

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Wind energy generation systems –
Part 25-4: Communications for monitoring and control of wind power plants –
Mapping to communication profile**

**Systèmes de génération d'énergie éolienne –
Partie 25-4: Communications pour la surveillance et la commande des centrales
éoliennes – Mapping pour les profils de communication**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2016 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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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

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

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - 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: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Wind energy generation systems –
Part 25-4: Communications for monitoring and control of wind power plants –
Mapping to communication profile**

**Systèmes de génération d'énergie éolienne –
Partie 25-4: Communications pour la surveillance et la commande des centrales
éoliennes – Mapping pour les profils de communication**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 27.180

ISBN 978-2-8322-3760-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	10
INTRODUCTION.....	13
1 Scope.....	14
2 Normative references	15
3 Terms and definitions	18
4 Abbreviated terms	18
5 General overview.....	19
5.1 General.....	19
5.2 Mapping to protocol stacks	20
5.3 Services of IEC 61400-25-3 mapped to protocol stacks.....	20
Annex A (normative) Specific communication service mapping – Definition and mapping to Web Services	23
A.1 General.....	23
A.1.1 Introduction to definition and mapping to Web Services	23
A.1.2 Scope of the definition and mapping to Web Service	23
A.1.3 The mapping architecture	23
A.2 Mapping of the IEC 61400-25 Information Model to Web Services	26
A.2.1 General introduction to mapping to web services.....	26
A.2.2 DATA OBJECT class	29
A.2.3 DATA ATTRIBUTE definition	29
A.3 Mapping of the Information Exchange Model to Web Services	30
A.3.1 General	30
A.3.2 SERVER class service mapping	30
A.3.3 LOGICAL-DEVICE class service mapping.....	36
A.3.4 LOGICAL-NODE class services mapping.....	38
A.3.5 DATA class service mapping.....	41
A.3.6 DATA-SET class services mapping.....	51
A.3.7 REPORT-CONTROL-BLOCK (RCB) class services mapping	58
A.3.8 LOG-CONTROL BLOCK (LCB) class services mapping	73
A.3.9 LOG class services mapping.....	77
A.3.10 CONTROL class services mapping	81
A.4 Protocol stack details.....	94
A.5 The WSDL specification for the definition and mapping to Web Services	95
Annex B (normative) Specific communication service mapping – Mapping to OPC XML-DA.....	129
B.1 General.....	129
B.1.1 Introduction to mapping to OPC XML-DA.....	129
B.1.2 Scope for the mapping to OPC XML-DA.....	129
B.1.3 The mapping architecture	129
B.2 Mapping of the IEC 61400-25 Information Model to OPC XML-DA.....	132
B.2.1 Mapping of IEC 61400-25-2 Information Model classes to OPC XML-DA	132
B.2.2 Server	132
B.2.3 Logical Device	133
B.2.4 Logical Node	133
B.2.5 Data Object	133
B.2.6 Data Attribute	134

B.3	Mapping of the Information Exchange Model to OPC XML-DA services.....	140
B.3.1	General	140
B.3.2	Association model	140
B.3.3	Server class services – GetServerDirectory	143
B.3.4	Logical device class services – GetLogicalDeviceDirectory.....	145
B.3.5	Logical node class services	147
B.3.6	Data class services.....	149
B.3.7	Data set model	156
B.3.8	Report model.....	160
B.3.9	Control model.....	164
B.4	Protocol stack details.....	174
Annex C (normative)	Specific communication service mapping – Mapping to ISO 9506 specified in IEC 61850-8-1	176
C.1	General.....	176
C.1.1	Introduction to mapping to ISO 9506 specified in IEC 61850-8-1	176
C.1.2	Scope of the mapping to ISO 9506 specified in IEC 61850-8-1	176
C.1.3	The mapping architecture	176
C.2	Mapping of the IEC 61400-25 Information Model to ISO 9506 as specified in IEC 61850-8-1	178
C.2.1	General	178
C.2.2	Extended Logging services	179
C.3	Protocol stack details.....	179
C.3.1	General	179
C.3.2	A-Profile	179
C.3.3	TCP/IP T-Profile	180
Annex D (normative)	Specific communication service mapping – Mapping to IEC 60870-5-104 specified in IEC TS 61850-80-1	182
D.1	General.....	182
D.1.1	Introduction to mapping to IEC 60870-5-104 specified in IEC TS 61850-80-1.....	182
D.1.2	Scope of the mapping to IEC 60870-5-104 specified in IEC TS 61850-80-1.....	182
D.1.3	The mapping architecture	182
D.2	Mapping of the IEC 61400-25 Information Model to IEC 60870-5-104 as specified in IEC TS 61850-80-1.....	185
D.2.1	General	185
D.2.2	Logical Device IM class mapping	186
D.2.3	Logical Node IM class mapping	187
D.3	Mapping of IEC 61400-25 Information Model data to IEC 60870-5-104	187
D.3.1	Mapping of the Common Data Classes (CDC)	187
D.4	Mapping of the Information Exchange Model to IEC 60870-5-104 services.....	198
D.4.1	List of service models and corresponding mappings	198
D.4.2	Control class mapping	199
D.5	Protocol stack selections for IEC 60870-5-104 (Protocol stack details)	211
D.5.1	General	211
D.5.2	Structure of application data	211
D.5.3	IEC 60870-5-104 Interoperability	211
D.6	Use of SCL (Substation Configuration Language) extension to include IEC 60870-5-101/104 information (informative)	224
D.6.1	General	224

