USE61400-25
IEC 61400-25 user group

Windenergie Tage Potsdam
Wednesday 08th – Friday 10th
November 2023

Die IEC 61400-25 als standardisierte Datenschnittstelle

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IEC 61400-25 User group Technical Team Member

Agenda

1	Introduction of the standard IEC61400-25
2	Compliance to security standards
3	IEC61400-25 based SCADA example
4	Introduction of the IEC61400-25 user group

IEC 61400-25 is the wind information model for interoperable plant to supervision/operation/network control centers

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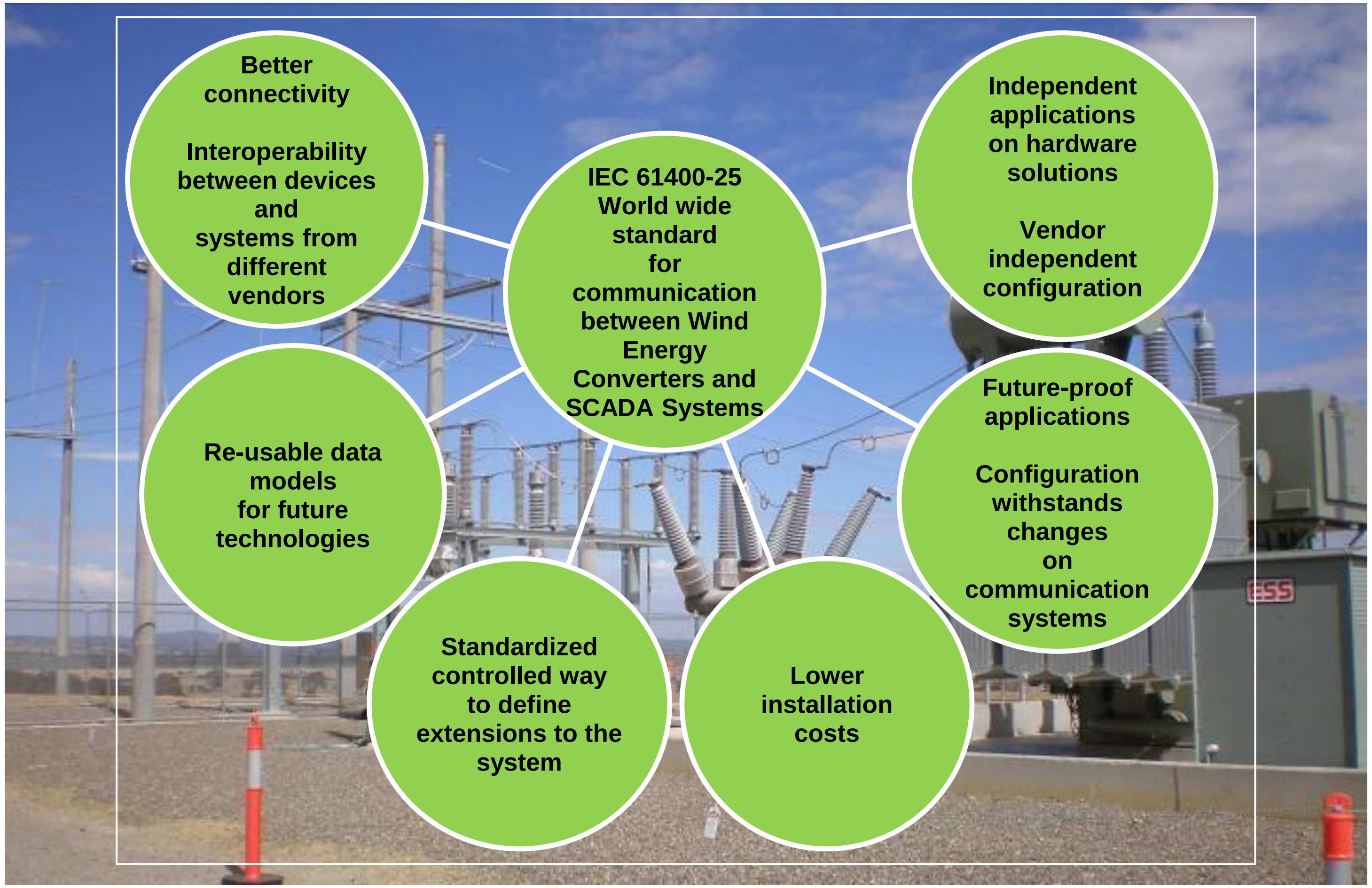
- IEC 61400-25 builds on IEC 61850 the worlds most used substation automation architecture
- enables connectivity between a heterogeneous combination of client and servers from different manufacturers and suppliers
- only defines how to model the information, information exchange and mapping to specific communication protocols
- excludes a definition of how and where to implement the communication interface, the application program interface and implementation recommendations



Conceptual Model of the IEC 61400-25

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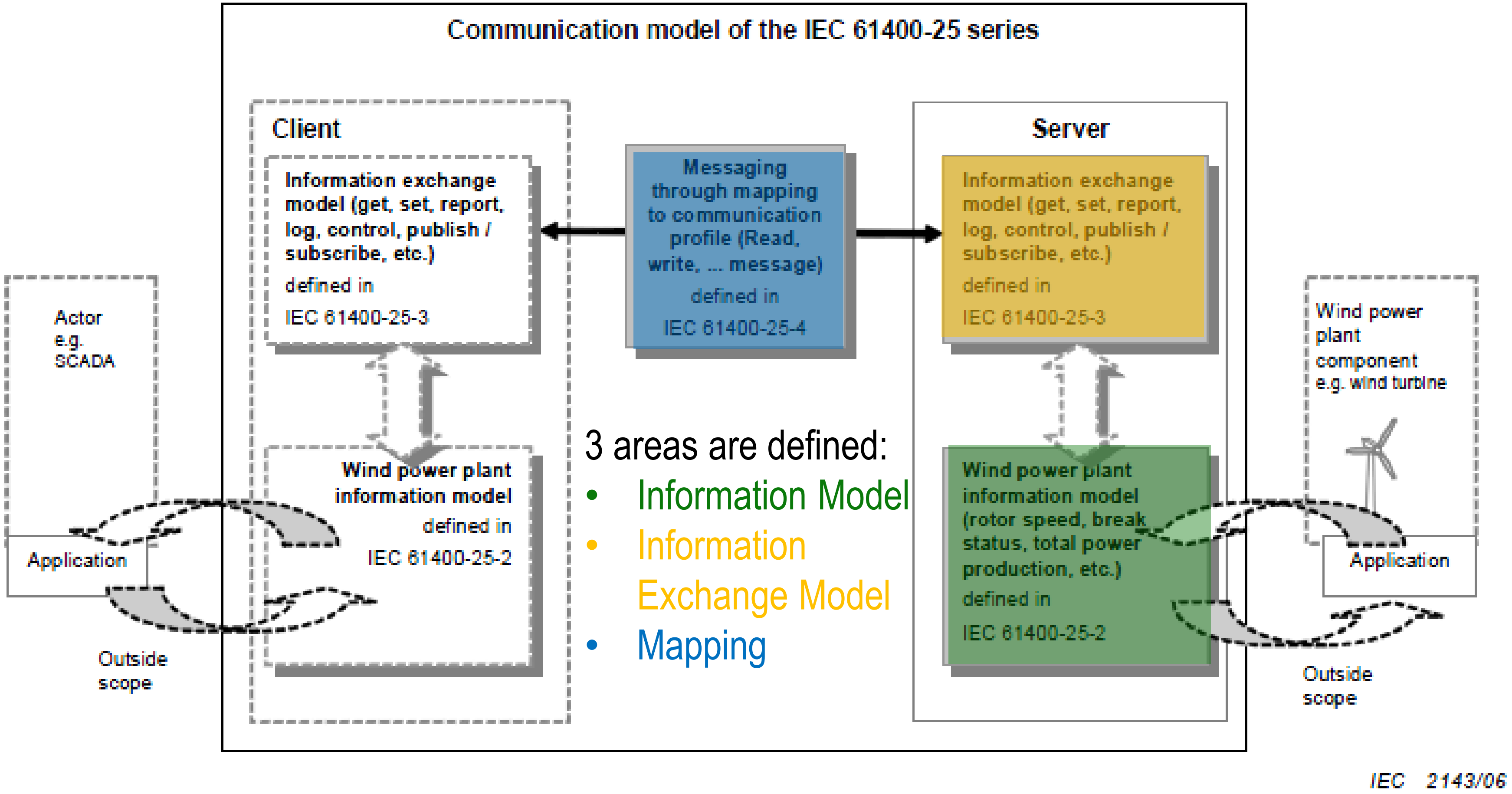
The main focus is on communications between wind power plant components and SCADA systems

