Presentation of IEC 61400-25 work:
“A generic communication solution for Wind Power Plants”

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Why a standard for wind power?

Objectives for the IEC 61400-25:

- Provide a uniform communication platform for monitoring and control of wind power plants
- Perform a way to minimize the communication barriers arising from the wide variety of proprietary protocols, data labels, data semantics etc.
- Offering the possibility to manage different wind power plants independently of the vendor specific SCADA systems
- Enable components from various vendors to easily communicate with other subsystems, at any location, at any time
- Applying modern software object-oriented software technology, data structures, enabling more efficient handling and presentation of information from wind power plants
- Maximize scalability, connectivity, and interoperability in order to reduce total cost of ownership or cost of energy
Companies behind the IEC61400-25 standard series:

- DONG (Energi E2), Denmark
- EnerNex Corporation, USA
- General Electric Energy, USA
- Hydro Tasmania, Australia
- Ingeteam, Spain
- KC Associates, USA
- n@tcon7 – rep. ENERCON, NORDEX, REpower Systems AG, Germany
- Schwarz Consulting Company, Germany
- Siemens Wind Power A/S, Denmark
- Statkraft, Norway
- Vattenfall, Sweden
- Vestas Wind Systems A/S, Denmark
- Q-Technology, Denmark – rep. Gamesa, Spain
IEC 61400-25 Scope

The scope of the IEC 61400-25 standard are as follows:

• Addressing all communication means between wind power plant components such as wind turbines and actors such as SCADA systems and dispatch centres

• Applies to any wind power plant operational concept, i.e., both in individual and integrated operations

• The application area of IEC 61400-25 covers all components required for the operation of wind power plants including the meteorological subsystem, the electrical subsystem and the wind power plant management system

• IEC 61400-25 defines how to
  – model the information
  – perform information exchange
  – map to specific communication protocols stacks
  – perform conformance testing

• The wind power plant specific information given in IEC 61400-25 is build on the common data classes specified in the IEC 61850 series of standards

• The standard excludes a definition of how and where to implement the communication interface and thereby enable any topology to be applied
IEC 61400-25 Scope

Communication model of IEC 61400-25

**Client**
- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  - defined in IEC 61400-25-3

**Messaging through mapping to communication profile (Read, write, … message)**
- defined in IEC 61400-25-4

**Wind power plant information model**
- defined in IEC 61400-25-2

**Server**
- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  - defined in IEC 61400-25-3

- Wind power plant information model (roto speed, break status, total power production, …)
  - defined in IEC 61400-25-2

Application e.g. SCADA

Outside scope

- Wind power plant component e.g. wind turbine

Application

Outside scope

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IEC 61400-25-1 Objectives

Part 25-1: Overall description of principles and models

• An introductory orientation - standard document complex in brief
• Customer requirements – what to implement for the wind power domain
• A modelling guide – how to make extensions
IEC 61400-25 Introduction – platform

IEC 62?

Hydro, Solar, Fuel Cell, ...

IEC 61400-25

Wind Power
2006 - ...

IEC 61850

Substations (HV, MV), SCADA, 1995 - 2003
Power Quality, 2006
IEC 61400-25-1 Introduction - overview

- Hides/encapsulates real World
- Mapping
- (Virtual World)
- LN
- LN
- LN
- LN
- Speed
- mapping to protocol stack
- TCP/IP Network Prot.
- logical component
- virtualisation
- Real component in wind turbine
- 61400-25 logical part of component (Rotor)
- 61400-25 data (Rotor Speed)
- configuration file
- 61400-25 Services
IEC 61400-25-1 Introduction – modelling
IEC 61400-25-2 Objectives

Part 25-2: Information Models

- The wind power plant specific information, describes the common process data, meta-data (data about data, e.g. scale factor or engineering unit), and configuration data of a wind power plant

- Hierarchically structured information covering e.g. process information found in the rotor subsystem, generator, converter, grid connection etc. The data may be simple (value, timestamp, and quality) or more comprehensive incl. scale, description, short hand reference, statistical and historical information of processed values.

