 61850-7-4 namespace content may be revised in future in order to discriminate the elements which are generic from the ones which are substation specific.

3.4

IEC 61850 domain namespace

data model namespace which extends IEC 61850 with the purpose of better supporting an application domain

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

3.5

IEC 61850 product namespace

data model namespace which extends IEC 61850 with the purpose of better supporting a specific product (like switchgear) or function (like metering)

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

3.6

IEC 61850 private namespace

private data model namespace which extends IEC 61850 with the purpose of better supporting a private implementation or specification of IEC 61850

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

3.7

IEC 61850 transitional namespace

data model namespace which has the goal to expose a proposed extension of the data model to the market, before being formally embedded into a standard (product, domain or basic) namespace

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

Note 2 to entry: Transitional namespaces are supposed to have a limited time life, their future being to be integrated into standard namespaces (or standard namespace extensions). At the time of the integration of transitional namespace into the concerned standard parts, backward compatibility may be broken to take into account market feedbacks.

3.8

IEC 61850 core standard

standard from the following list: IEC 61850-5, IEC 61850-6, IEC 61850-7-1, IEC 61850-7-2, IEC 61850-7-3, IEC 61850-7-4, IEC 61850-8-x, IEC 61850-9-x

3.9

IEC 61850 flexibility

option or user-free area stated as such in the IEC 61850 standards

3.10

IEC 61850 extension

additional element or requirement, taking advantage of the IEC 61850 flexibilities, and which therefore goes beyond the original definition/mandatory requirements of IEC 61850 as stated in the IEC 61850 standards

Note 1 to entry: Typical extensions of IEC 61850 are new namespaces, including new LNs, and/or new data objects, or more stringent requirements for presence of DOs/Attributes than required by the IEC 61850 core standards, additional rules for naming LN prefixes, LDs, IEDs, etc.

3.11

model managers team

team within the IEC in charge of handling/maintaining the IEC 61850 model throughout the different IEC publications and the different IEC entities, and in charge of preserving its consistency, as well as its backward compatibility

3.12

profile

agreed-upon subset of requirements derived from a specification

Note 1 to entry: A common profile is required for achieving interoperability especially in those cases when a specification could have more than one interpretation and there are probably many optional features. Refer to IEC TR 62361-103 and IEC TR 61850-7-6 for more in-depth content on profiles and profiling.

3.13

tissue

technical issue related to an IEC 61850 part

4 Key principles reminder

4.1 General

This clause summarizes some main IEC 61850 principles needed for understanding of the rest of the document.

4.2 Namespace introduction

4.2.1 General

Considering that namespaces can be handled by multiple entities, which can evolve over time at different speeds, IEC 61850 introduced the following namespace concepts and requirements from the beginning (Refer to IEC 61850-7-1, "Namespaces" (Clause 13 in Edition 2, Amendment 1¹)).):

- The concept of namespaces: namespaces are largely used and widespread in the IT world to organize the names or identifiers of data types, data objects, functions, etc. into logical sets in order to prevent name collisions that can occur when these are being defined in parallel. In the specific case of IEC 61850, namespaces are a defined but structured collection of logical nodes (LN), data objects and potentially common data classes (CDC) and attributes. Each IEC publication which extends the IEC 61850 data models shall have its own namespace. Each private extension of IEC 61850 shall also have its own namespace. Each namespace has a unique "machine" name, i.e. a name which can be used by a machine to uniquely refer to the semantic attached to a data.
- The concept of namespace owner: IEC TC 57 is the owner of the basic namespaces contained in the IEC 61850 core data object model standards.
- The ability to clearly state and tag which namespace a data object is contained in, through a specific attribute.
- Strict rules for managing/expanding namespaces: rules are provided to allow third parties to make extensions to a data object model standard in a way that does not jeopardize interoperability.

¹ Under preparation. Stage at the time of publication: IEC/TFDIS 61850-7-1/AMD1:2019.

Namespaces are chained together, i.e. dependencies have been established between namespaces.

Basically, there are 5 types of namespaces (as per current IEC 61850-7-1 "Namespaces" clause content):

- **Basic namespaces** contain definitions of the basic classes from which are built all other namespaces, namely IEC 61850-7-2; IEC 61850-7-3; IEC 61850-7-4.
- **Domain namespaces** include Parts 7-4xx of the IEC 61850 series, and possibly other namespaces hosted in dedicated standards or technical specifications such as IEC TS 61850-80-4 and the IEC 61400-25 series.
- **Product standard namespaces** typically contain the nameplate detailed information model but can also be broader than specific products. IEC 62271-3:2015 for switchgears or IEC 61869-9 for merging units are typical examples of product namespaces.
- **Transitional namespaces** are used in technical reports such as the 90-xx parts of the IEC 61850 series. These technical reports may extend any of the basic namespaces (IEC 61850-7-2, IEC 61850-7-3 and IEC 61850-7-4) as well as any domain namespaces. They specify extensions that are expected to be included eventually as part of the basic or domain namespaces in IEC 61850.
- **Private namespaces** are developed to provide a private data model extension (i.e. a set of non-standardized data object added to the standard one). They may be constructed to include standard common data classes from the standard namespaces or from the standard namespace extensions. They are expected to be managed by the entity (company) which produced them.