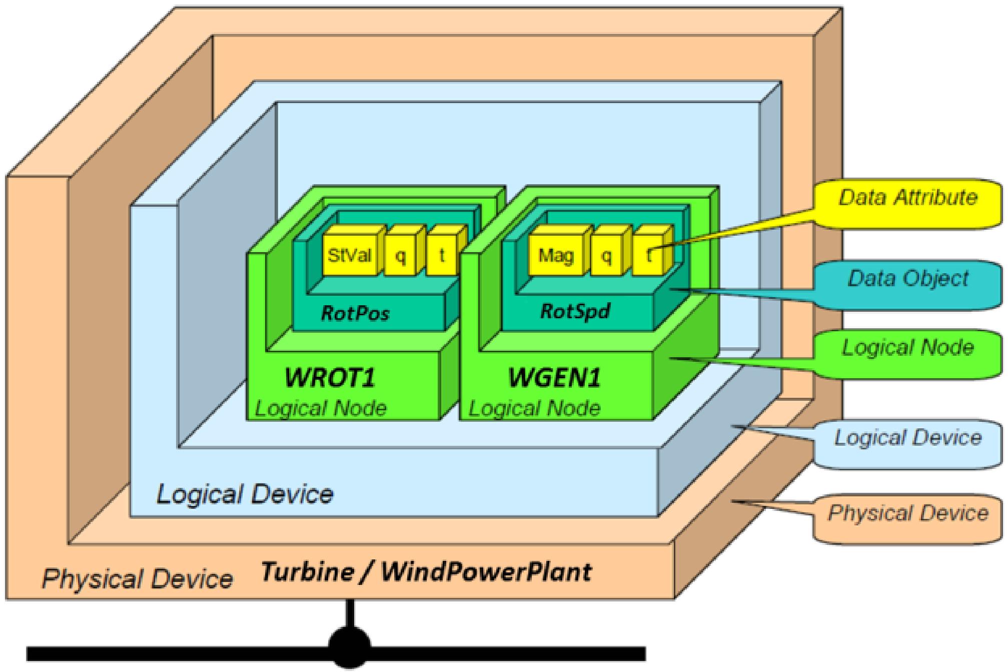


3 areas are defined:

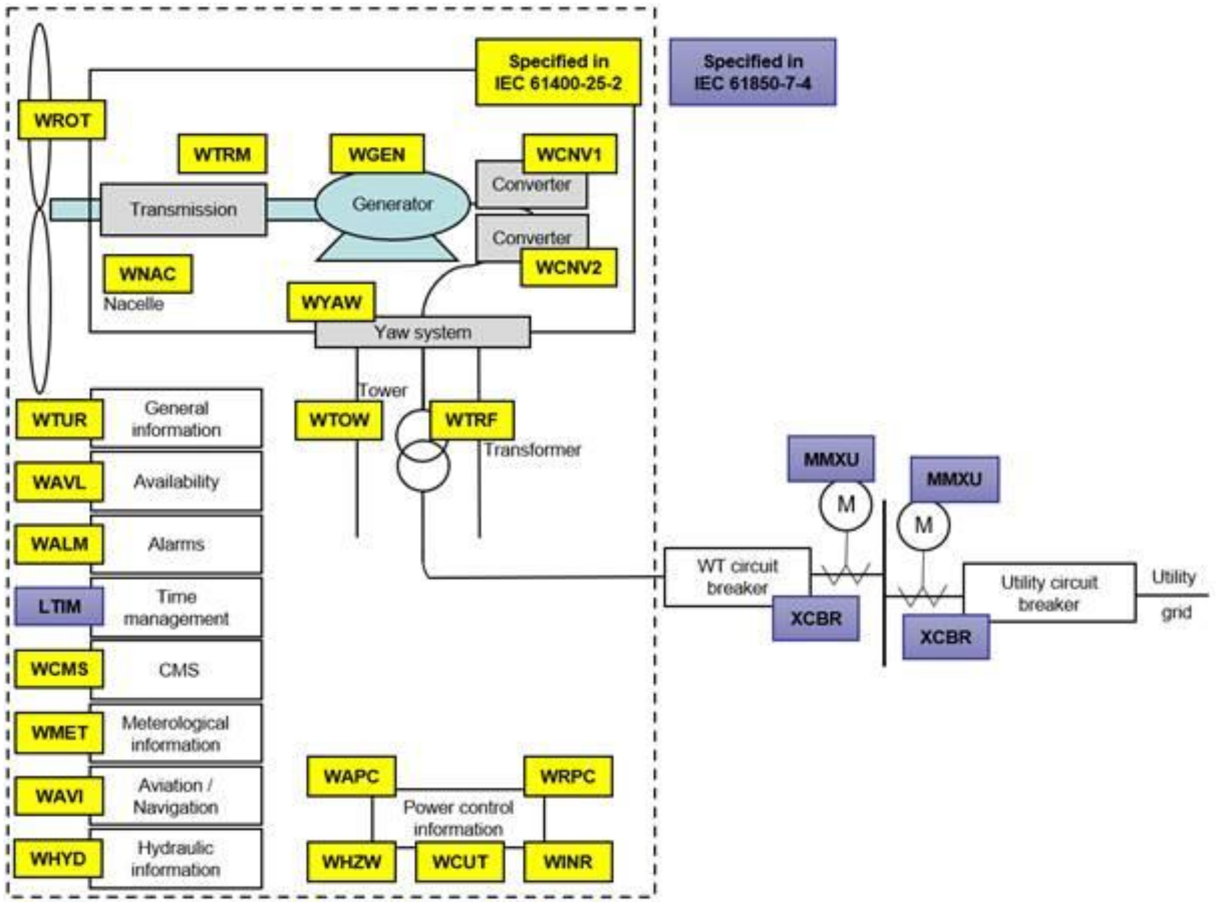
- Information Model
- Information Exchange Model
- Mapping

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

Structure of wind power plant information model



Logical node instances to model a wind turbine (CDV Ed.3)



Structure of wind power plant information model

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- Data Objects are created from a certain CDC
- A CDC, e.g. „MV – measured value“, has certain Attributes (DA)
- There are complex CDCs which can own CDCs and heritate from the underlying structure