- All information of a wind power plant defined in the standard is name tagged – it defines a comprehensive name space. A concise meaning of each signal is given. The standardised wind power plant information can be easily extended by means of a name space extension rule.
IEC 61400-25-2 Information Models

Communication model of IEC 61400-25

Client
- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  - defined in IEC 61400-25-3

Messaging through mapping to communication profile (Read, write, ... message)
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- Information exchange model (get, set, report, log, control, publish / subscribe, …)
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Wind power plant information model (roto speed, break status, total power production, …)
- defined in IEC 61400-25-2

Actor e.g. SCADA

Application

Outside scope

Wind power plant component e.g. wind turbine
IEC 61400-25-2 Information Models

Data of wind power plant components
- Wind turbine
- Wind generator
- Nacelle
- Rotor
- Converter
- Yaw
- ...

Information Models
### Table 2 – Wind Power Plant specific logical nodes

<table>
<thead>
<tr>
<th>LN classes</th>
<th>Description</th>
<th>M/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTUR</td>
<td>Wind turbine general information</td>
<td>M</td>
</tr>
<tr>
<td>WMET</td>
<td>Wind power plant meteorological information</td>
<td>O</td>
</tr>
<tr>
<td>WAPC</td>
<td>Wind power plant active power control information</td>
<td>O</td>
</tr>
<tr>
<td>WRPC</td>
<td>Wind power plant reactive power control information</td>
<td>O</td>
</tr>
</tbody>
</table>

### Table 3 – Wind Turbine specific logical nodes

<table>
<thead>
<tr>
<th>LN classes</th>
<th>Description</th>
<th>M/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>WROT</td>
<td>Wind turbine rotor information</td>
<td>M</td>
</tr>
<tr>
<td>WTRM</td>
<td>Wind turbine transmission information</td>
<td>O</td>
</tr>
<tr>
<td>WGEN</td>
<td>Wind turbine generator information</td>
<td>M</td>
</tr>
<tr>
<td>WCNV</td>
<td>Wind turbine converter information</td>
<td>O</td>
</tr>
<tr>
<td>WTRF</td>
<td>Wind turbine transformer information</td>
<td>O</td>
</tr>
<tr>
<td>WNAC</td>
<td>Wind turbine nacelle information</td>
<td>M</td>
</tr>
<tr>
<td>WYAW</td>
<td>Wind turbine yawing information</td>
<td>M</td>
</tr>
<tr>
<td>WTOW</td>
<td>Wind turbine tower information</td>
<td>O</td>
</tr>
<tr>
<td>WALM</td>
<td>Wind turbine alarm information</td>
<td>M</td>
</tr>
<tr>
<td>WSLG</td>
<td>Wind turbine state log information</td>
<td>O</td>
</tr>
<tr>
<td>WALG</td>
<td>Wind turbine analogue log information</td>
<td>O</td>
</tr>
<tr>
<td>WREP</td>
<td>Wind turbine report information</td>
<td>O</td>
</tr>
</tbody>
</table>
Part 25-3: Information Exchange Models

- All modelled and tagged data and meta-data can be exchanged by corresponding services

- Access to the meta-data (including configuration information with regard to the wind power plant information model and services and communication stacks) provides the so-called self-description of a device
IEC 61400-25-3 Information Exch. Models

Communication model of IEC 61400-25

Client
- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  defined in IEC 61400-25-3

Server
- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  defined in IEC 61400-25-3

Messaging through mapping to communication profile (Read, write, … message)
defined in IEC 61400-25-4

Wind power plant information model
e. g. wind turbine
- defined in IEC 61400-25-2

Application
e. g. SCADA

Outside scope
# IEC 61400-25-3 Information Exch. Models

Table 1 – Information exchange models

<table>
<thead>
<tr>
<th>Functional Group</th>
<th>Information Exchange Model</th>
<th>Short Description</th>
<th>Information categories</th>
<th>Transfer Principles</th>
<th>ACSI Service models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorisation (see 7.1)</td>
<td>Authentication and restriction of access to operational and management functions.</td>
<td>Short text messages</td>
<td>Data transfer on demand</td>
<td>Command transfer</td>
<td>ASSOCIATION</td>
</tr>
<tr>
<td>Control (see 7.2)</td>
<td>Control of operational devices.</td>
<td>Setpoints, Commands</td>
<td>Command transfer</td>
<td>Set point transfer</td>
<td>CONTROL</td>
</tr>
<tr>
<td>Monitoring (see 7.3)</td>
<td>Monitoring of current data and change of data of operational devices.</td>
<td>Measured Data, Processed data (Average Values, Min/Max), Status, Alarms, Events, Timer, Counter, Setpoints, Parameters, Commands, Time Series Data (i.e., Alarm/Event Log, Command Log, Setpoint Log) (Analogue Values, Binary Values)</td>
<td>Periodic data transfer (all data or only data that has changed since last transfer)</td>
<td>Data transfer on demand</td>
<td>LOGICAL-DEVICE, LOGICAL-NODE</td>
</tr>
<tr>
<td>Reporting and logging (see 7.3)</td>
<td>Trigger controlled continuous scanning and recording of values and events.</td>
<td>Histories (Logs), Reports, Statistics, Curves, Trends, Events</td>
<td></td>
<td></td>
<td>DATA, DATA-SET, BUFFERED-REPORT-CONTROL, UNBUFFERED-REPORT-CONTROL, LOG, LOG-CONTROL (see 9 for de-</td>
</tr>
</tbody>
</table>
IEC 61400-25-4 Objectives

Part 25-4: Mapping to communication profiles

• Providing a protocol stack to carry the exchanged values from the modelled information in a server – client based communication

• Mapping to five optional communication profiles:
  – SOAP-based Web Services (primary Western Europe + North America)
  – OPC/XML-DA (primary Western Europe)
  – IEC 61850-8-1 MMS (primary US, Sweden and Germany)
  – IEC 60870-5-104 (primary Norway)
  – DNP3 (primary North America, Australia and Asia)
IEC 61400-25-4 Mapping to Com. Profiles

Communication model of IEC 61400-25

Client

- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  - defined in IEC 61400-25-3

Server

- Information exchange model (get, set, report, log, control, publish / subscribe, …)
  - defined in IEC 61400-25-3

Messaging through mapping to communication profile (Read, write, … message)
  - defined in IEC 61400-25-4

Wind power plant information model
  - defined in IEC 61400-25-2

Actor e.g. SCADA

Application

Wind power plant component e.g. wind turbine

Outside scope

Outside scope
Table 1 – Mapping overview of IEC 61400-25-3 services

<table>
<thead>
<tr>
<th>IEC 61400-25-3 Services</th>
<th>M/O</th>
<th>Web-services</th>
<th>OPC XML-DA</th>
<th>IEC 61850-8-1 (MMS)</th>
<th>IEC 60870-5-104</th>
<th>DNP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate</td>
<td>M</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Release</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Abort</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GetServerDirectory</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>GetLogicalDeviceDirectory</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>GetLogicalNodeDirectory</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GetDataValues</td>
<td>M</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SetDataValues</td>
<td>M</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>GetDataDirectory</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GetDataDefinition</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GetDataSetValues</td>
<td>M</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>SetDataSetValues</td>
<td>O</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>CreateDataSet</td>
<td>O</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>DeleteDataSet</td>
<td>O</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GetDataSetDirectory</td>
<td>O</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Report</td>
<td>O</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GetDataCRAValues</td>
<td>O</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
IEC 61400-25-4 Mapping - overview

Information Model
IEC 61400-25-2

Information Exchange Model
IEC 61400-25-3

Mapping to protocol stacks
IEC 61400-25-4

Application
Presentation
Session
Transport
Network
Data Link
Physical

Mapping 1
Mapping 2
Mapping 3...
Mapping N

TCP
IP
Ethernet, ...
other
Physical

Communication profile 1
Communication profile 2
Communication profile 3
Communication profile N

out of scope
out of scope
IEC 61400-25-5 Objectives

Part 25-5: Conformance testing

• Specifies standard techniques for testing of conformance of implementations

• Specifies measurement techniques to be applied when declaring performance parameters.

• Application of standard test techniques will enhance the ability of customers to purchase systems that integrate easily, operate correctly, and support the applications as intended by the standard
IEC 61400-25-5 Conformance Testing
IEC 61400-25 User Group

USE61400-25 User Group

Mission
• To support use of the IEC 61400-25 standard series

Vision
• Add value for the users of IEC 61400-25
• Share information of relevance for use of IEC 61400-25
• Share documents of relevance for use of IEC 61400-25
• Discussion forum for resolution of technical issues / data base
• Feedback to IEC 61400-25 maintenance team
• Coordinate activities with related user groups and organizations
• Validate member devices spending the least effort, money and time “This means efficient and with expected interoperability”

More info
• On web site: WWW.USE61400-25.COM
• Knud Johansen, Q-Technology: e-mail: KJ@QTECHNOLOGY.DK
A generic com. solution IS available for wind power: IEC61400-25 standard series

Thanks for your attention