D.6.2	SCL information model hierarchy	224
D.6.3	IEC 60870-5-101/104 Private section syntax.....	224
D.6.4	IEC 60870-5-104 communication parameters configuration using SCL.....	224
Annex E (normative)	Specific communication service mapping – Mapping to DNP3	225
E.1	General.....	225
E.1.1	Introduction to mapping to DNP3	225
E.1.2	Scope for the mapping to DNP3.....	225
E.1.3	Mapping architecture	225
E.2	Mapping of the IEC 61400-25 Information Model to DNP3.....	228
E.2.1	Mapping of IEC 61850-7-3 inherited common Data Classes	228
E.2.2	CDC Setpoint Parameter Value (SPV)	229
E.2.3	CDC Status Value (STV).....	229
E.2.4	CDC Alarm (ALM)	230
E.2.5	CDC Command (CMD).....	232
E.2.6	CDC Event Counting (CTE)	232
E.2.7	CDC State Timing (TMS)	233
E.2.8	CDC Device Name Plate (WDPL).....	234
E.2.9	CDC Alarm Set Status (AST)	235
E.3	Mapping of the Information Exchange Model to DNP3 services	236
Annex F (normative)	Time synchronization	237
F.1	General.....	237
F.2	A-Profile	237
F.3	T-Profile.....	237
Annex G (informative)	Interfaces – Implementation considerations	238
G.1	General.....	238
G.2	Example interfaces of a real system	238
Bibliography	240
Figure 1	– Conceptual communication model of IEC 61400-25 series	15
Figure 2	– Communication profile	20
Figure A.1	– Mapping architecture (conceptual)	24
Figure A.2	– Naming structure applied in the IEC 61400-25 series (conceptual).....	27
Figure A.3	– Client behavior in the reporting service (conceptual)	59
Figure A.4	– Server behavior in the reporting service (conceptual).....	60
Figure A.5	– Reporting Services mechanism (conceptual).....	61
Figure B.1	– Mapping architecture (conceptual)	130
Figure B.2	– Differences between OPC XML-DA and IEC Information Model timestamp.....	137
Figure B.3	– Sequence of services to establish an association.....	142
Figure B.4	– CreateDataSet sequence of services	158
Figure C.1	– Mapping architecture (conceptual)	177
Figure D.1	– Mapping architecture (conceptual)	183
Figure D.2	– Direct Control with Normal Security with status update – positive case	200
Figure D.3	– Direct Control with Normal Security in general – negative case a)	201
Figure D.4	– Direct Control with Normal Security in general – negative case b)	201
Figure D.5	– Direct Control with Normal Security with status update – negative case c).....	202
Figure D.6	– Direct Control with Normal Security without status update – positive case	203