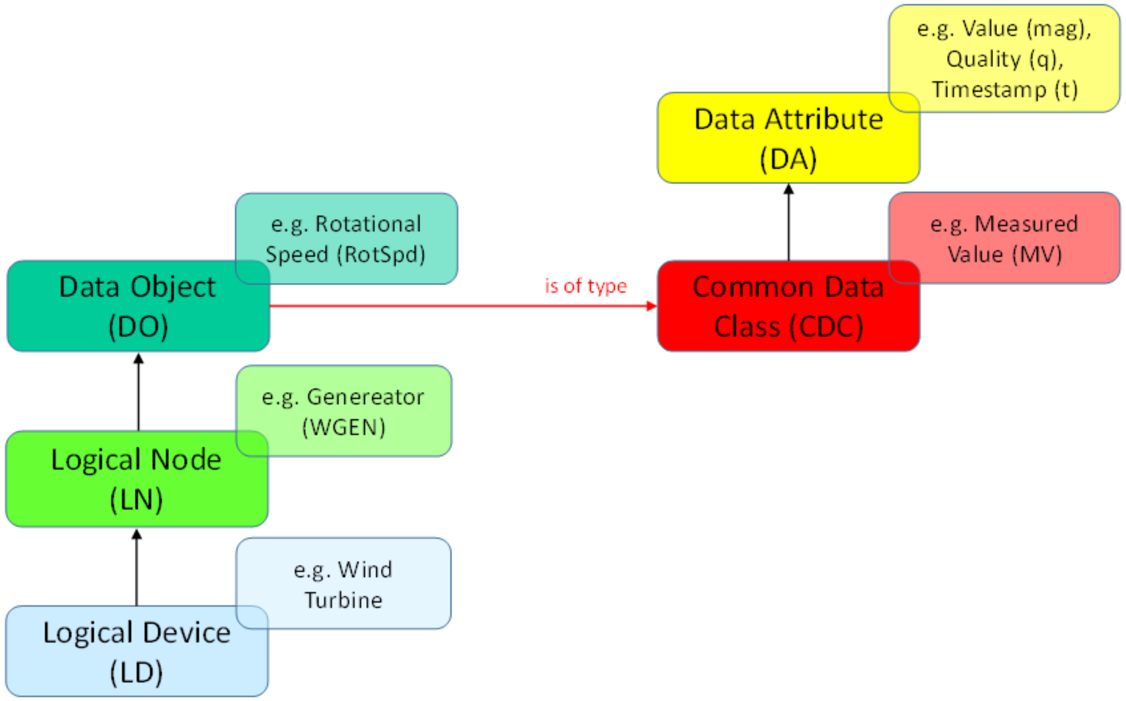

Figure 5 – Role of Common Data Classes (CDC) in WPP information model

Structure of wind power plant information model

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- Wind turbine logical nodes
- Mandatory Nodes (M) **must** be implemented
- Optional Nodes (O) **can** be implemented
- → Most important information is available for every turbine type

Logical nodes for modelling a wind turbine (CDV Ed.3)

LN classes	Description	M/O
WTUR	General information	M
WROT	Rotor information	M
WTRM	Transmission information	O
WGEN	Generator information	M
WCNV	Converter information	O
WTRF	Transformer information	O
WNAC	Nacelle information	M
WYAW	Yawing information	M
WTOW	Tower information	O
WALM	Alarm information	M
WMET	Meteorological information	O
WAVI	Aviation and navigation information (AviNavi).	O
WHYD	General hydraulic system information	O
WAVL	Availability information	O
LTIM	Time management (inherited from IEC 61850-7-4)	O
WCMS	Turbine supervision status from the turbine condition monitoring device	O
WHZW	Frequency response information	O
WINR	Inertia response information	O
WAPC	Active power control information	O
WRPC	Reactive power control information	O

Structure of wind power plant information model

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- Wind power plant logical nodes
- Mandatory Nodes (M) **must** be implemented
- Optional Nodes (O) **can** be implemented

Wind power plant general logical nodes (CDV Ed.3)

LN classes	Description	M/O
WALM	Alarm information	O
WAPC	Active power control information	O
WAVL	Availability information	O
WCUT	Wind power plants high wind cut off	O
WHZW	Frequency response information	O
WINR	Inertia response	O
WMET	Meteorological information	O
WPPD	Wind power plant device general information	O
WPPL	Wind power plant faceplate information	O
WRPC	Reactive power control information	O
LTIM	Time management (inherited from IEC 61850-7-4)	O

Structure of wind power plant information model

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- Logical nodes contains:
- Mandatory Data Objects (M) **must** be implemented
- Optional Data Objects (O) **can** be implemented
- **User defined extensions** are possible by adding for example own Data Objects

WTUR class			
Attribute name	**Attribute type**	**Explanation**	**M/O**
		LN shall inherit all Mandatory Data from Wind Power Plant Common Logical Node Class (see 6.1.1)	M
Data			
Common information			
AvlTmRs	TMS	Turbine availability time (vendor-specific)	O
OpTmRs	TMS	Operation time (vendor-specific)	O
StrCnt	CTE	Number of turbine starts (vendor-specific)	O
StopCnt	CTE	Number of turbine stops (vendor-specific)	O
TotWh	CTE	Total (net) active energy production	M
TotVArh	CTE	Total (net) reactive energy production	O
DmdWh	BCR	Active (real) energy demand (default demand direction: energy flow from a substation busbar away and towards the wind turbine)	O
DmdVArh	BCR	Reactive energy demand (default demand direction: energy flow from a substation busbar away and towards the wind turbine)	O
SupWh	BCR	Active (real) energy supply (default supply direction: energy flow from the wind turbine and towards a substation busbar)	O
SupVArh	BCR	Reactive energy supply (default supply direction: energy flow from the wind turbine and towards a substation busbar)	O
Status information			
TurSt	STV	Turbine status	M
Analogue information			
W	MV	Active power generation	M
VAr	MV	Reactive power generation	O
Control information			
SetTurOp	CMD	Wind turbine operation command	M
VArOvW	CMD	Windturbine reactive priority over active command	O
VArRefPri	CMD	Windturbine reactive setpoint priority command	O
DmdW	SPV	Turbine active power generation setpoint	O
DmdVAr	SPV	Turbine reactive power generation setpoint	O
DmdPF	SPV	Turbine power factor setpoint	O

IEC 61400-25: Communications for monitoring and control of wind power plants

Standard series based on IEC 61850 (Communication networks and systems for power utility automation)

Standard	Description	Status
61400-25-1	Overall description of principles and models	Edition 2, published 2017
61400-25-2	Information models	Edition 2, published 2015 Edition 3, 2024
61400-25-3	Information exchange models	Edition 2, published 2015
61400-25-4	Mapping to communication profile [web services, OPC XML-DA, MMS, IEC 60870-5-101/104, DNP3]	Edition 2, published 2016
61400-25-41	Mapping to communication profile based on IEC 62541 (OPC UA)	2024 (Ongoing work in cooperation with USE61400-25 and OPC foundation)
61400-25-5	Compliance testing	Edition 2, published 2017
61400-25-6	Logical node classes and data classes for condition monitoring	Edition 2, published 2016 Will become part of IEC61400-25-2 Ed.3
61400-25-71	Configuration Description Language	Edition 1, published 2019

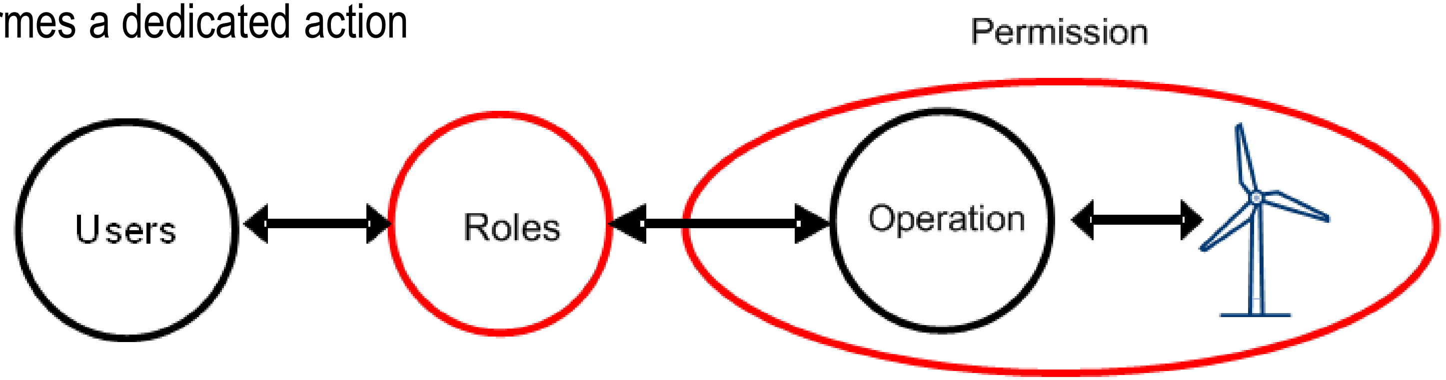
Agenda

1	Introduction of the standard IEC61400-25
2	Compliance to security standards
3	IEC61400-25 based SCADA example
4	Introduction of the IEC61400-25 user group

Existing IEC standards and recommendations handle security topics:

- Authentication and authorization using Role Based Access Control (RBAC)
- Secure IP- based and serial communication
- Secure application level exchanges
- Security monitoring and event logging
- Test case definition
- Guidelines for applying specific security measures

For example utilize IEC 62351-8:
RBAC supports verification of who is
authorized and performes a dedicated action