NOTE Private namespaces are of great interest in the standardization process because they can often identify some standardisation gaps that should be filled. Therefore, it is expected that some portions of private namespaces will be proposed as "addendums" to the IEC process.

4.2.2 Basic namespaces

4.2.2.1 General

The basic namespaces of the IEC 61850 series, defined in Parts 7-2, 7-3 and 7-4, contain a collection of standard logical nodes, data object classes, common data classes and attributes defining at least:

- its wording (exact spelling)
- its semantic (meaning and possibly also the meaning of each of the states this data may take)
- its type and structure
- its presence conditions

4.2.2.2 Logical nodes (LNs) and their objects classes included in the basic namespace

Over 280 logical nodes (LNs) are defined in the IEC 61850 basic namespaces and cover the most common applications of the domains covered by the IEC 61850 series. While original focus has been on substation automation, the common applications also include many other functions like monitoring, measurement, control, and power quality that are important for many other domains. These logical nodes are defined in IEC 61850-7-4.

Most logical nodes provide information (data object and data attributes) that can be categorised in six categories:

- Descriptions
- Common logical node information
- Status information
- Settings
- Measured values
- Controls

The data object and attribute names are standardized ones (i.e. they are built from standardized acronyms) that have a specific semantic in the context of the IEC 61850 series.

Finally, the semantic of a logical node is represented by the data objects and data attributes it contains.

4.2.2.3 Common data classes (CDCs)

The whole set of all the data attributes defined for a data object is based on predefined types and structures called "Common Data Classes" (CDCs) which can be seen as defining the "internal data structure template" of data objects.

IEC 61850-7-3 defines common data classes for a wide range of well-known applications. The core standard information classes are classified into the following groups:

- measurand information,
- controllable status information,
- description information
- controllable analogue information,
- status settings,
- analogue settings and
- description information settings

5 Main cases of extensions of IEC 61850

5.1 Namespace extensions and associated rules

5.1.1 General

This clause lists per type of namespaces the main high-level requirements attached to the creation of such namespace.

5.1.2 Domain namespaces

Formally domain namespaces include the basic namespaces plus the needed extensions they require to meet their domain application requirements. They are produced by International Standardization Bodies. Standard namespaces have usually a status of IS or possibly TS. In order to comply with IS (or TS) stability constraint, it is highly recommended to have any new content initially exposed as transitional namespaces.

Refer to IEC 61850-7-1 "Specification of Name Spaces" (Subclause 13.5 in Edition 2, Amendment 1).

5.1.3 Product standard namespaces

Product standard namespaces are designed as close as possible from the product knowledge, i.e. within the product standardisation committee, with the ambition to provide through extensions the most comprehensive product data model.

The nature of LN extensions shall only be the addition of new optional or mandatory data objects and possibly LNs limited to:

- "Product characteristics" (typically including nameplate) related information. These extensions may be located in the LPHD LN or in any product related LNs, i.e. any LN containing the data object EEName. "Product characteristics" information should be modelled in a way it allows machine processable treatment.
- Product specific LNs to depict product specific functions interface

The new data objects classes shall be assigned to any common data class defined in IEC 61850-7-3.

5.1.4 Transitional namespaces

Some specific requirements are attached to transitional namespace, especially due to the fact that potential incompatibilities may occur at the time of their (possible) integration into an IS document.

Transitional namespaces usually have a status of TR or in some cases TS.

Refer to IEC 61850-7-1 "Specification of Name Spaces" (Subclause 13.5 in Edition 2, Amendment 1).

By nature, conformance testing will not be applied to transitional namespaces.

5.1.5 Private namespaces

Private namespaces are namespace extensions defined by third parties, i.e. not refer to IEC 61850-7-1 "Name Spaces" (Clause 13 in Edition 2, Amendment 1), as well as the clause "Private extension" of the same part (Subclause 14.3 in Edition 2, Amendment 1).

5.2 IEC 61850 profiles for domains

An IEC 61850 profile is an agreed-upon selection of flexibilities, as defined in 6.2, where some more stringent rules may apply, and which is built with the purpose of increasing the IEC 61850 interoperability in a dedicated context (refer to IEC TR 62361-103 for further elements on profiling).

