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Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes

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FOREWORD

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This Consolidated version of IEC 61850-7-4 bears the edition number 2.1. It consists of the second edition (2010-03) [documents 57/1045/FDIS and 57/1051/RVD] and its amendment 1 (2020-02) [documents 57/2102A/FDIS and 57/2133/RVD]. The technical content is identical to the base edition and its amendment.

International Standard IEC 61850-7-4 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The motivation and goal of the amendment is to improve consistency of the data model over all application domains of IEC 61850. Data (Logical Nodes, Data Objects, Data Attributes) with the same semantics shall have the same naming where this part of IEC 61850 refers to Logical Nodes and Data Objects and IEC 61850-7-3 to the Data Attributes.

Therefore, the amendement complements and updates the second edition of this part of IEC 61850, which was published in 2010. It constitutes editorial revisions for consistency and technical corrections of bugs as far as interoperability is touched.

To reach this goal and to keep it for all future as common working source a comprehensive back-office UML version was created and will be maintained for future standard development. The published parts of IEC 61850such as IEC 61850-7-4, on which the amendment is based, are generated automatically from the UML version. This allows publishing, voting and reading the various parts of IEC 61850-7 as in the past.

This amendment includes the following changes with respect to IEC 61850-7-4:2010:

- provides clarifications and corrections to the second edition of IEC 61850-7-4, based on the tissues = {671, 672, 674, 675, 676, 677, 679, 680, 682, 683, 685, 686, 689, 693, 694, 695, 696, 712, 713, 714, 715, 716, 724, 725, 732, 734, 735, 736, 742, 743, 744, 748, 749, 772, 773, 774, 775, 776, 800, 802, 808, 819, 830, 831, 835, 838, 842, 843, 844, 849, 871, 877, 878, 879, 881, 882, 902, 908, 909, 910, 911, 912, 913, 920, 928, 932, 933, 937, 939, 940, 952, 967, 991, 1007, 1029, 1044, 1046, 1071, 1075, 1076, 1077, 1081, 1086, 1117, 1119, 1128, 1137, 1139, 1176, 1177, 1190, 1191, 1203, 1205, 1229, 1235, 1236, 1244, 1250, 1256, 1258, 1259, 1261, 1269, 1273, 1278, 1282, 1292, 1294, 1310, 1316, 1330, 1331, 1333, 1339, 1347, 1348, 1364, 1368, 1375, 1380, 1390, 1404, 1411, 1420, 1423, 1425, 1426, 1456, 1568};
- adds to each functional LN group a parent abstract Logical node where the functional nodes are children from (full object oriented model). Since all abstract LNs are in a common clause, the relative position of the functional LNs is not changed within their clause.
- adds new abbreviated terms
- has extension of the list of abbreviate terms to be used for object names
- has more precise combination rules for abbreviated terms to object names
- has extensions by new logical nodes mainly from power quality domains and others
- has corrections of editorial errors.

Clauses 4 through 8 and their subclauses (except for 5.1, 5.2, and 5.3) and XML enumerations from Annex H are automatically generated from the UML model.

The structure of the document has been changed for the following reasons:

– To split the description of logical nodes preliminaries (Clause 5) from logical node specification (Clause 6). Some content of this clause has been moved from the previous description of logical nodes (was in IEC 61850-7-4:2007(revision A – 5.1 and 5.2).
– To include abstract logical nodes. These abstract logical nodes have been described in 6.2.
– The specification of logical nodes begins with 6.3 (was in IEC 61850-7-4:2007 (revision A – 5.3). In consequence all clauses in IEC 61850-7-4:2007 (revision A beginning with 5.3 count one number higher (beginning with 6.3) than they were in IEC 61850-7-4 (revision A).
– The description of data object semantics and enumerations starts with Clause 7. A new clause has been included to specify the enumerations used in IEC 61850-7-4 separately.

Annex J and Annex K have been added.

The content of this part of IEC 61850 is based on existing or emerging standards and applications. In particular the definitions are based upon:

- the specific data objects types defined in IEC 60870-5-101 and IEC 60870-5-103;
- the common class definitions from the Utility Communication Architecture 2.0: Generic Object Models for Substation and Feeder Equipment (GOMSFE) (IEEE TR 1550);
- CIGRE Report 34-03, Communication requirements in terms of data flow within substations, December 1996.

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.

This IEC standard includes Code Components i.e. components that are intended to be directly processed by a computer. Such content is any text found between the markers <CODE BEGINS> and <CODE ENDS>, or otherwise is clearly labeled in this standard as a Code Component. In the current version of this document, such indication is made at the beginning of each concerned top-level clauses

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If any updates are required to the published code component that needs to apply immediately and can not wait for an amendment (i.e. fixing a major problem), a new release of the Code Component will be issued and distributed through the IEC WebSite. Any new release of the Code Component related to this part will supersede any previously published Code Component including the one published within the current document.