Build In Security By Using Security Standards

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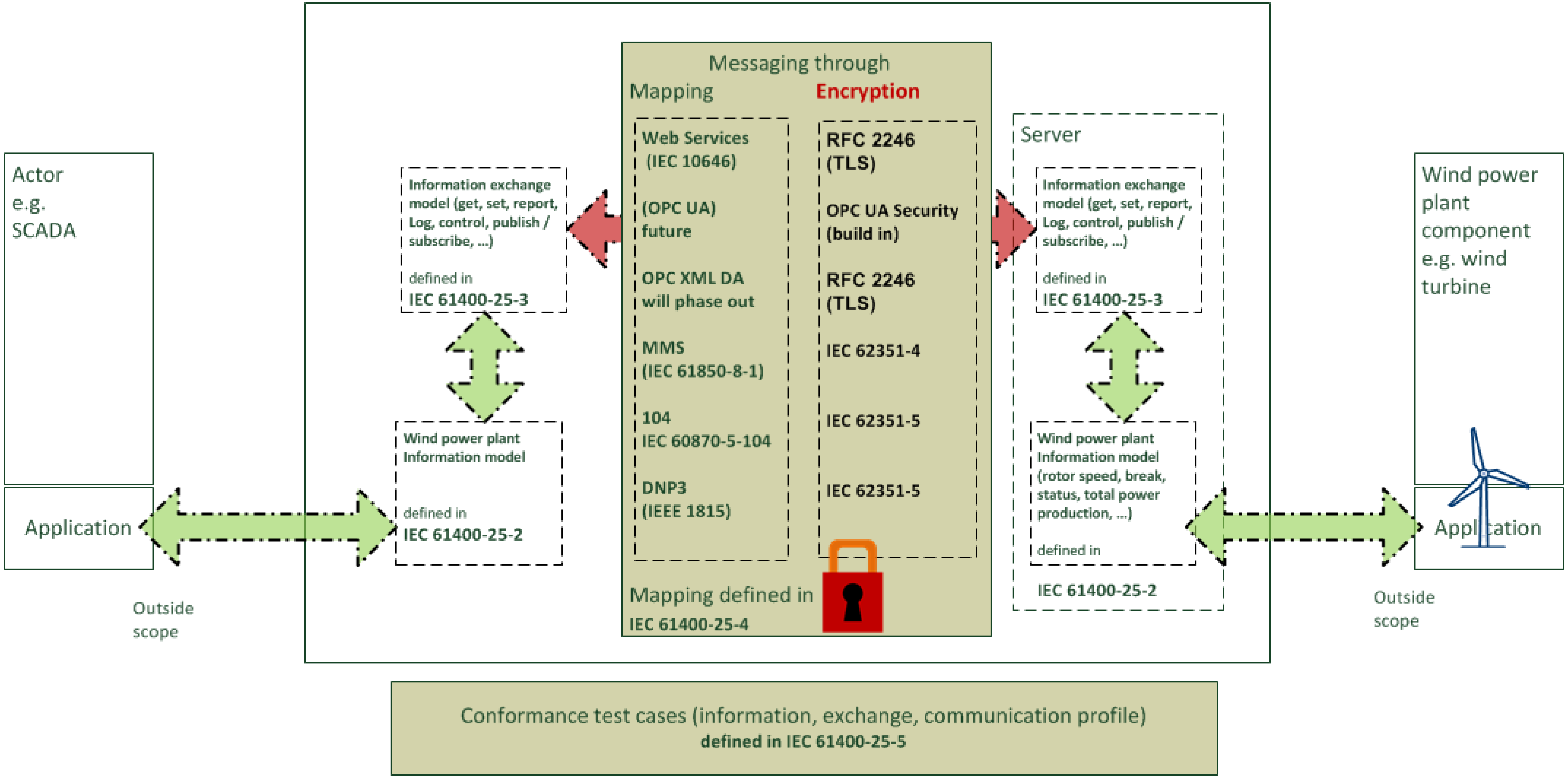

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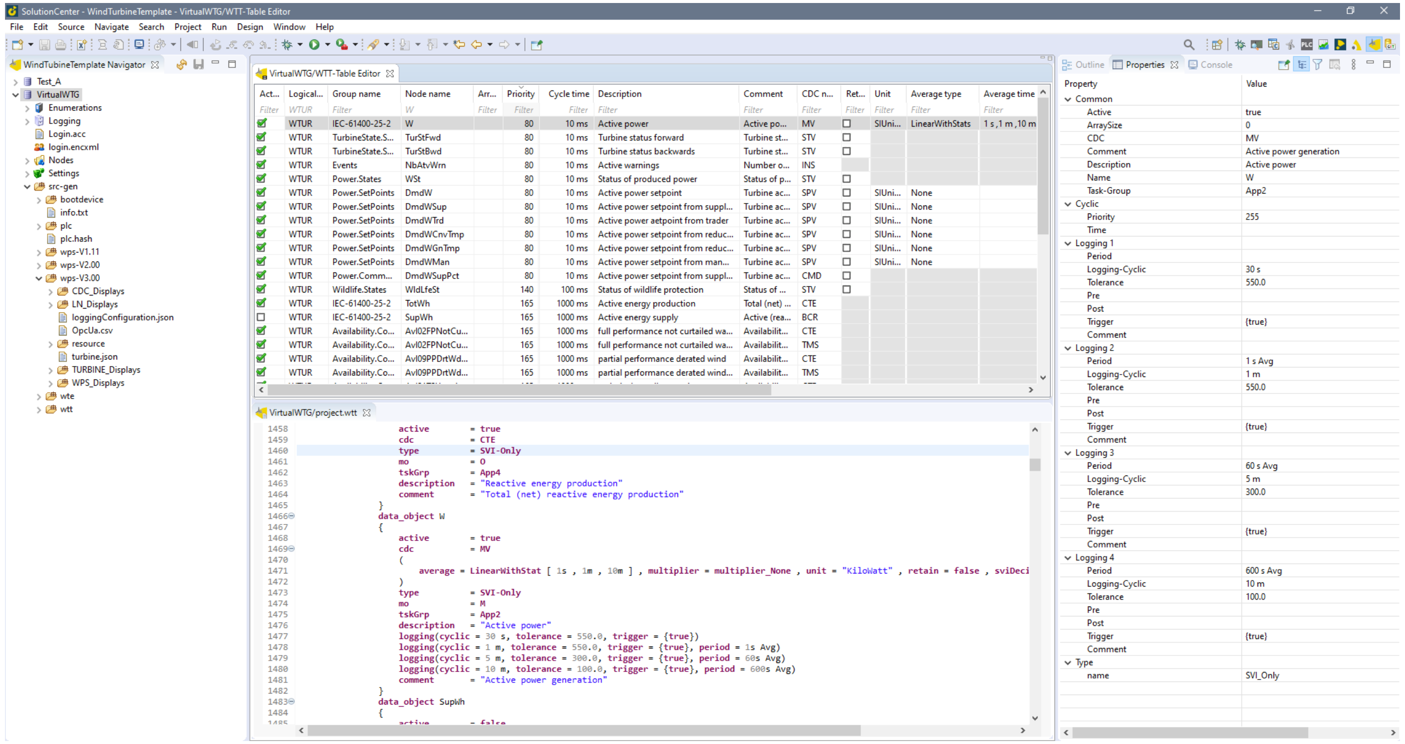
Bachmann Wind Power SCADA (WPS)

IEC 61400-25 based SCADA example

How to start …

…with Wind Turbine Template configuration

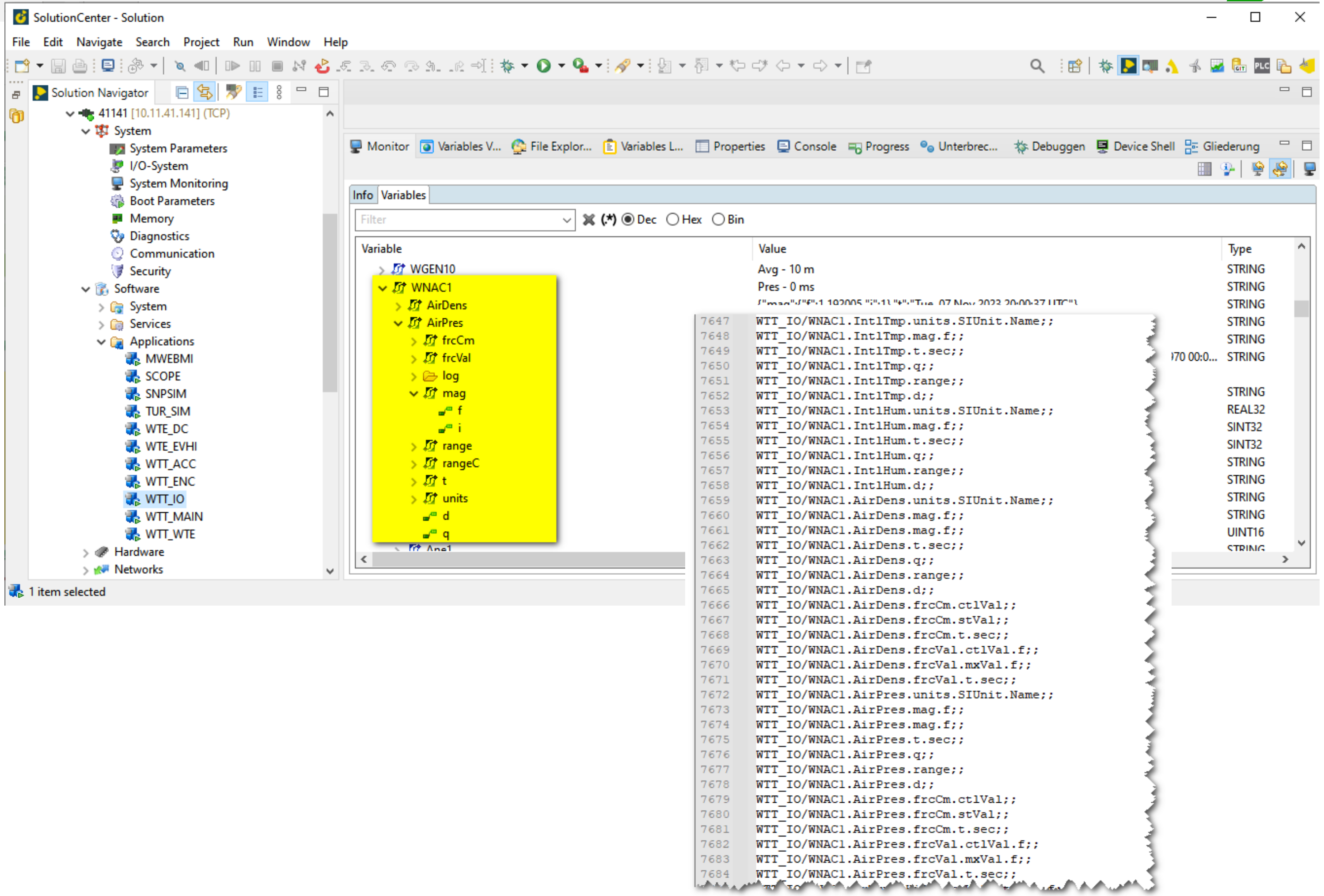
- SC configurator **plugin** installation
  - Made for modelling whole turbine (PLC Project & WTT IO)
- Focus on WTT IO:
  Only M1-Interface is necessary (!) for SCADA
- Main configuration file: **project.wtt**
- **Generation** of configuration code for WPS /OPCUA / Snapshots / Alarming



on the way to SCADA system …

…with IEC61400-25 data structure and OPC-UA

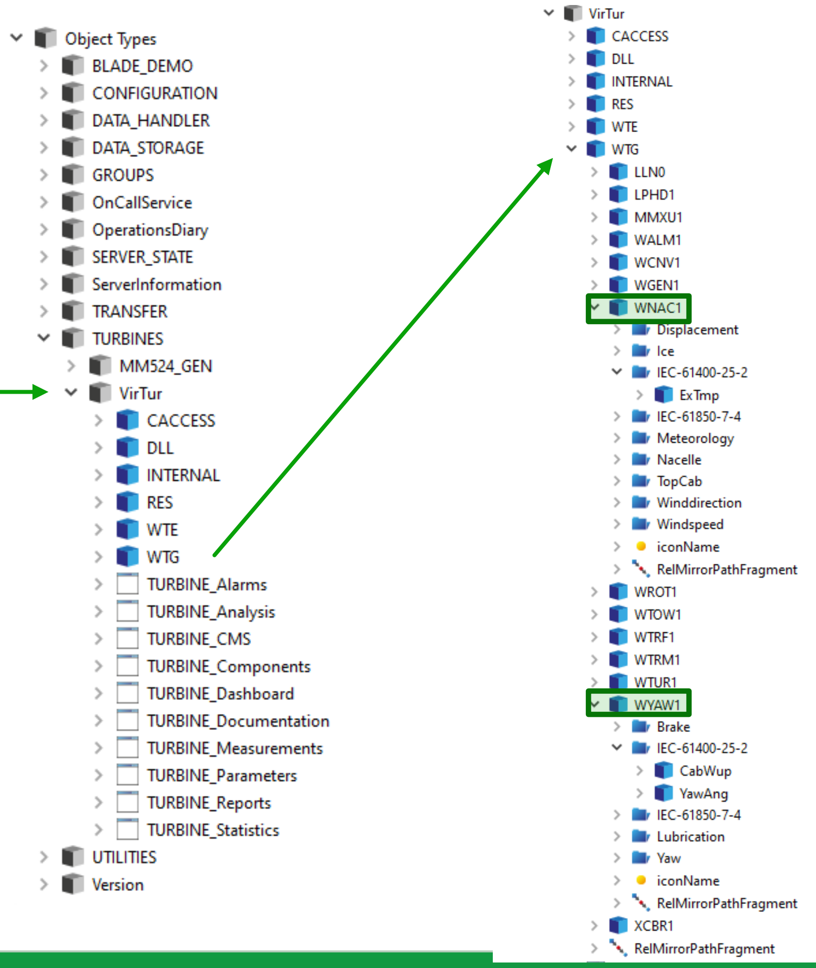
- Data structure in WTT-IO compliant to IEC61400-25
- Generated OPC-UA server configuration
- Generated WPS configuration file imported as device type
- Automatic build data structure in SCADA system – no user action required, just import configuration file



WPS structure

Object types and structure

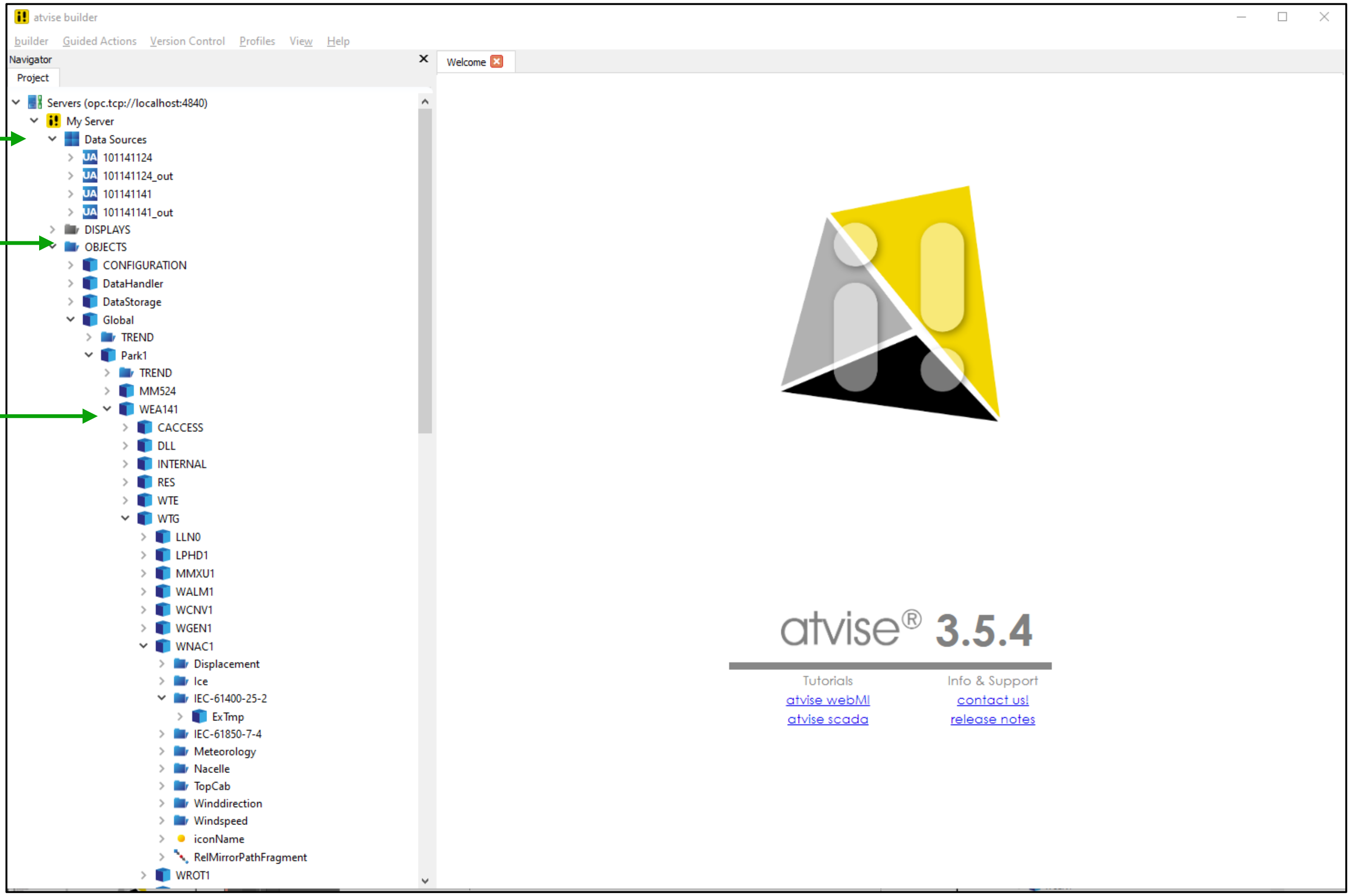
- WPS uses the object-oriented technology from atvise© SCADA
- A wind turbine or device shown in WPS is described throughout its object structure
- The object structure consists of fixed content and dynamic content (variables/parameters) which differs from each turbine or device type
- The object types are instantiated, and this results in showing them as turbines or devices in WPS