Such a profile may build from building blocks called "Basic Application profile" as defined in IEC TR 61850-7-6.

Thus a profile shall define explicitly, the list of selected flexibilities, and the "additional" rules associated with these one, typically:

- Consider an LN class presence as required, possibly attached with a (partially or totally) predefined prefix name and/or predefined suffix number
- Consider a DO presence as required, where the standard only defines it as optional
- Consider a DA presence as required, where the standard only defines it as optional
- Etc.

A first example is the IEC TR 61850-90-17 related to the profile defined to characterise the use of IEC 61850 in the specific context of IEC 61000-4-30 (power quality standard).

5.3 Mapping of IEC 61850 data model to other protocols at CDC level

These extensions provide additional rules to convey information, as modelled in IEC 61850 onto different protocols, not supporting the communication services as defined in Part 7-2. Typical examples are IEC TS 61850-80-1, IEC TS 61850-80-4 or IEEE 1815.1.

6 What to extend in relation with IEC 61850?

6.1 List of basic requirements

6.1.1 General

This clause tries to identify all requirements which have to be considered whatever the considered case of extension.

6.1.2 IEC 61850 structure reminder

IEC 61850 is made of many parts which need to be clearly understood. These parts are organized as presented in Figure 1 (Figure extracted from IEC 61850-1):

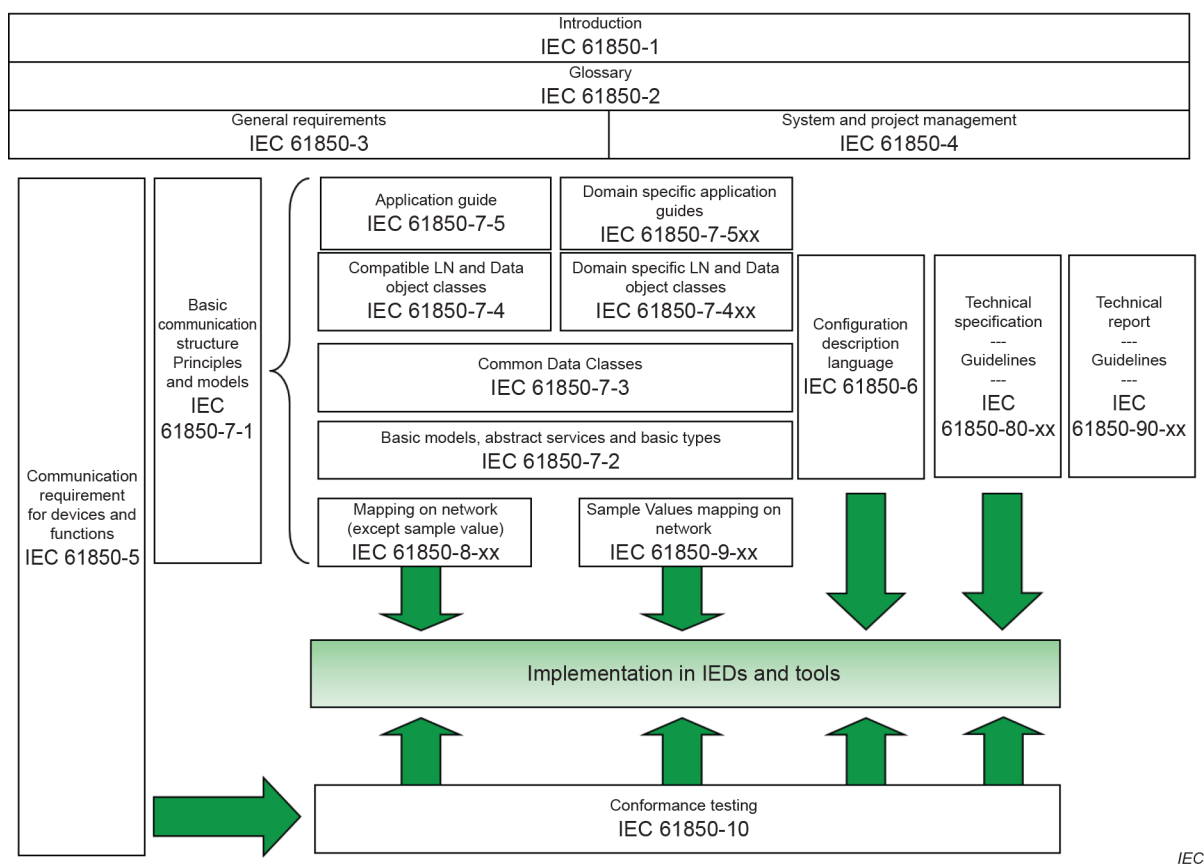


Figure 1 – IEC 61850 documentation structure