

# 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**



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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**WIND ENERGY GENERATION SYSTEMS –****Part 25-4: Communications for monitoring  
and control of wind power plants –  
Mapping to communication profile**

## FOREWORD

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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- b) Tables indicating services supported have been replaced by tables in accordance with IEC 61400-25-3:2015 Annex D including ACSI conformance statements for clients and servers, individually.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.

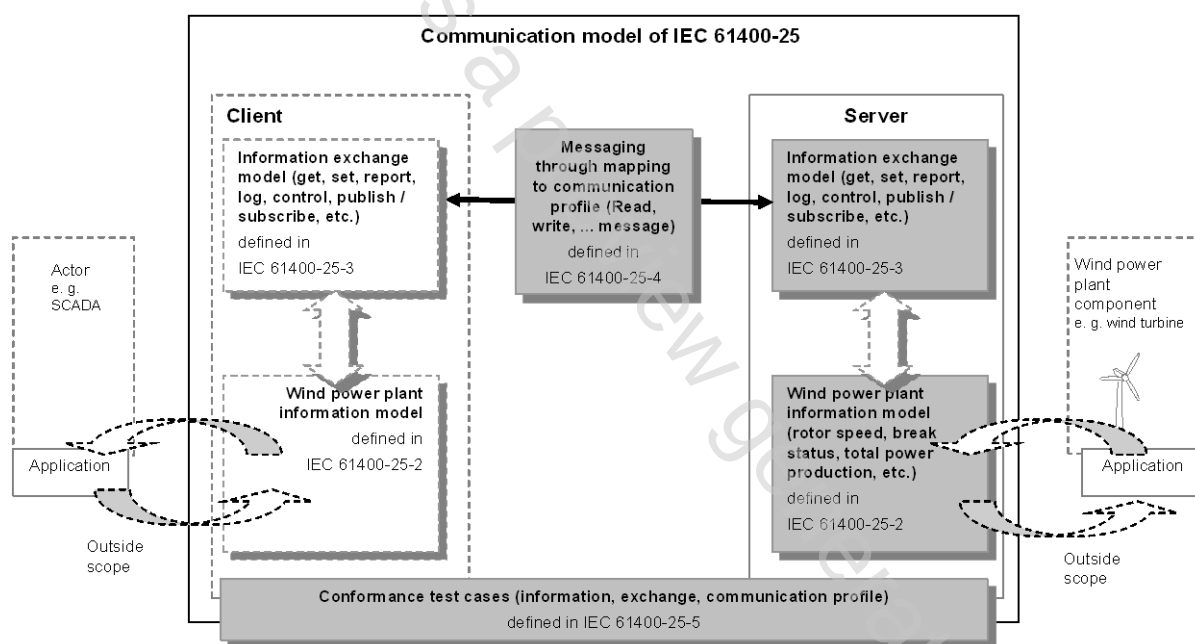
This part of the IEC 61400-25 series specifies the specific mappings to protocol stacks encoding the messages required for the information exchange between a client and a remote server for:

- data access and retrieval,
- device control,
- event reporting and logging,
- publisher/subscriber,
- self-description of devices (device data dictionary),
- data typing and discovery of data types.

The mappings specified in this part of IEC 61400-25 comprise:

- a mapping to SOAP-based web services,
- a mapping to OPC/XML-DA,
- a mapping to IEC 61850-8-1 MMS,
- a mapping to IEC 60870-5-104,
- a mapping to DNP3.

All mappings are optional, but at least one optional mapping needs to be selected in order to be compliant with this part of IEC 61400-25.



IEC

**Figure 1 – Conceptual communication model of IEC 61400-25 series**

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60870-5-4:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

IEC 60870-5-101:2003, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-104:2006, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IEC 61400-25-1:2006, *Wind turbines – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models*

IEC 61400-25-2:2015, *Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models*

IEC 61400-25-3:2015, *Wind turbines – Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models*

IEC 61400-25-5:2006, *Wind turbines – Part 25-5: Communications for monitoring and control of wind power plants – Conformance testing*

IEC 61850-6:2009, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs*

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*

IEC 61850-7-3:2010, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*

IEC 61850-8-1:2011, *Communication networks and systems for power utility automation – Part 8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

IEC TS 61850-80-1:2008, *Communication networks and systems for power utility automation – Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104*

IEC 62439-3:2016, *Industrial communication networks – High availability automation networks – Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)*

ISO 639-2, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ISO/IEC 8326:1996, *Information technology – Open Systems Interconnection – Session service definition*

ISO/IEC 8327-1:1996, *Information technology – Open Systems Interconnection – Connection-oriented Session protocol: Protocol specification*

ISO/IEC 8649:1996, *Information technology – Open Systems Interconnection – Service definition for the Association Control Service Element*

ISO/IEC 8650-1:1996, *Information technology – Open Systems Interconnection – Connection-oriented protocol for the Association Control Service Element: Protocol specification*

ISO/IEC 8822:1994, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 8823-1:1994, *Information technology – Open Systems Interconnection – Connection-oriented presentation protocol: Protocol specification*

ISO/IEC 8824-1:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8825-1:2015, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO 9506-1:2003, *Industrial automation systems – Manufacturing Message Specification – Part 1: Service definition*

ISO 9506-2:2003, *Industrial automation systems – Manufacturing Message Specification – Part 2: Protocol specification*

W3C, *Web Services Architecture*, <http://www.w3.org/TR/2002/WD-ws-arch-20021114/>

W3C, *Extensible Markup Language (XML) 1.0*, <http://www.w3.org/TR/2000/REC-xml-20001006>

SOAP ver. 1.1, *W3C Note Simple Object Access Protocol (SOAP) 1.1*, 8 May 2000. <http://www.w3.org/TR/2006/NOTE-soap11-ror-httpbinding-20060321/#reqoptrespbinding> and <http://www.w3.org/TR/2000/NOTE-SOAP-20000508/> (Referenced in Annex B)

SOAP ver. 1.2, *W3C*, 27. April 2007: <http://www.w3.org/TR/soap> (Referenced in Annex A)

RFC 791, *Internet Protocol specification (IP)*

RFC 792, *Internet Control Message Protocol (ICMP)*

RFC 793, *Transmission Control Protocol (TCP)*

RFC 826, *Ethernet Address Resolution Protocol*

RFC 919, *Broadcasting internet datagrams*

RFC 922, *Broadcasting internet datagrams in presence of subnets*

RFC 950, *Internet Standard Subnetting Procedure*

RFC 1006, *ISO Transport Service on top of the TCP Version: 3*

RFC 1112, *Host Extensions for IP Multicasting*

RFC 1122, *Requirements for Internet Hosts – Communication Layers*, IETF

RFC 2200, *Internet Official Protocol Standards, Request for Comments 2200*, June 1997

RFC 2616, *Hypertext Transfer Protocol – HTTP/1.1*

RFC 2817, *Upgrading to TLS Within HTTP/1.1*

RFC 4122, *Universally Unique IDentifier (UUID) URN Namespace*

RFC 5246, *Transport Layer Security (TLS version 1.2) protocol*

OPC XML-DA Specification. Version1.01, 18 December 2004

IEEE Std 754:1985, *IEEE Standard for Binary Floating-Point Arithmetic*

IEEE 802.1D:2004, *IEEE Standard for Local and Metropolitan Area Networks: Media access control (MAC) Bridges*

IEEE P1815.1:2015, *Standard for exchanging Information between networks implementing IEC 61850 and IEEE Std 1815 (Distributed Network Protocol – DNP3)*

### 3 Terms and definitions

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

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

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

#### 3.1

##### function

task that is performed in the control centre or the wind power plant

Note 1 to entry: Generally, a function consists of subfunctions that exchange data with each other. Depending on the function definition, functions themselves exchange data with other functions.

### 4 Abbreviated terms

|           |                                                                     |
|-----------|---------------------------------------------------------------------|
| ACSI      | Abstract Communication Service Interface (defined in IEC 61850-7-2) |
| A-Profile | Application profile                                                 |
| ASDU      | Application Service Data Unit                                       |
| CASDU     | Common Address of ASDU                                              |
| CI        | Counter Interrogation                                               |
| COT       | Cause of transmission                                               |
| DA        | Data Attribute                                                      |
| DAComp    | Data attribute component                                            |
| DNP3      | Distributed Network Protocol version 3.00                           |
| GI        | General Interrogation                                               |
| HTTP      | HyperText Transfer Protocol                                         |
| ICMP      | Internet Control Message Protocol                                   |
| IED       | Intelligent Electronic Device                                       |
| IEM       | Information Exchange Model                                          |
|           | NOTE In Annex B and Annex C, the term IEM is used instead of ACSI.  |
| IM        | Information Model                                                   |
| IOA       | Information Object Address                                          |
| IP        | Internet Protocol                                                   |