WPS structure

Instantiation of objects – building a wind farm

- Data Sources: connection to each controller/turbine for live data
- Objects: Object structure of the asset/project (*Global/Park1/WEA141*)
- WEA141: Instantiated turbine type from an object template with the describing set of vars/params etc.



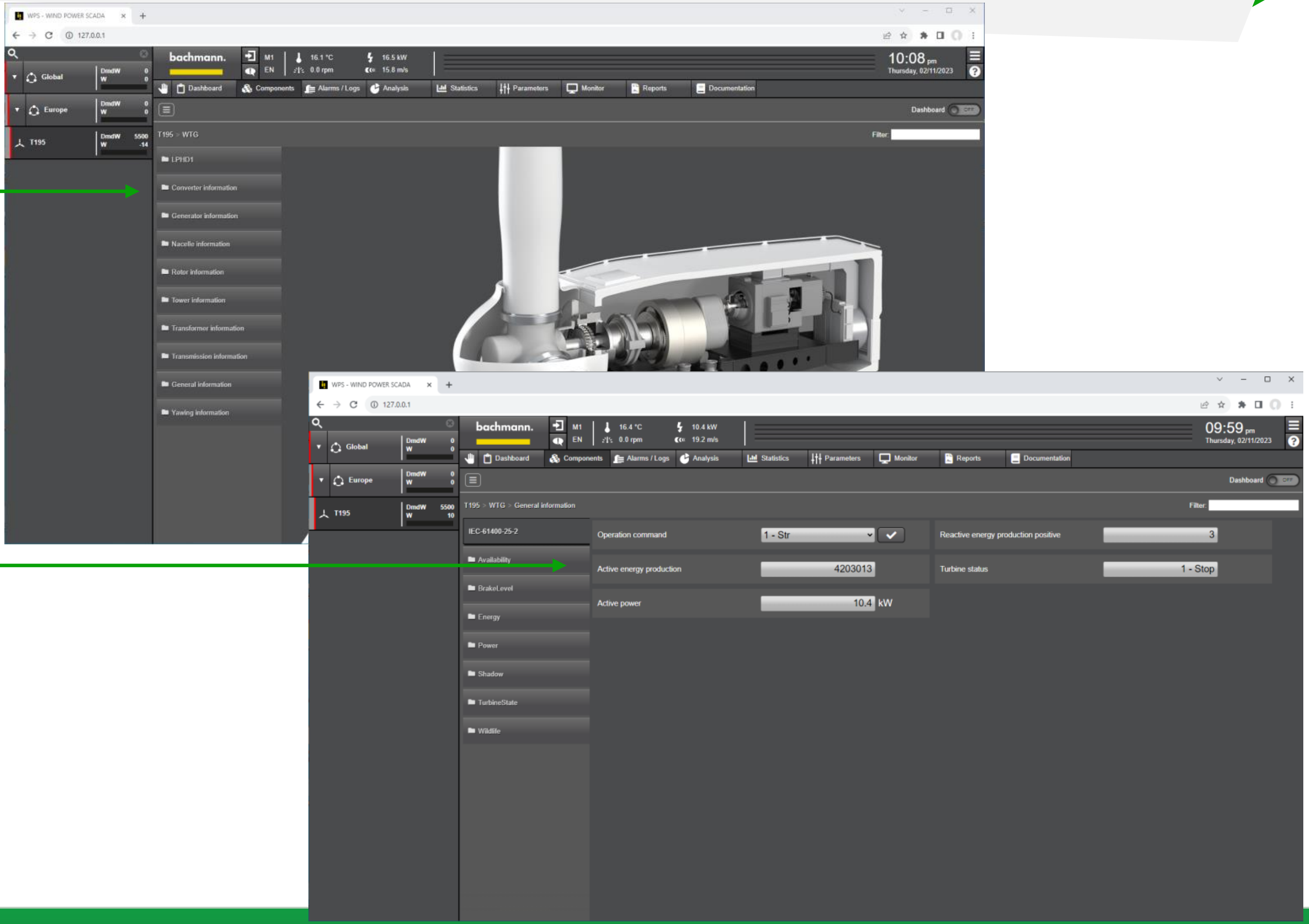
WPS structure

Visualization of 61400-25 standardized data – measured values & command values

- Logical Device:
  Instantiated turbine type from an object template with the describing set of vars/params etc.

- Logical Nodes:
  Different logical parts of the turbine

- Data Objects:
  Monitoring and control elements depending on type of Data Object (CDC)