This publication contains attached nsd files which compose the Code Component of this part. These files are intended to be used as a complement and do not form an integral part of this standard.

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://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 a set of standards, the IEC 61850 series. IEC 61850 defines communication networks and systems for power utility automation, and more specifically the communication architecture for subsystems such as substation automation systems. The sum of all subsystems may result also in the description of the communication architecture for the overall power system management. The defined architecture provided in specific parts of IEC 61850-7-x gives both a power utility specific data model and a substation domain specific data model with abstract definitions of data objects classes and services independently from the specific protocol stacks, implementations, and operating systems. The mapping of these abstract classes and services to communication stacks is outside the scope of IEC 61850-7 and may be found in IEC 61850-8 and in IEC 61850-9.

IEC 61850-7-1 gives an overview of the basic communication architecture to be used for all applications in the power system domain. IEC 61850-7-3 defines common attribute types and common data classes related to all applications in the power system domain. The attributes of the common data classes may be accessed using services defined in IEC 61850-7-2. These common data classes are used in this part to define the compatible data object classes.

To reach interoperability, all data objects in the data model need a strong definition with regard to syntax and semantics. The semantics of the data objects is mainly provided by names assigned to common logical nodes defined in this part and the data objects they contain, as defined in this basic part, and dedicated logical nodes defined in domain specific parts such as for hydro power control systems. Interoperability is easiest if as many as possible of the data objects are defined as mandatory. Because of different approaches and technical features, some data objects, especially settings, were declared as optional in IEC 61850-7-4:2010. There are also data objects which were declared as conditional, i.e. they will become mandatory under some well-defined conditions. After some experience has been gained with this standard, this decision may be reviewed in the next edition of this part of IEC 61850-7.

It should be noted that data objects with full semantics are only one of the elements required to achieve interoperability. The standardized access to the data objects is defined in compatible, power utility and domain specific services (see IEC 61850-7-2). Since data objects and services are hosted by devices (IED), a proper device model is also needed. To describe both the device capabilities and the interaction of the devices in the related system, a configuration language is also needed, as defined in IEC 61850-6 by the substation configuration description language (SCL).

The compatible logical node name and data object name definitions found in this part and the associated semantics are fixed. The syntax of the type definitions of all data objects classes is governed by abstract definitions provided in IEC 61850-7-2 and IEC 61850-7-3. Not all features of logical nodes are listed in this part; for example, data sets and logs are covered in IEC 61850-7-2.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

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1 Scope

1.1 General

This part of IEC 61850 specifies the information model of devices and functions generally related to common use regarding applications in systems for power utility automation. It also contains the information model of devices and function-related applications in substations. In particular, it specifies the compatible logical node names and data object names for communication between intelligent electronic devices (IED). This includes the relationship between logical nodes and data objects.

The logical node names and data object names defined in this document are part of the class model introduced in IEC 61850-7-1 and defined in IEC 61850-7-2. The names defined in this document are used to build the hierarchical object references applied for communicating with IEDs in systems for power utility automation and, especially, with IEDs in substations and on distribution feeders. The naming conventions of IEC 61850-7-2 are applied in this part.

To avoid private, incompatible extensions, this part specifies normative naming rules for multiple instances and private, compatible extensions of logical node (LN) classes and data object names. Any definition is based on IEC 61850 or on referenced well identified public documents.

This part does not provide tutorial material. It is recommended to read parts IEC 61850-5 and IEC 61850-7-1 first, in conjunction with IEC 61850-7-3, and IEC 61850-7-2.

This standard is applicable to describe device models and functions of substation and feeder equipment. The concepts defined in this standard are also applied to describe device models and functions for:

- substation-to-substation information exchange,
- substation-to-control centre information exchange,
- power plant-to-control centre information exchange,
- information exchange for distributed generation,
- information exchange for distributed energy resources,
- information exchange for metering,
- information exchanged for hydro power plants, or
- information exchange for wind generation plants.

Figure 1 provides a general overview of this standard. The groups of logical nodes defined in this standard are shown in Figure 1. For convenience, the logical nodes are defined below in alphabetical order.

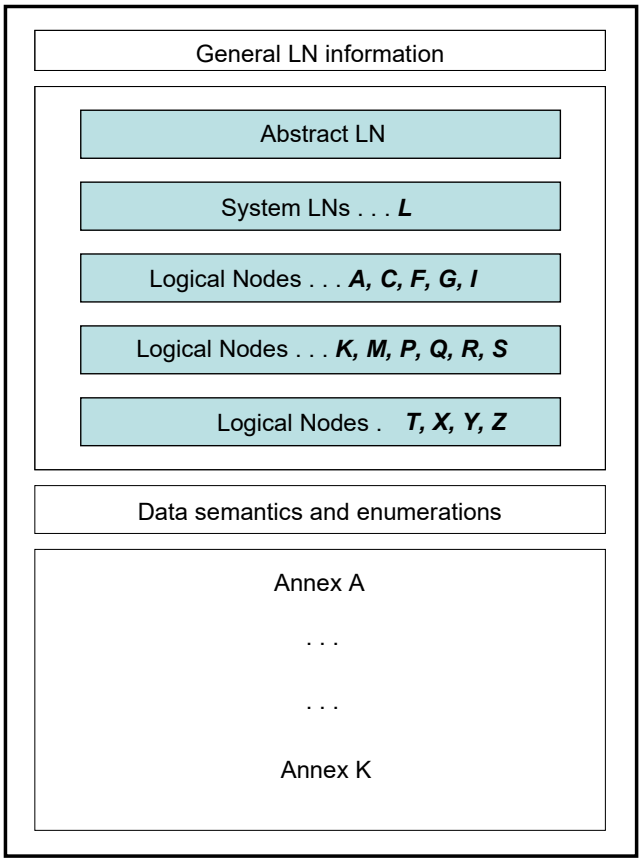

Figure 1 – Overview of this standard

1.2 Namespace name and version

This new subclause is mandatory for any IEC 61850 namespace (as defined by IEC 61850-7-1:2011).

The parameters which identify this new release of this namespace are:

- Namespace Version: 2007
- Namespace Revision: B
- Namespace name: “IEC 61850-7-4:B”
- Namespace release: 3
- Namespace release date: 2019-10-31

IEC 61850-7-4 depends on IEC 61850-7-3:2007B latest release.

The table below provides an overview of all published versions of this namespace.

Edition	Publication date	Webstore	Namespace
Edition 1.0	2003-05	IEC 61850-7-4:2003	IEC 61850-7-4:2003
Edition 2.0	2010-03	IEC 61850-7-4:2010	IEC 61850-7-4:2007
Amendment 1 of Edition 2.0	2020-02	IEC 61850-7-4:2010/AMD1:2020	IEC 61850-7-4:2007B
Edition 2.1	2020-02	IEC 61850-7-4:2010+AMD1:2020 CSV	IEC 61850-7-4:2007B

1.3 Code Component distribution

The Code Component will be available in light and full version:

– Full version will contain definition of the whole LNs defined in this standard with the documentation associated and access will be restricted to purchaser of this part
– Light version will not contain the documentation but will contain the whole definition of the LNs as per full version, and this light version will be freely accessible on the IEC website for download, but the usage remains under the licensing conditions.

The link for downloading the light version of this code component is:

http://www.iec.ch/tc57/supportdocuments/IEC_61850-7-4.NSD.2007B3.light.zip

The Code Components for IEC 61850 data models (like LN definition in this IEC standard) are available as the file format NSD defined by standard IEC 61850-7-7.

The Code Component included in this IEC standard are potentially subject to maintenance works and user shall select the latest release in the repository located at:
http://www.iec.ch/tc57/supportdocuments

The latest version/release of the document will be found by selecting the file IEC_61850-7-4.NSD.{VersionStateInfo}.light.zip with the filed VersionStateInfo of the highest value.

Each Code Component is a ZIP package containing the electronic representation of the Code Component itself, with a file describing the content of the package (IECManifest.xml).

The IECManifest contains different sections giving information on:

– The copyright notice
– The identification of the code component
– The publication related to the code component
– The list of the electronic files which compose the code component
– An optional list of history files to track changes during the evolution process of the code component

The life cycle of a code component is not restricted to the life cycle of the related publication. The publication life cycle goes through two stages, Version (corresponding to an edition) and Revision (corresponding to an amendment). A third publication stage (Release) allow publication of Code Component without need to publish an amendment.

This is useful when InterOp Tissues need to be fixed. Then a new release of the Code Component will be released, which supersedes the previous release, and distributed through the IEC TC57 web site.

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 60255-24:2013 / IEEE Std C37.111-2013, *Measuring relays and protection equipment - Part 24: Common format for transient data exchange (COMTRADE) for power systems*

IEC 60270:2000, *High-voltage test techniques - Partial discharge measurements*

IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

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

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

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

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

IEC/IEEE 60255-118-1:2018, *Measuring relays and protection equipment – Part 118-1: Synchrophasor for power systems – Measurements*

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*

IEEE 519:1992, *IEEE Recommended Practises and Requirements for Harmonic Control in Electrical Power Systems*

IEEE C37.2:1996, *Electrical Power System Device Function Numbers and Contact Designation*

IEEE 1459:2000, *IEEE Trial-Use Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions*