



IEC 61850-7-2

Edition 2.0 2010-08

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.200

ISBN 978-2-88912-065-9

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	12
2 Normative references.....	12
3 Terms and definitions	13
4 Abbreviated terms.....	14
5 ACSI overview and basic concepts.....	15
5.1 Conceptual model of IEC 61850.....	15
5.2 The meta-meta model.....	16
5.3 The meta model.....	16
5.3.1 General	16
5.3.2 Information modelling classes	17
5.3.3 Information exchange modelling classes	18
5.3.4 Relations between classes	20
5.4 The domain type model.....	21
5.5 The data instance model.....	21
6 TypeDefinitions.....	22
6.1 General	22
6.1.1 BasicTypes.....	22
6.1.2 CommonACSI Types.....	23
7 GenServerClass model	29
7.1 GenServerClass definition	29
7.1.1 GenServerClass syntax.....	29
7.1.2 GenServerClass attributes	30
7.2 Server class services.....	30
7.2.1 Overview of directory and GetDefinition services	30
7.2.2 GetServerDirectory	31
8 Application association model	32
8.1 Introduction	32
8.2 Concept of application associations	32
8.3 TWO-PARTY-APPLICATION-ASSOCIATION (TPAA) class model.....	32
8.3.1 TWO-PARTY-APPLICATION-ASSOCIATION (TPAA) class definition	32
8.3.2 Two-party application association services	34
8.4 MULTICAST-APPLICATION-ASSOCIATION (MCAA) class	37
8.4.1 MULTICAST-APPLICATION-ASSOCIATION (MCAA) class definition.....	37
8.4.2 MULTICAST-Application-association (MCAA) class attributes.....	37
9 GenLogicalDeviceClass model	38
9.1 GenLogicalDeviceClass definition	38
9.1.1 GenLogicalDeviceClass syntax	38
9.1.2 GenLogicalDeviceClass attributes	38
9.2 GenLogicalDeviceClass services.....	38
9.2.1 GetLogicalDeviceDirectory.....	38
10 GenLogicalNodeClass model	39
10.1 GenLogicalNodeClass definition.....	39
10.1.1 GenLogicalNodeClass diagram	39
10.1.2 GenLogicalNodeClass syntax.....	40

10.1.3	GenLogicalNodeClass attributes	41
10.2	GenLogicalNodeClass services	42
10.2.1	Overview	42
10.2.2	GetLogicalNodeDirectory	42
10.2.3	GetAllDataValues	43
11	Generic data object class model	45
11.1	GenDataObjectClass diagram	45
11.2	GenDataObjectClass syntax	45
11.3	GenDataObjectClass attributes	46
11.3.1	DataObjectName	46
11.3.2	DataObjectRef – data object reference	46
11.3.3	m/o/c	46
11.3.4	DataObjectType	46
11.4	GenDataObjectClass services	46
11.4.1	General definitions and overview	46
11.4.2	GetDataValues	47
11.4.3	SetDataValues	48
11.4.4	GetDataDirectory	49
11.4.5	GetDataDefinition	50
12	Generic common data class model	50
12.1	General	50
12.2	GenCommonDataClass	51
12.2.1	GenCommonDataClass diagram	51
12.2.2	GenCommonDataClass syntax	51
12.2.3	GenCommonDataClass attributes	52
12.3	GenDataAttributeClass	52
12.3.1	GenDataAttributeClass diagram	52
12.3.2	GenDataAttributeClass syntax	53
12.3.3	GenDataAttributeClass attributes	53
12.4	GenConstructedAttributeClass	57
12.4.1	GenConstructedAttributeClass diagram	57
12.4.2	GenConstructedAttributeClass syntax	57
12.4.3	GenConstructedAttributeClass attributes	57
12.5	GenSubDataAttributeClass	57
12.5.1	SubDataAttributeClass diagram	57
12.5.2	SubDataAttributeClass syntax	58
12.5.3	GenSubDataAttributeClass attributes	58
12.6	Referencing data objects and their components	58
12.6.1	General	58
12.6.2	Reference syntax	59
12.6.3	Base types and their relation	59
12.6.4	Example of using references	60
13	DATA-SET class model	61
13.1	General	61
13.2	DATA-SET class definition	62
13.2.1	DATA-SET class syntax	62
13.2.2	DATA-SET class attributes	63
13.3	DATA-SET class services	63
13.3.1	Overview	63

