



IEC 61850-7-1

Edition 2.1 2020-08  
CONSOLIDATED VERSION

# INTERNATIONAL STANDARD



---

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





**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2020 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

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

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

**About the IEC**

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

**About IEC publications**

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

**IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)**

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

**IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

**Electropedia - [www.electropedia.org](http://www.electropedia.org)**

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)**

67 000 electrotechnical terminology entries in English and French extracted from the Terms and definitions clause of IEC publications issued between 2002 and 2015. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.



IEC 61850-7-1

Edition 2.1 2020-08  
CONSOLIDATED VERSION

# INTERNATIONAL STANDARD



---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 33.200

ISBN 978-2-8322-8823-8

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD .....	11
INTRODUCTION .....	13
1 Scope .....	14
2 Normative references .....	14
3 Terms and definitions .....	15
4 Abbreviated terms .....	16
5 Overview of the IEC 61850 series concepts .....	17
5.1 Objective .....	17
5.2 Topology and communication functions of substation automation systems .....	18
5.3 The information models of substation automation systems .....	19
5.4 Applications modelled by logical nodes defined in IEC 61850-7-4 .....	21
5.5 The semantic is attached to data .....	24
5.6 The services to exchange information .....	26
5.7 Services mapped to concrete communication protocols .....	28
5.8 The configuration of the automation system .....	28
5.9 Summary .....	29
6 Modelling approach of the IEC 61850 series .....	30
6.1 Decomposition of application functions and information .....	30
6.2 Creating information models by stepwise composition .....	32
6.3 Example of an IED composition .....	34
6.4 Information exchange models .....	35
6.4.1 General .....	35
6.4.2 Output model .....	36
6.4.3 Input model .....	40
6.4.4 Model for statistical and historical statistical data .....	50
6.4.5 Model for system functions .....	53
7 Application view .....	55
7.1 General .....	55
7.2 First modelling step – Logical nodes and data .....	57
7.3 Mode and behaviour of a logical node .....	60
7.4 Use of measurement ranges and alarms for supervision functions .....	60
7.5 Data used for limiting the access to control actions .....	61
7.6 Data used for blocking functions described by logical nodes .....	61
7.7 Data used for logical node inputs/outputs blocking (operational blocking) .....	61
7.7.1 General .....	61
7.7.2 Blocking incoming commands .....	62
7.7.3 Blocking process outputs .....	62
7.7.4 Blocking the communication of status outputs updates .....	62
7.8 Data used for testing .....	63
7.8.1 General .....	63
7.8.2 Multicast signals used for simulation .....	63
7.8.3 Input signals used for testing .....	64
7.8.4 Test mode .....	66
7.9 Logical node used for extended logging functions .....	66
8 Device view .....	67

8.1	General.....	67
8.2	Second modelling step – logical device model .....	68
8.2.1	The logical device concept.....	68
8.2.2	The device nameplate.....	69
8.2.3	Gateways and proxies.....	70
8.2.4	Logical devices for monitoring external device health.....	74
8.2.5	Logical devices management hierarchy.....	74
9	Communication view.....	76
9.1	General.....	76
9.2	The service models of the IEC 61850 series .....	76
9.3	The virtualisation .....	78
9.4	Basic information exchange mechanisms .....	79
9.5	The client-server building blocks.....	81
9.5.1	Server.....	81
9.5.2	Client-server roles .....	82
9.6	Logical nodes communicate with logical nodes .....	83
9.7	Interfaces inside and between devices.....	84
10	Where physical devices, application models and communication meet.....	85
11	Relationships between IEC 61850-7-2, IEC 61850-7-3 and IEC 61850-7-4 .....	86
11.1	Refinements of class definitions.....	86
11.2	Example 1 – Logical node and data object class .....	87
11.3	Example 2 – Relationship of IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4 ..	91
12	Formal specification method .....	93
12.1	Notation of ACSI classes .....	93
12.2	Class modelling .....	93
12.2.1	Overview .....	93
12.2.2	Common data class .....	95
12.2.3	Logical node class .....	99
12.3	Service parameters tables .....	101
12.4	Referencing instances .....	102
13	Namespaces.....	105
13.1	General.....	105
13.2	Namespaces defined in the IEC 61850-7-x series .....	106
13.3	Namespaces dependencies .....	110
13.3.1	General.....	110
13.3.2	Basic namespaces dependencies .....	110
13.3.3	Other namespaces dependencies .....	112
13.4	Specification of namespaces.....	113
13.5	Attributes for references to namespaces .....	113
13.5.1	General.....	113
13.5.2	Attribute for logical device namespace (ldNs) .....	114
13.5.3	Attribute for logical device basic namespace (LLN0.NamPit.InNs).....	114
13.5.4	Attribute for logical node namespace (lnNs).....	115
13.5.5	Attribute for data namespace (dataNs).....	115
13.5.6	Attribute for common data class namespace (cdcNs) .....	115
13.5.7	Attribute for naming a common data class name (cdcName) .....	115
13.6	Deprecation of namespaces.....	116
14	Common rules for new version of classes and for extension of object classes .....	116

14.1	General.....	116
14.2	Basic rules.....	116
14.2.1	General.....	116
14.2.2	Use of optional information.....	119
14.2.3	General rules for enumerations types and enumeration-based data objects and attributes.....	119
14.3	Rules for extensions within private namespace.....	119
14.3.1	Rules for LN classes.....	119
14.3.2	New LN classes.....	120
14.3.3	Rules for Common Data Classes.....	120
14.3.4	Rules for enumeration types and enumeration-based data objects and attributes.....	121
14.4	Extensions made within product standard namespaces.....	121
14.5	Extensions made within transitional namespaces.....	121
14.6	Extensions made within basic and domain namespaces.....	121
14.7	Multiple instances of LN classes for dedicated and complex functions.....	122
14.7.1	Example for time overcurrent.....	122
14.7.2	Example for PDIS.....	122
14.7.3	Example for power transformer.....	122
14.7.4	Example for auxiliary network.....	122
14.8	Specialisation of data by use of number extensions.....	123
14.9	Examples for new LNs.....	123
14.10	Example for new Data.....	123
15	Compatibility between different versions of the standard.....	124
Annex A	(informative) Overview of logical nodes and data.....	125
A.1	Compatible logical node classes and data classes (IEC 61850-7-4).....	125
A.1.1	List of LN groups (IEC 61850-7-4).....	125
A.1.2	LN classes (IEC 61850-7-4).....	125
A.1.3	Data object classes (IEC 61850-7-4).....	125
A.2	Common data class specifications (IEC 61850-7-3).....	125
Annex B	(informative) Allocation of data to logical nodes.....	127
Annex C	(informative) Use of the substation configuration language (SCL).....	130
C.1	General.....	130
C.2	SCL and options in logical nodes.....	130
C.3	SCL and options in data.....	131
Annex D	(xxx).....	132
Annex E	(informative) Relation between logical nodes and PICOMs.....	133
Annex F	(informative) Mapping the ACSI to real communication systems.....	134
F.1	General.....	134
F.1.1	Mapping example (IEC 61850-8-1).....	136
Annex G	(normative) LGOS/LSVS engineering.....	142
G.1	General.....	142
G.2	LGOS/LSVS engineering by the ICT.....	143
G.3	LGOS/LSVS engineering by the SCT.....	144
Annex H	(normative) GOOSE/SMV Subscription Configuration.....	146
H.1	General.....	146
H.2	SCT supplied input binding workflow.....	147
H.3	ICT supplied input binding (for later binding).....	148

Annex I (informative) Specification of namespaces for Edition 3 .....	149
I.1 Namespaces dependencies .....	149
I.1.1 General.....	149
I.1.2 Namespaces dependencies .....	149
I.2 Example 2 – Standardized data objects used in standardized LNs .....	150
I.3 Example 3 – Edition 2 device: standardized data object introduced in IEC61850-7-4:2007B .....	151
I.4 Example 4 – Edition 2 device: standardized LN introduced in IEC61850-7-4:2007B .....	152
I.5 Example 5 – Edition 1 device: Logical nodes in technical reports .....	153
I.6 Example 6- Edition 2.1 device: Logical nodes in technical reports defining new CDCs.....	155
I.7 Example 7- Edition 2.1 device: devices for product family standards.....	156
I.8 Example 8 – Standardized logical nodes introduced by other domain applications .....	157
I.9 Example 9 – Standardized logical nodes introduced by other domain applications than moved to IEC 61850-7-4 .....	159
Annex J (normative) Use case scenarios examples for clarifying the common rules of Clause 14 .....	162
J.1 General.....	162
J.2 Example 1 – Private LN using standardized DOs .....	162
J.3 Example 2 – Standardized data objects used in standardized LNs .....	163
J.4 Example 3 – Edition 2 device: standardized data object introduced in IEC61850-7-4:2007B .....	163
J.5 Example 4 – Edition 2 device: standardized LN introduced in IEC61850-7-4:2007B .....	164
J.6 Example 5 – Edition 1 device: Logical nodes in technical reports .....	165
J.7 Example 6- Edition 2.1 device: Logical nodes in technical reports defining new CDCs.....	167
J.8 Example 7- Edition 2.1 device: devices for product family standards.....	168
J.9 Example 8 – Standardized logical nodes introduced by other domain applications .....	169
J.10 Example 9 – Standardized logical nodes introduced by other domain applications than moved to IEC 61850-7-4 .....	171
Annex K (normative) General requirements and recommendations regarding compatibility issues between different versions of IEC 61850.....	174
K.1 Overview.....	174
K.1.1 General.....	174
K.1.2 Definitions (to go to part 2): .....	174
K.1.3 Introduction to compatibility discussion .....	175
K.1.4 Assumptions .....	175
K.1.5 Generic rules .....	176
K.1.6 Overview on use cases .....	177
K.2 Use cases related to the data model .....	181
K.2.1 Use case 1: Add new type .....	181
K.2.2 Use case 2: Add new FC.....	181
K.2.3 Use case 3: Extend CDC with elements of existing types and FCs.....	182
K.2.4 Use case 4: Add a new DataObject (DO) based on new CDCs.....	183
K.2.5 Use case 5: Add a new DO based on existing CDCs.....	184
K.2.6 Use case 6: Rename a DO.....	184
K.2.7 Use case 7: Rename a DA, subDO or subDA .....	184

K.2.8	Use case 8: Deprecation of a FC .....	185
K.2.9	Use case 9: Deprecation of a DA .....	186
K.2.10	Use case 10: Removal of a DA .....	186
K.2.11	Use case 11: Deprecation of a DO .....	187
K.2.12	Use case 12: Use a weaker presence condition .....	187
K.2.13	Use case 13: Use a stronger presence condition .....	188
K.2.14	Use case 14: Extend Enumeration List with an enumerated value .....	188
K.2.15	Use case 15: Modification of an Enumerated value .....	189
K.2.16	Use case 16: Deprecation of an Enumerated value .....	190
K.2.17	Use case 17: Extension of a PACKED LIST .....	190
K.2.18	Use case 18: Extend Name Length .....	190
K.3	Use cases related to the services I.....	191
K.3.1	Use case 30: Add new type.....	191
K.3.2	Use case 31: Using new control block class .....	192
K.3.3	Use case 32: Using new services.....	192
K.3.4	Use case 33: Extending control block class with an attribute of existing type .....	193
K.3.5	Use case 34: Rename a service parameter not associated with a control block attribute .....	193
K.3.6	Use case 35: Removing / Deprecating Control Block Classes .....	193
K.3.7	Use case 36: Using a stronger presence condition.....	194
	Bibliography.....	195
	Figure 1 – Relations between modelling and mapping parts of the IEC 61850 series .....	17
	Figure 2 – Sample substation automation topology .....	19
	Figure 3 – Modelling approach (conceptual).....	20
	Figure 4 – Logical node information categories .....	23
	Figure 5 – Build-up of devices (principle) .....	23
	Figure 6 – Position information depicted as a tree (conceptual) .....	24
	Figure 7 – Service excerpt .....	27
	Figure 8 – Example of communication mapping .....	28
	Figure 9 – Summary .....	30
	Figure 10 – Decomposition and composition process (conceptual).....	31
	Figure 11 – XCBR1 information depicted as a tree.....	33
	Figure 12 – Example of IED composition.....	35
	Figure 13 – Output and input model (principle).....	36
	Figure 14 – Output model (step 1) (conceptual) .....	37
	Figure 15 – Output model (step 2) (conceptual) .....	38
	Figure 16 – GSE output model (conceptual).....	38
	Figure 17 – Setting data (conceptual) .....	39
	Figure 18 – Input model for analogue values (step 1) (conceptual) .....	41
	Figure 19 – Range and deadbanded value (conceptual).....	42
	Figure 20 – Input model for analogue values (step 2) (conceptual) .....	43
	Figure 21 – Reporting and logging model (conceptual).....	44
	Figure 22 – Data set members and reporting .....	45
	Figure 23 – Buffered report control block (conceptual).....	46

Figure 24 – Buffer time .....	47
Figure 25 – Data set members and inclusion-bitstring .....	48
Figure 26 – Log control block (conceptual).....	48
Figure 27 – Peer-to-peer data value publishing model (conceptual) .....	49
Figure 28 – Conceptual model of statistical and historical statistical data (1) .....	51
Figure 29 – Conceptual model of statistical and historical statistical data (2) .....	53
Figure 30 – Concept of the service tracking model – Example: control service tracking.....	55
Figure 31 – Real world devices .....	56
Figure 32 – Logical nodes and data (IEC 61850-7-2) .....	57
Figure 33 – Simple example of modelling.....	58
Figure 34 – Basic building blocks .....	58
Figure 35 – Logical nodes and PICOM .....	59
Figure 36 – Logical nodes connected (outside view in IEC 61850-7-x series).....	59
Figure 37 – Mode and behaviour data (IEC 61850-7-4).....	60
Figure 38 – Data used for limiting the access to control actions (IEC 61850-7-4) .....	61
Figure 39 – Data used for logical node inputs/outputs blocking (IEC 61850-7-4) .....	62
Figure 40 – Data used for receiving simulation signals.....	63
Figure 80 – GOOSE subscription supervision state machine .....	64
Figure 81 – SV subscription supervision state machine.....	64
Figure 41 – Example of input signals used for testing .....	65
Figure 42 – Test mode example.....	66
Figure 43 – Logical node used for extended logging functions (GLOG) .....	67
Figure 44 – Logical device building block.....	68
Figure 45 – Logical devices and LLN0/LPHD .....	69
Figure 46 – The common data class DPL.....	70
Figure 47 – Logical devices in proxies or gateways.....	72
Figure 79 – Logical devices in proxies or gateways (functional naming).....	73
Figure 48 – Logical devices for monitoring external device health .....	74
Figure 49 – Logical devices management hierarchy .....	75
Figure 50 – ACSI communication methods.....	77
Figure 51 – Virtualisation .....	79
Figure 52 – Virtualisation and usage .....	79
Figure 53 – Information flow and modelling.....	80
Figure 54 – Application of the GSE model.....	80
Figure 55 – Server building blocks .....	81
Figure 56 – Interaction between application process and application layer (client/server) .....	82
Figure 57 – Example for a service.....	82
Figure 58 – Client/server and logical nodes .....	82
Figure 59 – Client and server roles .....	83
Figure 60 – Logical nodes communicate with logical nodes.....	84
Figure 61 – Interfaces inside and between devices .....	85
Figure 62 – Component hierarchy of different views (excerpt).....	86

Figure 63 – Refinement of the DATA class.....	87
Figure 64 – Instances of a Data object class (conceptual).....	91
Figure 65 – Relation between parts of the IEC 61850 series .....	92
Figure 66 – Abstract data model example for IEC 61850-7-x.....	94
Figure 67 – Relation of TrgOp and Reporting.....	99
Figure 68 – Sequence diagram .....	102
Figure 69 – References.....	102
Figure 70 – Use of FCD and FCDA .....	103
Figure 71 – Object names and object reference .....	105
Figure 72 – Definition of names and semantics .....	106
Figure 73 – Name space as class repository .....	107
Figure 74 – All instances derived from classes in a single name space .....	108
Figure 75 – Instances derived from multiple namespaces .....	109
Figure 76 – Inherited namespaces .....	109
Figure 77 – Basic namespaces dependencies.....	111
Figure 78 – Other namespaces dependencies.....	112
Figure 78 – Basic extension rules diagram.....	117
Figure B.1 – Example for control and protection LNs combined in one physical device .....	127
Figure B.2 – Merging unit and sampled value exchange (topology) .....	128
Figure B.3 – Merging unit and sampled value exchange (data) .....	128
Figure C.1 – Application of SCL for LNs (conceptual) .....	130
Figure C.2 – Application of SCL for data (conceptual).....	131
Figure E.1 – Exchanged data between subfunctions (logical nodes) .....	133
Figure E.2 – Relationship between PICOMS and client/server model .....	133
Figure F.1 – ACSI mapping to an application layer.....	134
Figure F.2 – ACSI mappings (conceptual).....	135
Figure F.3 – ACSI mapping to communication stacks/profiles .....	136
Figure F.4 – Mapping to MMS (conceptual).....	136
Figure F.5 – Mapping approach .....	137
Figure F.6 – Mapping detail of mapping to a MMS named variable.....	138
Figure F.7 – Example of MMS named variable (process values) .....	138
Figure F.8 – Use of MMS named variables and named variable list.....	139
Figure F.9 – MMS information report message.....	140
Figure F.10 – Mapping example.....	141
Figure G.1 – LGOS/LSVS engineering .....	143
Figure G.2 – LGOS/LSVS engineering by ICT.....	144
Figure G.3 – LGOS/LSVS engineering by the SCT.....	145
Figure H.1 – GOOSE/SMV subscription engineering workflow.....	146
Figure H.2 – SCT supplied input binding .....	147
Figure H.3 – ICT supplied input binding (for later binding).....	148
Figure I.1 – Private LN using standardized DOs (Edition 2).....	150
Figure I.2 –Standardized data objects used in standardized LNs.....	151

Figure I.3 – Edition 2 device: standardized data object introduced in IEC61850-7-4:2007B .....	152
Figure I.4 – Edition 2 device: standardized LN introduced in IEC61850-7-4:2007B.....	153
Figure I.5 – Edition 1 device: Logical nodes in technical reports .....	154
Figure I.6 – Edition 2 device: Logical nodes in technical reports .....	155
Figure I.7 – Edition 2.1 device: Logical nodes in technical reports defining new CDCs.....	156
Figure I.8 – Edition 2.1 device: standardized LNs extended by other domains .....	157
Figure I.9 – Edition 2 device: standardized LN introduced in IEC 61850-7-420:2009 .....	158
Figure I.10 – Edition 2.1 device: standardized LN introduced in IEC 61850-7-420:2015 .....	159
Figure I.11 – Edition 2 device: standardized LN moved from introduced in IEC 61850-7-420:2009 to IEC 61850-7-4:2007 .....	160
Figure I.12 – Edition 2.1 device: standardized LN moved from introduced in IEC 61850-7-420:2009 to IEC 61850-7-4:2007.....	161
Figure J.1 – Private LN using standardized DOs (Edition 2) .....	162
Figure J.2 –Standardized data objects used in standardized LNs.....	163
Figure J.3 – Edition 2 device: standardized data object introduced in IEC61850-7-4:2007B .....	164
Figure J.4 – Edition 2 device: standardized LN introduced in IEC61850-7-4:2007B.....	165
Figure J.5 – Edition 1 device: Logical nodes in technical reports.....	166
Figure J.6 – Edition 2 device: Logical nodes in technical reports.....	167
Figure J.7 – Edition 2.1 device: Logical nodes in technical reports defining new CDCs .....	168
Figure J.8 – Edition 2.1 device: standardized LNs extended by other domains.....	169
Figure J.9 – Edition 2 device: standardized LN introduced in IEC 61850-7-420:2009 .....	170
Figure J.10 – Edition 2.1 device: standardized LN introduced in IEC 61850-7-420:2015 .....	171
Figure J.11 – Edition 2 device: standardized LN moved from introduced in IEC 61850-7-420:2009 to IEC 61850-7-4:2007 .....	172
Figure J.12 – Edition 2.1 device: standardized LN moved from introduced in IEC 61850-7-420:2009 to IEC 61850-7-4:2007.....	173
Table 1 – LN groups .....	21
Table 2 – Logical node class XCBR (conceptual).....	32
Table 3 – Excerpt of integer status setting .....	40
Table 4 – Comparison of the data access methods .....	45
Table 5 – ACSI models and services.....	77
Table 6 – Logical node circuit breaker.....	88
Table 7 – Controllable double point (DPC).....	90
Table 8 – ACSI class definition .....	93
Table 9 – Single point status common data class (SPS).....	95
Table 10 – Quality components attribute definition.....	96
Table 16 – Attributes of DetailQual .....	97
Table 11– Functional constraints (excerpt).....	98
Table 12– Trigger option.....	98
Table 13 – GenLogicalNodeClass definition.....	100
Table 14 – Excerpt of logical node name plate common data class (LPL).....	114
Table 15 – Excerpt of the abstract common data class BasePrimitiveCDC .....	114

Table A.2 – List of common data classes (excerpt) .....	125
Table K.1 – Information users and information providers.....	175
Table K.2 – Data model use cases .....	177
Table K.3 – Services use cases .....	179
Table K.4 – Data Forbidden cases .....	180
Table K.5 – Add new basic type .....	181
Table K.6 – Extend CDC with DA of new FC .....	182
Table K.7 – Add new DA using existing type and FCs .....	182
Table K.8 – Add a new DO based on new CDC using existing types and FCs .....	183
Table K.9 – Adding a new DO based on existing CDC .....	184
Table K.10 – Renaming a DO .....	184
Table K.11 – Renaming a DA, subDO or subDA.....	185
Table K.12 – Deprecation of a FC .....	186
Table K.13 – Deprecation of a DA.....	186
Table K.14 – Removal of a DA.....	187
Table K.15 – Deprecation of a DO .....	187
Table K.16 – Use of a weaker presence condition.....	188
Table K.17 – Use of a stronger presence condition .....	188
Table K.18 – Extend an enumeration with an enumerated value .....	189
Table K.19 – Modification of an enumerated value from an enumeration list .....	189
Table K.20 – Deprecate an enumerated value from an enumeration list.....	190
Table K.21 – Extension of a PACKED LIST.....	190
Table K.22 – Extend size of names / references .....	191
Table K.23 – Add new basic type .....	191
Table K.24 – Adding new Control Blocks.....	192
Table K.25 – Adding new services .....	192
Table K.26 – Add new attributes in control block.....	193
Table K.27 – Deprecating control block class.....	193
Table K.28 – Using a stronger presence condition .....	194

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

#### Part 7-1: Basic communication structure – Principles and models

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

**IEC 61850-7-1 edition 2.1 contains the second edition (2011-07) [documents 57/1121/FDIS and 57/1145/RVD] and its amendment 1 (2020-08) [documents 57/2201/FDIS and 57/2221/RVD].**

International Standard IEC 61850-7-1 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition edition constitutes a technical revision.

Compared to the first edition, this second edition introduces:

- the model for statistical and historical statistical data,
- the concepts of proxies, gateways, LD hierarchy and LN inputs,
- the model for time synchronisation,
- the concepts behind different testing facilities,
- the extended logging function.

It also clarifies the following points:

- the use of numbers for data extension,
- the use of namespaces,
- the mode and behaviour of a logical node,
- the use of range and deadbanded values,
- the access to control actions and others.

Compared to the second edition, this first revision of the second edition:

- provides clarifications and corrections to the second edition of IEC 61850-7-1, based 55 on the tissues = {828, 874, 948, 1060, 1072, 1129, 1151, 1196, 1251, 1268, 1312, 1396, 1437, 1468, 1491};
- re-edit the Clause 8.2.3 on gateways and proxies;
- re-edit the complete Clauses 13 and 14 about namespaces and rules for extension of object classes;
- include three new normative annexes respectively for LGOS/LSVS engineering (G), GOOSE/SMV Subscription Configuration (H) and use case scenarios examples for clarifying the common rules of Clause 14 (J);
- introduces in the informative annex I, the concept of decoupling domain namespaces from basic namespaces in edition 3 of this document;

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

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://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 the IEC 61850 series provides an overview of the architecture for communication and interactions between systems for power utility automation such as protection devices, breakers, transformers, substation hosts etc.

This document is part of a set of specifications which details a layered communication architecture for power utility automation. This architecture has been chosen to provide abstract definitions of classes (representing hierarchical information models) and services such that the specifications are independent of specific protocol stacks, implementations, and operating systems.

The goal of the IEC 61850 series is to provide interoperability between the IEDs from different suppliers or, more precisely, between functions to be performed by systems for power utility automation but residing in equipment (physical devices) from different suppliers. Interoperable functions may be those functions that represent interfaces to the process (for example, circuit breakers) or substation automation functions such as protection functions. This part of the IEC 61850 series uses simple examples of functions to describe the concepts and methods applied in the IEC 61850 series.

This part of the IEC 61850 series describes the relationships between other parts of the IEC 61850 series. Finally this part defines how interoperability is reached.

**NOTE** Interchangeability is the ability to replace a device from the same vendor, or from different vendors, utilising the same communication interface and as a minimum, providing the same functionality, with no impact on the rest of the system. If differences in functionality are accepted, the exchange may also require some changes somewhere else in the system. Interchangeability implies a standardisation of functions and, in a strong sense, of devices which are outside the scope of this standard. Interchangeability is outside the scope, but it will be supported following this standard for interoperability.

This part of the IEC 61850 series is intended for all stakeholders of standardised communication and standardised systems in the utility industry. It provides an overview of and an introduction to IEC 61850-7-4, IEC 61850-7-3, IEC 61850-7-2, IEC 61850-6, and IEC 61850-8-1.

## COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

### Part 7-1: Basic communication structure – Principles and models

#### 1 Scope

This part of the IEC 61850 series introduces the modelling methods, communication principles, and information models that are used in the various parts of the IEC 61850-7-x series. The purpose of this part of the IEC 61850 series is to provide – from a conceptual point of view – assistance to understand the basic modelling concepts and description methods for:

- substation-specific information models for power utility automation systems,
- device functions used for power utility automation purposes, and
- communication systems to provide interoperability within power utility facilities.

Furthermore, this part of the IEC 61850 series provides explanations and provides detailed requirements relating to the relation between IEC 61850-7-4, IEC 61850-7-3, IEC 61850-7-2 and IEC 61850-5. This part explains how the abstract services and models of the IEC 61850-7-x series are mapped to concrete communication protocols as defined in IEC 61850-8-1.

The concepts and models provided in this part of the IEC 61850 series may also be applied to describe, among others, information models and functions for:

- hydroelectric power plants,
- substation to substation information exchange,
- information exchange for distributed automation,
- substation to control centre information exchange,
- information exchange for metering,
- condition monitoring and diagnosis, and
- information exchange with engineering systems for device configuration.

NOTE 1 This part of IEC 61850 uses examples and excerpts from other parts of the IEC 61850 series. These excerpts are used to explain concepts and methods. These examples and excerpts are informative in this part of IEC 61850.

NOTE 2 Examples in this part use names of classes (e.g. XCBR for a class of a logical node) defined in IEC 61850-7-4, IEC 61850-7-3, and service names defined in IEC 61850-7-2. The normative names are defined in IEC 61850-7-4, IEC 61850-7-3, and IEC 61850-7-2 only.

NOTE 3 This part of IEC 61850 does not provide a comprehensive tutorial. It is recommended that this part be read first – in conjunction with IEC 61850-7-4, IEC 61850-7-3, and IEC 61850-7-2. In addition, it is recommended that IEC 61850-1 and IEC 61850-5 also be read.

NOTE 4 This part of IEC 61850 does not discuss implementation issues.

#### 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.