Figure D.7 – Direct Control with Enhanced Security – positive case.....	204
Figure D.8 – Direct Control with Enhanced Security – negative case c).....	205
Figure D.9 – Direct Control with Enhanced Security – negative case d)	206
Figure D.10 – SBOw control – positive case	207
Figure D.11 – SBOw control – negative case a)	207
Figure D.12 – SBOw control – negative case b)	208
Figure D.13 – SBOw control – negative case c)	209
Figure D.14 – SBO with Enhanced Security – positive case	209
Figure D.15 – SBO with Enhanced Security – negative case a).....	210
Figure D.16 – SBO with Enhanced Security – negative case b).....	211
Figure E.1 – Mapping architecture (conceptual)	226
Figure G.1 – Implementation issues (example)	239
Table 1 – Mapping overview of IEC 61400-25-3 services	22
Table A.1 – Web Services mapping overview of IEC 61400-25 IM and IE 1.....	25
Table A.2 – Mapping the IEC 61400-25 IM to Web Services.....	26
Table A.3 – XML schema for wind power information model.....	29
Table A.4 – Server class services mapped to Web Services	30
Table A.5 – GetServerDirectoryRequest	31
Table A.6 – GetServerDirectoryResponse	31
Table A.7 – AssociateRequest	33
Table A.8 – AssociateResponse	34
Table A.9 – ReleaseRequest.....	35
Table A.10 – ReleaseResponse	35
Table A.11 – AbortRequest.....	36
Table A.12 – AbortResponse	36
Table A.13 – LOGICAL-DEVICE service mapping	37
Table A.14 – GetLogicalDeviceDirectoryRequest	37
Table A.15 – GetLogicalDeviceDirectoryResponse	38
Table A.16 – LOGICAL-NODE mapping	38
Table A.17 – GetLogicalNodeDirectoryRequest	39
Table A.18 – GetLogicalNodeDirectoryResponse	39
Table A.19 – GetAllDataValuesRequest	40
Table A.20 – GetAllDataValuesResponse	41
Table A.21 – Data mapping.....	41
Table A.22 – GetDataValuesRequest.....	42
Table A.23 – GetDataValuesResponse	42
Table A.24 – SetDataValuesRequest	45
Table A.25 – SetDataValuesResponse.....	46
Table A.26 – GetDataDirectoryRequest	46
Table A.27 – GetDataDirectoryResponse	47
Table A.28 – GetDataDefinitionRequest.....	48
Table A.29 – GetDataDefinitionResponse	49

Table A.30 – DATA-SET mapping	51
Table A.31 – GetDataSetValuesRequest.....	52
Table A.32 – GetDataSetValuesResponse	52
Table A.33 – SetDataSetValuesRequest	54
Table A.34 – SetDataSetValuesResponse	54
Table A.35 – CreateDataSetRequest	55
Table A.36 – CreateDataSetResponse.....	56
Table A.37 – DeleteDataSetRequest.....	56
Table A.38 – DeleteDataSetResponse	57
Table A.39 – GetDataSetDirectoryRequest	57
Table A.40 – GetDataSetDirectoryResponse.....	58
Table A.41 – Report control block services mapping	58
Table A.42 – ReportFormat.....	62
Table A.43 – GetBRCBValuesRequest.....	63
Table A.44 – GetBRCBValuesResponse	64
Table A.45 – SetBRCBValuesRequest	66
Table A.46 – SetBRCBValuesResponse	67
Table A.47 – GetURCBValuesRequest.....	68
Table A.48 – GetURCBValuesResponse.....	68
Table A.49 – SetURCBValuesRequest.....	70
Table A.50 – SetURCBValuesResponse	71
Table A.51 – ReportRequest.....	72
Table A.52 – ReportResponse	73
Table A.53 – LOG-CONTROL-BLOCK services mapping	73
Table A.54 – GetLCBValuesRequest	74
Table A.55 – GetLCBValuesResponse.....	75
Table A.56 – SetLCBValuesRequest.....	76
Table A.57 – SetLCBValue Response	76
Table A.58 – Log class services mapping	77
Table A.59 – GetLogStatusValuesRequest.....	77
Table A.60 – GetLogStatusValuesResponse	78
Table A.61 – QueryLogByTimeRequest.....	79
Table A.62 – QueryLogByTimeResponse	80
Table A.63 – QueryLogAfterRequest.....	80
Table A.64 – QueryLogAfterResponse	81
Table A.65 – Control class services mapping.....	82
Table A.66 – SelectRequest.....	82
Table A.67 – SelectResponse	83
Table A.68 – SelectWithValueRequest.....	84
Table A.69 – SelectWithValueResponse	85
Table A.70 – CancelRequest.....	86
Table A.71 – CancelResponse	87
Table A.72 – OperateRequest.....	88