13.3.2	GetDataSetValues	64
13.3.3	SetDataSetValues.....	65
13.3.4	CreateDataSet.....	66
13.3.5	DeleteDataSet	66
13.3.6	GetDataSetDirectory.....	67
14	Service tracking.....	68
14.1	General.....	68
14.2	Common service tracking (CST).....	68
15	Modelling of control block classes.....	70
15.1	General.....	70
15.2	Control block class models.....	70
15.2.1	Control block attributes.....	71
15.2.2	Control block services.....	71
15.2.3	Attribute type.....	71
15.3	Control block tracking services.....	71
15.3.1	General.....	71
15.3.2	Common data classes for control block service tracking.....	72
16	SETTING-GROUP-CONTROL-BLOCK class model.....	82
16.1	General.....	82
16.2	SGCB class definition.....	83
16.2.1	SGCB class syntax.....	83
16.2.2	SGCB class attributes.....	84
16.3	SGCB class services.....	85
16.3.1	Overview.....	85
16.3.2	SelectActiveSG.....	85
16.3.3	SelectEditSG.....	86
16.3.4	SetEditSGValue.....	87
16.3.5	ConfirmEditSGValues.....	88
16.3.6	GetEditSGValue.....	89
16.3.7	GetSGCBValues.....	90
17	REPORT-CONTROL-BLOCK and LOG-CONTROL-BLOCK class models.....	91
17.1	Overview.....	91
17.2	REPORT-CONTROL-BLOCK class model.....	93
17.2.1	Basic concepts.....	93
17.2.2	BUFFERED-REPORT-CONTROL-BLOCK (BRCB) class definition.....	93
17.2.3	BRCB class services.....	103
17.2.4	UNBUFFERED-REPORT-CONTROL-BLOCK (URCB) class definition.....	116
17.2.5	URCB class services.....	117
17.3	LOG-CONTROL-BLOCK class model.....	118
17.3.1	General.....	118
17.3.2	LCB class definition.....	119
17.3.3	LOG class definition.....	124
17.3.4	Reason code for log entries.....	127
17.3.5	LOG services.....	127
18	Generic substation event class model (GSE).....	131
18.1	Overview.....	131
18.2	GOOSE-CONTROL-BLOCK (GoCB) class.....	132
18.2.1	GoCB definition.....	132
18.2.2	GOOSE service definitions.....	134

18.2.3	Generic object oriented substation event (GOOSE) message	139
19	Transmission of sampled value class model.....	140
19.1	Overview	140
19.2	Transmission of sampled values using multicast	142
19.2.1	MSVCB class definition.....	142
19.2.2	Multicast sampled value class services	144
19.3	Transmission of sampled values using unicast.....	147
19.3.1	USVCB class definition	147
19.3.2	Unicast sampled value services	150
19.4	Sampled value format.....	153
19.4.1	MsvID or UsvID	154
19.4.2	OptFlds	154
19.4.3	DatSet.....	154
19.4.4	Sample [1..n].....	155
19.4.5	SmpCnt.....	155
19.4.6	RefrTm.....	155
19.4.7	ConfRev	155
19.4.8	SmpSynch.....	155
19.4.9	SmpRate	155
19.4.10	SmpMod.....	155
19.4.11	Simulation	155
20	CONTROL class model.....	156
20.1	Introduction	156
20.2	Control with normal security.....	158
20.2.1	Direct control with normal security.....	158
20.2.2	SBO control with normal security.....	160
20.3	Control with enhanced security	162
20.3.1	Introduction	162
20.3.2	Direct control with enhanced security	162
20.3.3	SBO control with enhanced security	163
20.4	Time-activated operate	166
20.5	CONTROL class service definitions	167
20.5.1	Overview	167
20.5.2	Service parameter definition.....	168
20.5.3	Service specification	172
20.6	Tracking of control services	178
20.6.1	General	178
20.6.2	Control service tracking (CTS)	178
21	Time and time-synchronization model	179
21.1	General	179
21.2	External information.....	180
22	Naming conventions	181
22.1	Class naming and class specializations.....	181
22.2	Referencing an instance of a class.....	182
22.3	Scope.....	183
23	File transfer model.....	184
23.1	File class	184
23.1.1	FileName	184
23.1.2	FileSize	184

23.1.3 LastModified	184
23.2 File services	185
23.2.1 GetFile	185
23.2.2 SetFile	185
23.2.3 DeleteFile	186
23.2.4 GetFileAttributeValues	186
Annex A (normative) ACSI conformance statement.....	188
Annex B (normative) Formal definition of IEC 61850-7-2 Common Data Classes.....	195
Annex C (informative) Generic substation state event (GSSE) control block (GsCB)	203
Bibliography	212
Index	213
Figure 1 – Excerpt of conceptual model of IEC 61850	16
Figure 2 – Basic conceptual class model of the ACSI.....	17
Figure 3 – Conceptual service model of the ACSI	19
Figure 4 – Core of the conceptual meta model and relationship	21
Figure 5 – Data instance model (conceptual)	22
Figure 6 – Overview about GetDirectory and GetDefinition services	30
Figure 7 – Normal operation	33
Figure 8 – Aborting association	33
Figure 9 – Principle of multicast application association.....	37
Figure 10 – Basic conceptual model of the GenLogicalNodeClass.....	40
Figure 11 – Basic conceptual class model of the GenDataObjectClass	45
Figure 12 – Excerpt of GenDataObjectClass services	47
Figure 13 – Class diagram of the GenCommonDataClass.....	51
Figure 14 – Conceptual Class diagram of the GenCommonDataClass.....	51
Figure 15 – Class diagram of the GenDataAttributeClass.....	52
Figure 16 – Relation of TrgOp and Reporting.....	56
Figure 17 – Class diagram of the GenConstructedAttributeClass	57
Figure 18 – Relation of types (example)	60
Figure 19 – Example of a data object	61
Figure 20 – Dynamic creation of data set instances	62
Figure 21 – Control block service mapping	72
Figure 22 – Basic model of the settings model.....	83
Figure 23 – Basic building blocks for reporting and logging	92
Figure 24 – BRCB state machine.....	95
Figure 25 – General queue of entries for report handler.....	96
Figure 26 – Buffer time.....	98
Figure 27 – State Machine for Sequence Number Generation	99
Figure 28 – Logical state machine for general interrogation	101
Figure 29 – Report example on the use of sequence number.....	105
Figure 30 – Entry discard that does not cause indication of loss of information in enabled state	106
Figure 31 – Indication of loss of information due to resource constraints in enable state	107

Figure 32 – Data set members and reporting	108
Figure 33 – Report example	109
Figure 34 – Log model overview	119
Figure 35 – GoCB model	131
Figure 36 – Model for transmission of sampled values	141
Figure 37 – Principle of the control model	156
Figure 38 – State machine of direct control with normal security	159
Figure 39 – Direct control with normal security	160
Figure 40 – State machine of SBO control with normal security	161
Figure 41 – State machine of direct control with enhanced security	163
Figure 42 – State machine SBO control with enhanced security	164
Figure 43 – Select before operate with enhanced security – positive case	165
Figure 44 – Select before operate with enhanced security – negative case (no status change)	165
Figure 45 – Time-activated operate	167
Figure 46 – Time model and time synchronization (principle)	180
Figure 47 – Specializations	181
Figure 48 – Object names and object reference	183
Figure C.1 – GsCB model	203
Table 1 – ACSI model classes with related services	20
Table 2 – BasicTypes	23
Table 3 – ObjectName type	24
Table 4 – ObjectReference type	24
Table 5 – ServiceError type	25
Table 6 – PACKED-LIST type	26
Table 7 – TimeStamp type	26
Table 8 – TimeQuality definition	27
Table 9 – TimeAccuracy	28
Table 10 – TriggerConditions type	28
Table 11 – ReasonForInclusion	29
Table 12 – GenServerClass definition	29
Table 13 – TWO-PARTY-APPLICATION-ASSOCIATION (TPAA) class definition	33
Table 14 – MULTICAST-APPLICATION-ASSOCIATION (MCAA) class definition	37
Table 15 – GenLogicalDeviceClass (GenLD) class definition	38
Table 16 – GenLogicalNodeClass definition	40
Table 17 – GenDataObjectClass definition	46
Table 18 – GenCommonDataClass definition	52
Table 19 – GenDataAttributeClass definition	53
Table 20 – Functional constraint values	54
Table 21 – TrgOp	56
Table 22 – GenConstructedAttributeClass definition	57
Table 23 – GenSubDataAttributeClass definition	58

Table 24 – DATA-SET (DS) class definition	63
Table 25 – Common service tracking common data class (CST) definition	69
Table 26 – ServiceType type	70
Table 27 – CB class definition	71
Table 28 – Buffered report tracking service (BTS) definition.....	73
Table 29 – Unbuffered report tracking service (UTS) definition	74
Table 30 – Log control block tracking service (LTS) definition	76
Table 31 – Log tracking service (OTS) definition.....	77
Table 32 – GOOSE Control block tracking service (GTS) definition.....	78
Table 33 – MSVCB tracking service (MTS) definition	79
Table 34 – USVCB tracking service (NTS) definition	80
Table 35 – SGCB tracking service (STS) definition	81
Table 36 – SGCB class definition	84
Table 37 – BRCB class definition	94
Table 38 – Report format specification	104
Table 39 – URCB class definition	116
Table 40 – LCB class definition	120
Table 41 – LOG class definition.....	125
Table 42 – GOOSE control block class definition	132
Table 43 – GOOSE message definition.....	139
Table 44 – MSVCB class definition	142
Table 45 – USVCB class definition	148
Table 46 – Sampled value (SV) format definition	154
Table 47 – Generic behavior and negative responses	157
Table 48 – Control services.....	167
Table 49 – T definition.....	168
Table 50 – Test definition	169
Table 51 – Check condition definition	169
Table 52 – operTm definition.....	169
Table 53 – Additional cause diagnosis definition	170
Table 54 – AddCause semantic.....	171
Table 55 – Control service tracking (CTS) definition	179
Table 56 – FILE class definition.....	184
Table A.1 – Basic conformance statement.....	189
Table A.2 – ACSI models conformance statement	190
Table A.3 – ACSI service conformance statement	191
Table C.1 – GSSE control block class definition	204
Table C.2 – GSSE message definition	210

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMUNICATION NETWORKS AND SYSTEMS
FOR POWER UTILITY AUTOMATION –**
**Part 7-2: Basic information and communication structure –
Abstract communication service interface (ACSI)**

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.

International Standard IEC 61850-7-2 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

FDIS	Report on voting
57/1065/FDIS	57/1083/RVD

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

This second edition cancels and replaces the first edition published in 2003. It constitutes a technical revision.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The major technical changes with regard to the previous edition are as follows:

- class diagrams have been updated,
- data types not required have been removed,
- errors and typos have been corrected,
- substitution model has been moved to IEC 61850-7-3,
- service tracking for control blocks have been added,
- the view concept will be according to the new work on role bases access (RBA),
- security issues are solved by the IEC 62351 series, and
- several terms have been harmonized with those in the other parts.

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

In this document, the following print types are used:

- **bold** is used to highlight defined terms,
- Tahoma is used where the difference between a capital i (I) and a small L (l) is important to see.

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 this publication 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.

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

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 document is part of a set of definitions which details a layered utility communication architecture. This architecture has been chosen to provide abstract definitions of classes and services such that the definitions are independent of specific protocol stacks, implementations, and operating systems.

The IEC 61850 series is intended to provide interoperability between a variety of devices. Communication between these devices is achieved by the definition of a hierarchical class model (for example, logical device, logical node, data, data set, report control, or log) and services provided by these classes (for example, get, set, report, define, delete) in IEC 61850-7-x.

This part of IEC 61850 defines the abstract communication service interface (ACSI) for use in the utility application domain that requires real-time cooperation of intelligent electronic devices. The ACSI has been defined so as to be independent of the underlying communication systems. Specific communication service mappings¹⁾ (SCSM) are specified in IEC 61850-8-x and IEC 61850-9-x.

This part of IEC 61850 defines the abstract communication service interface in terms of

- a hierarchical class model of all information that can be accessed via a communication network,
- services that operate on these classes, and
- parameters associated with each service.

The ACSI description technique abstracts away from all the different approaches to implement the cooperation of the various devices.

NOTE 1 Abstraction in ACSI has two meanings. First, only those aspects of a real device (for example, a breaker) or a real function that are visible and accessible over a communication network are modelled. This abstraction leads to the hierarchical class models and their behaviour defined in IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4. Second, the ACSI abstracts from the aspect of concrete definitions on how the devices exchange information; only a conceptual cooperation is defined. The concrete information exchange is defined in the SCSMs.

NOTE 2 This part of IEC 61850 does not provide comprehensive tutorial material. It is recommended that IEC 61850-5 and IEC 61850-7-1 be read first in conjunction with IEC 61850-7-2 and IEC 61850-7-3.

NOTE 3 Examples use names of classes (for example XCBR for a class of a logical node) defined in IEC 61850-7-4 and IEC 61850-7-3. The normative names are defined in IEC 61850-7-4 and IEC 61850-7-3 only.

¹⁾ The ACSI is independent of the specific mapping. Mappings to standard application layers or middle ware technologies are possible.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)

1 Scope

This part of IEC 61850 applies to the ACSI communication for utility automation. The ACSI provides the following abstract communication service interfaces.

- a) Abstract interface describing communications between a client and a remote server for
 - real-time data access and retrieval,
 - device control,
 - event reporting and logging,
 - setting group control,
 - self-description of devices (device data dictionary),
 - data typing and discovery of data types, and
 - file transfer.
- b) Abstract interface for fast and reliable system-wide event distribution between an application in one device and many remote applications in different devices (publisher/subscriber) and for transmission of sampled measured values (publisher/subscriber).

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 61850-2, *Communication networks and systems in substations – Part 2: Glossary*

IEC 61850-5, *Communication networks and systems in substations – Part 5: Communication requirements for functions and devices models*

IEC 61850-6, *Communication networks and systems for power utility automation – Part 5: 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 models²⁾*

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes²⁾*

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

²⁾ To be published.

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 8802-3³⁾*

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 8802-3³⁾*

ISO 4217, *Codes for the representation of currencies and funds*

ISO 9506 (all parts), *Industrial automation systems – Manufacturing Message Specification*

IEEE 754, *Standard for Floating-Point Arithmetic*

3) To be published.