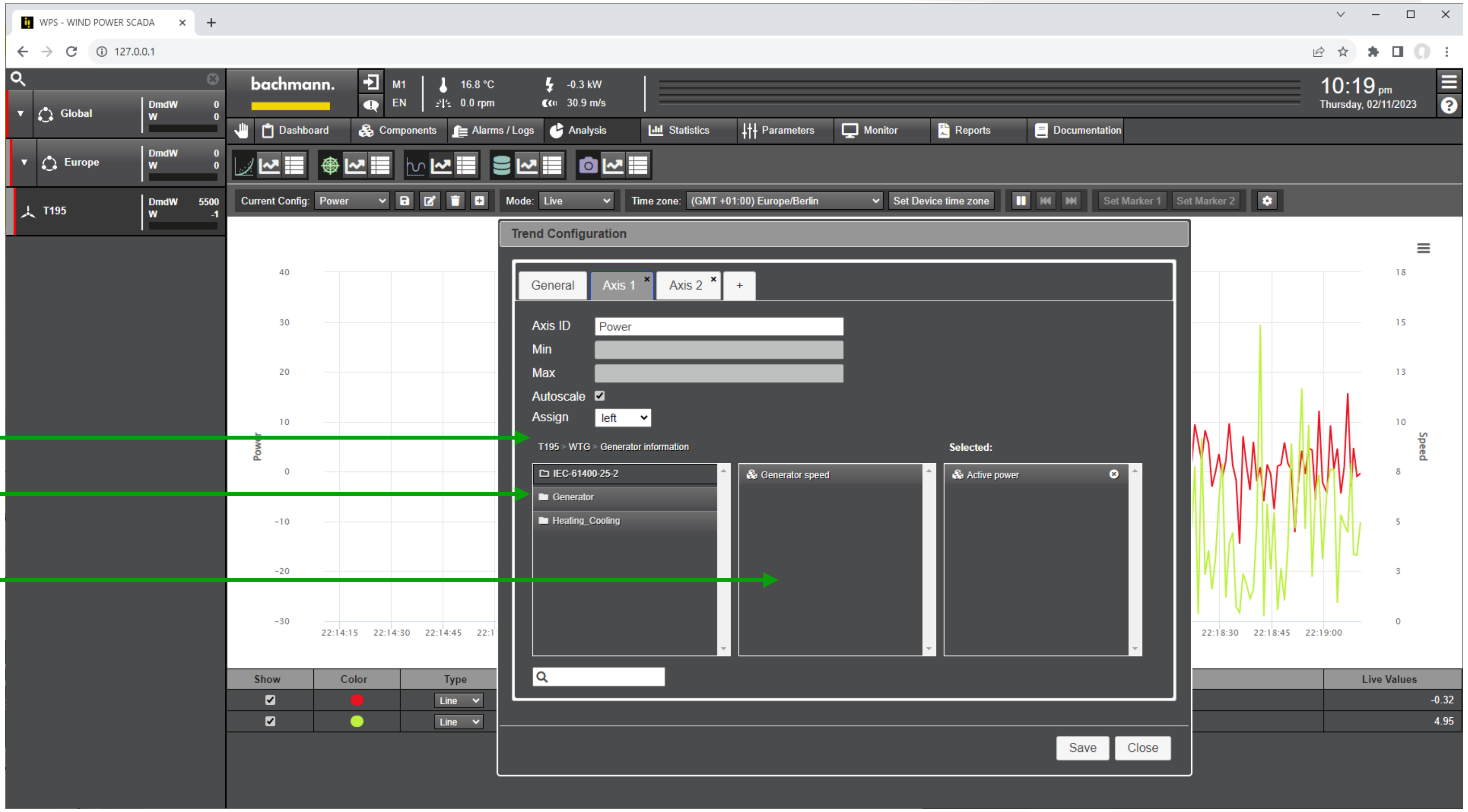
WPS structure

Visualization of 61400-25 standardized data – trend configuration

- Logical Device:
  Instantiated turbine type from an object template with the describing set of vars/params etc.

- Logical Nodes:
  Different logical parts of the turbine

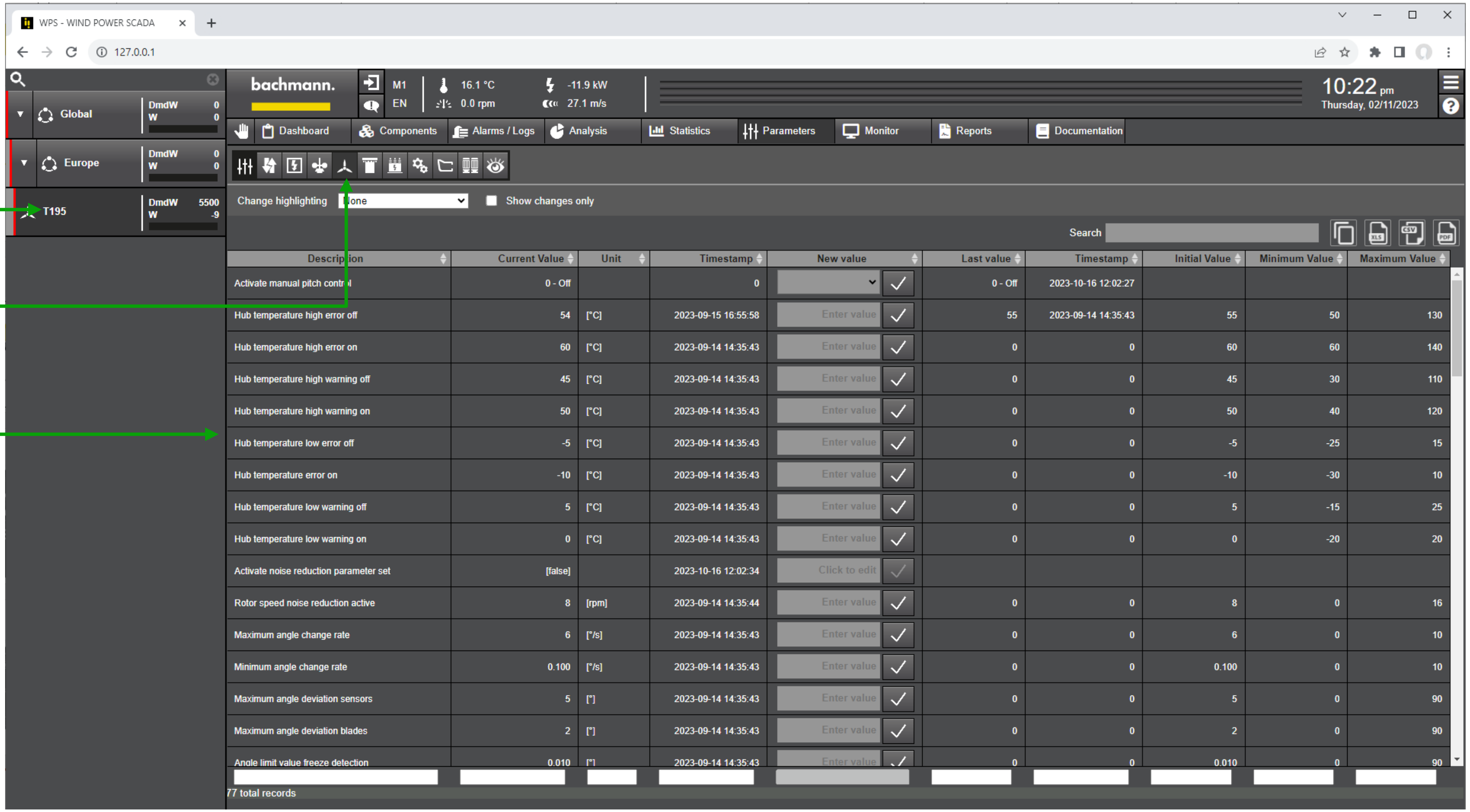
- Data Objects:
  Monitoring elements depending on type of Data Object (CDC) here: restriction to type MV (measured values)



WPS structure

Visualization of 61400-25 standardized data - parameters

- Logical Device:
  Instantiated turbine type from an object template with the describing set of vars/params etc.
- Logical Nodes:
  Different logical parts of the turbine
- Data Objects:
  Monitoring and control elements depending on type of Data Object (CDC)



Description	Current Value	Unit	Timestamp	New value	Last value	Timestamp	Initial Value	Minimum Value	Maximum Value
Activate manual pitch control	0 - Off		0		0 - Off	2023-10-16 12:02:27			
Hub temperature high error off	54	[°C]	2023-09-15 16:55:58	Enter value	55	2023-09-14 14:35:43	55	50	130
Hub temperature high error on	60	[°C]	2023-09-14 14:35:43	Enter value	0	0	60	60	140
Hub temperature high warning off	45	[°C]	2023-09-14 14:35:43	Enter value	0	0	45	30	110
Hub temperature high warning on	50	[°C]	2023-09-14 14:35:43	Enter value	0	0	50	40	120
Hub temperature low error off	-5	[°C]	2023-09-14 14:35:43	Enter value	0	0	-5	-25	15
Hub temperature error on	-10	[°C]	2023-09-14 14:35:43	Enter value	0	0	-10	-30	10
Hub temperature low warning off	5	[°C]	2023-09-14 14:35:43	Enter value	0	0	5	-15	25
Hub temperature low warning on	0	[°C]	2023-09-14 14:35:43	Enter value	0	0	0	-20	20
Activate noise reduction parameter set	[false]		2023-10-16 12:02:34	Click to edit					
Rotor speed noise reduction active	8	[rpm]	2023-09-14 14:35:44	Enter value	0	0	8	0	16
Maximum angle change rate	6	[°/s]	2023-09-14 14:35:43	Enter value	0	0	6	0	10
Minimum angle change rate	0.100	[°/s]	2023-09-14 14:35:43	Enter value	0	0	0.100	0	10
Maximum angle deviation sensors	5	[°]	2023-09-14 14:35:43	Enter value	0	0	5	0	90
Maximum angle deviation blades	2	[°]	2023-09-14 14:35:43	Enter value	0	0	2	0	90
Angle limit value freeze detection	0.010	[°]	2023-09-14 14:35:43	Enter value	0	0	0.010	0	90

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Mission & Objectives

The main goal is to:

- ease the use of IEC 61400-25
- support users implementing the standard within the wind power industry
- support the use of the IEC 61400-25 standard series
- communicate with other working groups

Objectives:

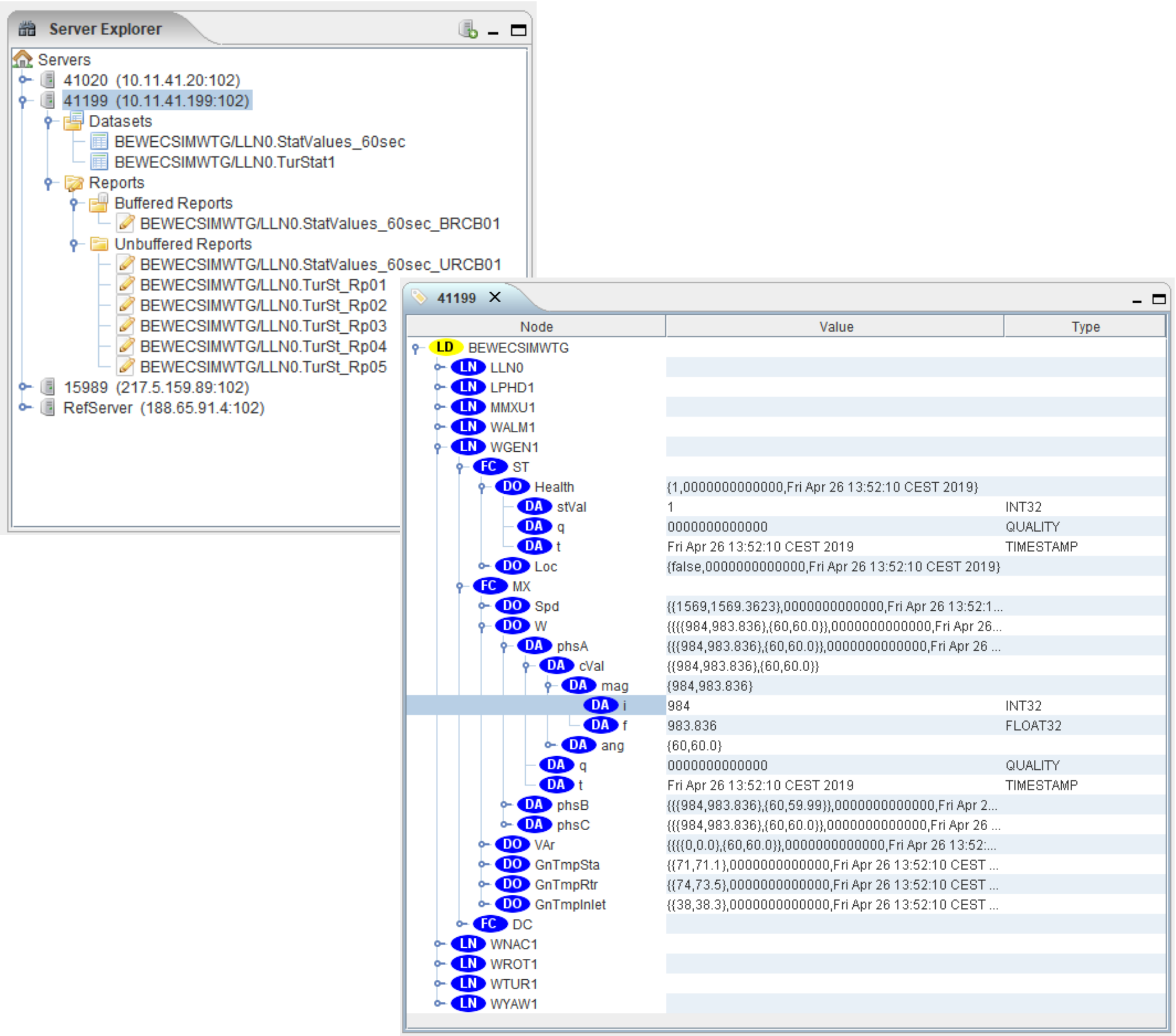
- Presentation how to use the standard within workshops with specific companies and organizations
- Conference exhibitions and congresses
- Reference server for edition 2
- Open Source Client (MMS)
- Implementation guideline for 61400-25
- Cooperation with OPC Foundation

The implementation guideline covers the following topics:

- Overview of the IEC 61400-25 standard series and the related standards
- Descriptions and examples how to read the standard
- Customization of the IEC 61400-25 models
- IEC 61400-25 as part of the wind power plant engineering process
- SCL guideline with examples

Open Source Client (MMS)

- Available for free (for user group members)
- Source code examples available



Reference server for edition 2 of IEC 61400-25 standard

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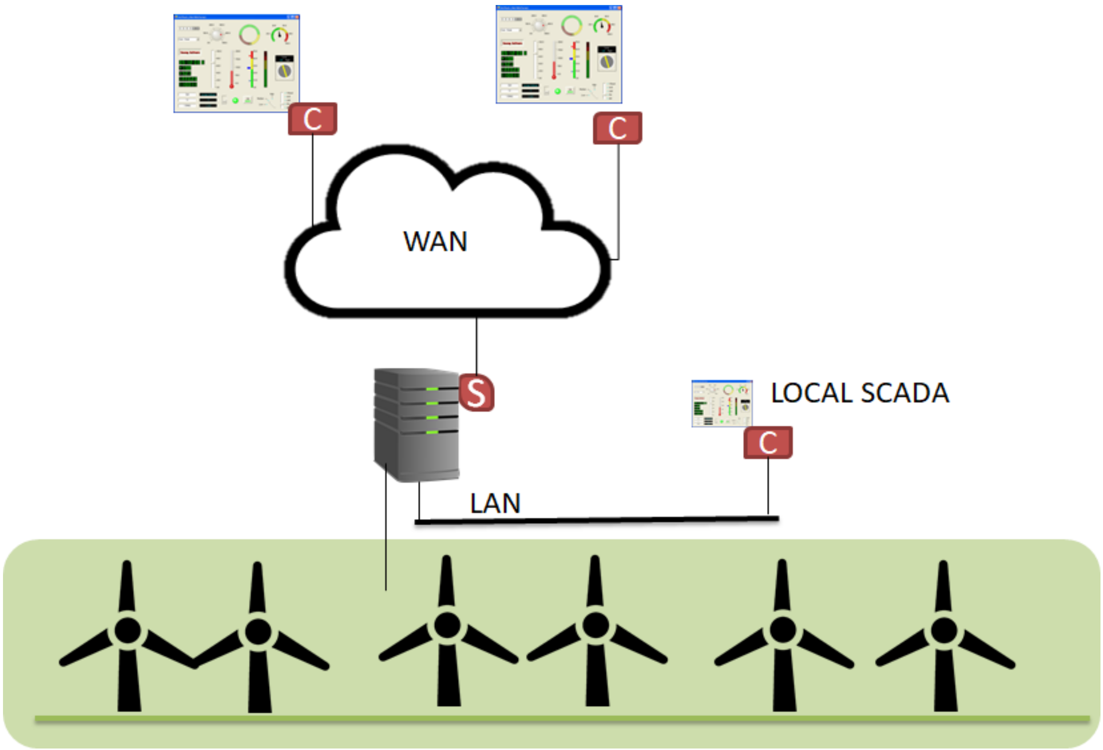

It is a Wind Power Plant Server acting as a gateway that provides access to a simultated with farm using different communication mappings:

- mappings to IEC 61850 MMS, webservices, IEC 60870-5-104, DNP3 and OPC XML-DA (soon OPC UA)
- Connected to the information of existing Wind Turbine controllers.
- Simulate several wind turbines to provide a full wind power plant view.
- Accessed with any standard based client or with the specific software developed for the association members

Management Team

Bertram Lange (Chairman)
Per Krause Kjaer (Technical Team Chairman)
Knud Johansen (Treasurer)
Finn Hoeg (Validation, Interoperability, Cyber Security)
Michael Rueter (Standardization)

Please visit: www.use61400-25.com

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