Table A.73 – OperateResponse	89
Table A.74 – CommandTerminationRequest	90
Table A.75 – CommandTerminationResponse.....	90
Table A.76 – TimeActivatedOperateRequest.....	91
Table A.77 – TimeActivatedOperateResponse	92
Table A.78 – TimeActivatedOperateTerminationRequest	93
Table A.79 – TimeActivatedOperateTerminationResponse	93
Table A.80 – AddCause parameter response	94
Table A.81 – Protocol stack selections.....	95
Table B.1 – Mapping of IEC 61400-25-3 IEM service into OPC XML-DA services	131
Table B.2 – Mapping of IEC 61400-25-2 IM classes to OPC XML-DA.....	132
Table B.3 – Server class attributes	132
Table B.4 – Logical Device Class attributes	133
Table B.5 – Logical Node Class attributes.....	133
Table B.6 – Data Object Class attributes	134
Table B.7 – Data Attribute Class attributes	134
Table B.8 – Mapping of the Basic Types	135
Table B.9 – New OPC XML-DA Error codes	137
Table B.10 – Timestamp mapping.....	138
Table B.11 – Mapping of the Quality attribute	138
Table B.12 – Cookie parameter explanation.....	141
Table B.13 – IEM GetServerDirectory mapping	143
Table B.14 – IEM GetServerDirectory mapping detailed.....	144
Table B.15 – IEM GetLogicalDeviceDirectory mapping.....	145
Table B.16 – IEM GetLogicalDeviceDirectory mapping detailed	145
Table B.17 – GetLogicalDeviceDirectory negative response mapping to IEM ServiceError	146
Table B.18 – IEM GetLogicalNodeDirectory mapping	147
Table B.19 – IEM GetLogicalNodeDirectory mapping detailed.....	147
Table B.20 – GetLogicalNodeDirectory negative response mapping to IEM ServiceError	148
Table B.21 – IEM GetDataValues mapping	149
Table B.22 – IEM GetDataValues mapping detailed	150
Table B.23 – GetDataValues negative response mapping to IEM ServiceError.....	151
Table B.24 – IEM SetDataValues mapping.....	152
Table B.25 – IEM SetDataValues mapping detailed	152
Table B.26 – SetDataValues negative response mapping to IEM ServiceError	154
Table B.27 – IEM GetDataDirectory mapping.....	154
Table B.28 – IEM GetDataDirectory mapping detailed.....	155
Table B.29 – GetDataDirectory negative response mapping to IEM ServiceError	156
Table B.30 – Mapping of CreateDataSet service parameters	158
Table B.31 – CreateDataSet negative response mapping to IEM ServiceError	158
Table B.32 – GetDataSetValues negative response mapping to IEM ServiceError	159
Table B.33 – SetDataSetValues negative response mapping to IEM ServiceError.....	159

Table B.34 – OPC Subscription attributes' constrained value	160
Table B.35 – Subscribe	161
Table B.36 – Subscription Cancel	163
Table B.37 – Fault mapping to IEM ServiceError	163
Table B.38 – Mapping of Report service parameters	163
Table B.39 – Control models supported in this mapping	164
Table B.40 – Control services supported	164
Table B.41 – Control model writable custom item properties	166
Table B.42 – AddCause mapping to OPC Error Code	167
Table B.43 – Select request service mapping	168
Table B.44 – SelectWithValue service parameter mapping	169
Table B.45 – Cancel service parameter mapping	170
Table B.46 – Cancel negative response mapping to IEM ServiceError	170
Table B.47 – Operate service parameter mapping	171
Table B.48 – Operate negative response mapping to IEM ServiceError	171
Table B.49 – TimeActivatedOperate service parameter mapping	172
Table B.50 – TimeActivatedOperate negative response mapping to IEM ServiceError	173
Table B.51 – Protocol stack details	175
Table C.1 – Mapping of IEC 61400-25-3 IEM to ISO 9506 according to IEC 61850-8-1	177
Table C.2 – QueryLogByTime mapping	179
Table C.3 – QueryLogAfter mapping	179
Table C.4 – Service and protocols for client/server communication A-Profile	180
Table C.5 – Service and protocols for client/server TCP/IP T-Profile	180
Table D.1 – Services Mapping overview of IEC 61400-25 IM and IEM	184
Table D.2 – Example for mapping of LD and LN to CASDU and IOA	186
Table D.3 – Logical device mapping	187
Table D.4 – Logical node mapping	187
Table D.5 – CDCs defined in IEC 61400-25-2	188
Table D.6 – CDC: Status Value, STV class	188
Table D.7 – CDC: Setpoint Value, SPV class	188
Table D.8 – CDC: Alarm, ALM class	189
Table D.9 – CDC: Command CMD class	189
Table D.10 – CDC: Event Counting, CTE class	189
Table D.11 – CDC: State Timing, TMS class	190
Table D.12 – Mapping structure basic CDC	190
Table D.13 – CDC: Controllable Analog set point, APC class	192
Table D.14 – CDC: Controllable analogue set point information (APC) mapping of data attributes of the Functional Constraint MX	192
Table D.15 – CDC: Controllable Analog set point, APC class mapping of data and attributes of the Functional Constraint CO	193
Table D.16 – CDC: Enumerated status, ENS class	193
Table D.17 – CDC: Enumerated status, ENS class mapping of data and attributes of the Functional Constraint ST	194
Table D.18 – CDC: ENC Controllable enumerated status, class ENC	195

Table D.19 – CDC: Controllable enumerated status, ENC class mapping of data and attributes of the Functional Constraint CO 195

Table D.20 – CDC: ENG Enumerated status setting, class ENG 197

Table D.21 – Relationship between complex CDCs and IEC 60870-5-104 ASDUs 197

Table D.22 – Mapping of IEC 61400-25 ACSI service into IEC 60870-5-104 services 198

Table E.1 – Services requiring Client/Server Communication Profile 227

Table E.2 – CDC: Setpoint Parameter Value (SPV) mapping 229

Table E.3 – CDC: Status Value (STV) mapping 230

Table E.4 – CDC: Alarm (ALM) mapping 231

Table E.5 – CDC: Command (CMD) mapping 232

Table E.6 – CDC: Event Counting (CTE) mapping 233

Table E.7 – CDC: State Timing (TMS) mapping 234

Table E.8 – CDC: Device Name Plate (WDPL) mapping 235

Table E.9 – CDC: Alarm Set Status (AST) mapping 236

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND ENERGY GENERATION SYSTEMS –

Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile

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 61400-25-4 has been prepared by IEC technical committee 88: Wind energy generation systems.

This second edition cancels and replaces the first edition published in 2008. This edition constitutes a technical revision.

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

General harmonization with information models in IEC 61400-25-2 and information exchange services in IEC 61400-25-3.

Reduction of overlap between standards and simplification by increased referencing.

For Annex A Webservices: Changes are limited to harmonization with IEC 61850 and with other parts of IEC 61400-25. Updating of webservices to use soap over websockets have been considered.

Maintenance of Annex B OPC/XML-DA included an evaluation of the use of custom item properties. OPC UA was not chosen as basis for IEC 61850-8-2, however the work of TS 61400-25-41 is currently considering if OPC UA can replace the existing OPC/XML-DA mapping in future editions of IEC 61400-25-4. A mapping to OPC UA is thus not part of this second edition of IEC 61400-25-4, but could be submitted as a separate document.

The mapping to IEC 61850-8-1 in Annex C is harmonized with the latest edition of IEC 61850-8-1.

The mapping to IEC 60870-5-104 in Annex D includes further harmonization with IEC 61850-80-1.

Finally, Annex E DNP3 is harmonized with the latest version of IEEE 1815-1. This includes an adaptation to support wind power specific models.

- a) Mapping of AddSubscription and RemoveSubscription services have been removed, to be in line with IEC 61400-25-3.
- b) Tables indicating services supported have been replaced by tables in accordance with IEC 61400-25-3:2015 Annex D including ACSI conformance statements for clients and servers, individually.
- c) Technical issues (Tissues) for IEC 61850-7-2:2010 have been considered and changes have been made accordingly
- d) Technical issues (Tissues), as collected by the IEC 61400-25 users group USE61400-25, have been considered, and changes have been made accordingly.
- e) The changes made to Annex A includes the following: Mapping to object classes has been removed for objects (Server, LD, LN, Data Set, RCB, UCB, LCB and Log) not used in the services. Object names are defined as names of complex types instead of elements. Faulty references have been removed. WSDL tags have been renamed for better alignment and consistency. Values for maximum message size are specified. Mapping to service GetAllDataValues have been added. Examples have been introduced for typical service requests and responses. A new version of the WSDL has been created, validated with XmlSpy.
- f) The changes to Annex B OPC/XML-DA have been made in accordance with the scope of the revision. Main focus has been on the mapping of the Array type, of the GetAllDataValues service, of the report model and the control services.
- g) The technical change made to Annex C is an adaptation of TCP/IP Profile services according to the changes in IEC 61850-8-1:2011 (Communication and link redundancy added).
- h) The most important change in Annex D is the synchronization with the second edition of referenced IEC 61850 standards. In accordance with the work on IEC 61850-80-1 Edition 2 the new CDCs are mapped to IEC 60870-5-104. Also an interoperability list for the IEC 61400-25-4 Mapping IEC 60870-5-104 has been created, as a subset of the interoperability list of IEC 61850-80-1.
- i) Annex E (DNP3) has been updated to use the same approach as IEEE 1815.1. It describes how to translate the IEC 61400-25-2 common data class attributes to DNP3 points. The use of DNP3 datasets described in IEC 61400-25-4:2008 has been removed, as it did not offer a flexible approach to map the IEC 61400-25-2 information.

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

FDIS	Report on voting
88/600/FDIS	88/607/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 publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61400 series, published under the general title *Wind energy generation systems*, can be found on the IEC website.

For the user's convenience, a file containing the text of Clause A.7 is included with this document.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document 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

The IEC 61400-25 series defines communications for monitoring and control of wind power plants. The architecture of the IEC 61400-25 series has been selected to provide an abstract definition of classes and services such that the specifications are independent of specific protocol stacks, implementations, and operating systems. This part of IEC 61400-25 specifies the mapping of these abstract classes and services to protocol stacks.

NOTE Performance of the IEC 61400-25 series implementations are application-specific. The IEC 61400-25 series does not guarantee a certain level of performance. This is beyond the scope of the IEC 61400-25 series. However, there is no underlying limitation in the communications technology to prevent high-speed application (millisecond level responses).

WIND ENERGY GENERATION SYSTEMS –

Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile

1 Scope

The focus of the IEC 61400-25 series is on the communications between wind power plant components such as wind turbines and actors such as SCADA systems. Internal communication within wind power plant components is outside the scope of the IEC 61400-25 series.

The IEC 61400-25 series is designed for a communication environment supported by a client-server model. Three areas are defined, that are modelled separately to ensure the scalability of implementations:

- a) wind power plant information model,
- b) information exchange model, and
- c) mapping of these two models to a standard communication profile.

The wind power plant information model and the information exchange model, viewed together, constitute an interface between client and server. In this conjunction, the wind power plant information model serves as an interpretation frame for available wind power plant information. The wind power plant information model is used by the server to offer the client a uniform, component-oriented view of the wind power plant data. The information exchange model reflects the whole active functionality of the server. The IEC 61400-25 series enables connectivity between a heterogeneous combination of client and servers from different manufacturers and suppliers.

As depicted in Figure 1, the IEC 61400-25 series defines a server with the following aspects:

- Information provided by a wind power plant component, for example, ‘wind turbine rotor speed’ or ‘total power production of a certain time interval’ is modelled and made available for access. The information modelled in the IEC 61400-25 series is defined in IEC 61400-25-2.
- Services to exchange values of the modelled information, defined in IEC 61400-25-3.
- Mapping to a communication profile, providing a protocol stack to carry the messages, i.e. the service requests and responses and the values from the modelled information (IEC 61400-25-4).

IEC 61400-25-5 defines test cases associated with information, services and protocol stacks for conformance testing of both servers and clients.

The IEC 61400-25 series only defines how to model the information, information exchange and mapping to specific communication protocols. The IEC 61400-25 series excludes a definition of how and where to implement the communication interface, the application program interface and implementation recommendations. However, the objective of the IEC 61400-25 series is that the information associated with a single wind power plant component (such as a wind turbine) is accessible through a corresponding logical device.

This part of the IEC 61400-25 series specifies the specific mappings to protocol stacks encoding the messages required for the information exchange between a client and a remote server for: