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IEC 61400-25 user group

Windenenergietage
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IEC 61400-25 in 2 Mappings: Die gemeinsame Sprache für Hybridparks

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Agenda

1. Introduction
2. The standard IEC 61400-25
3. The IEC 61400-25 user group
4. Mapping IEC 61850 and 61400-25 to OPC UA
5. IEC61850 and 61400-25 based SCADA example

How to get everything under one hat ?

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- Different kind of systems
- Different vendors
- Different languages
- Different communication protocols
- → How to integrate into SCADA systems ?
- → How to integrate into park controllers ?

Solution: Standardization of information and communication

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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

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

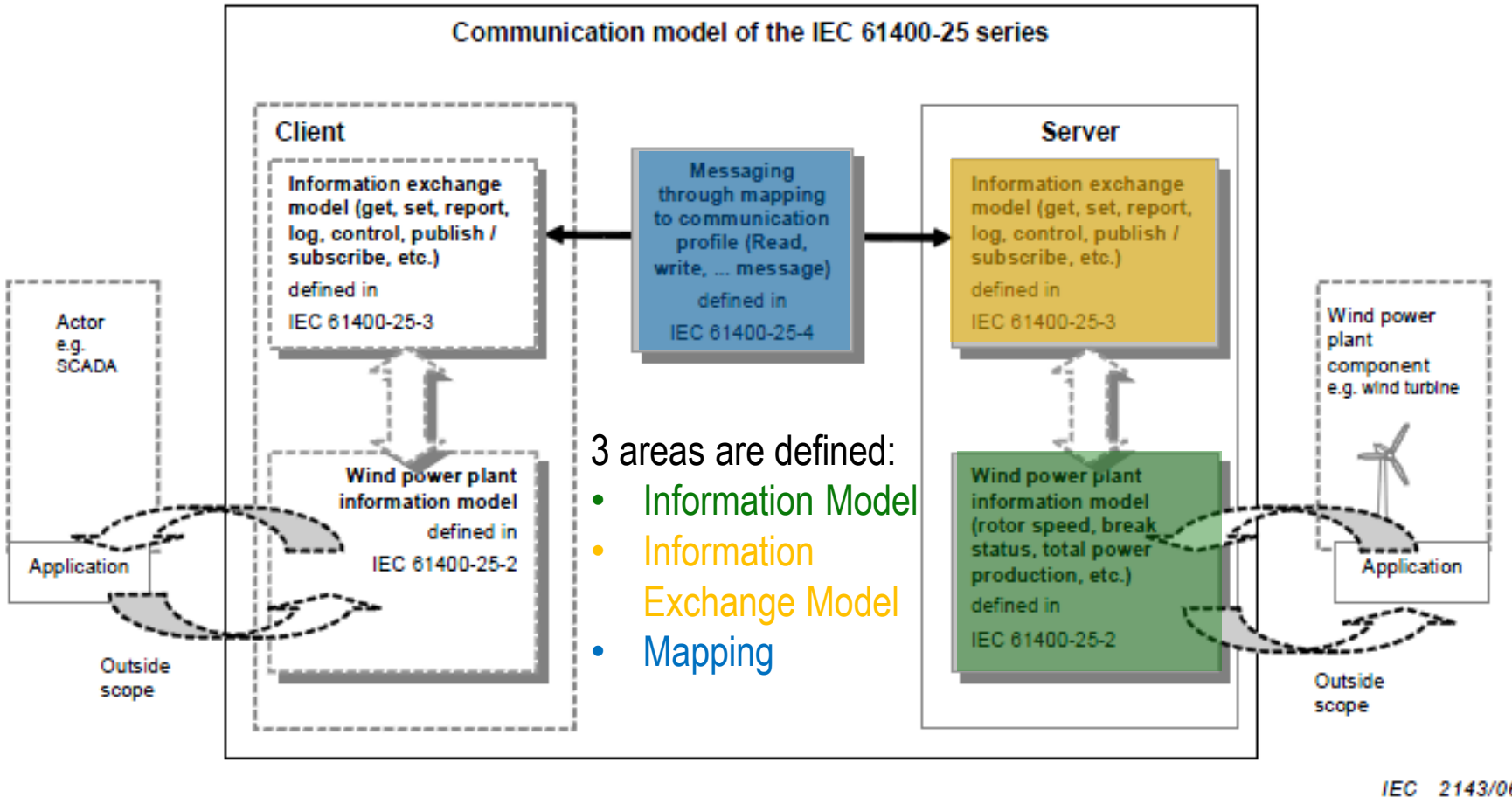
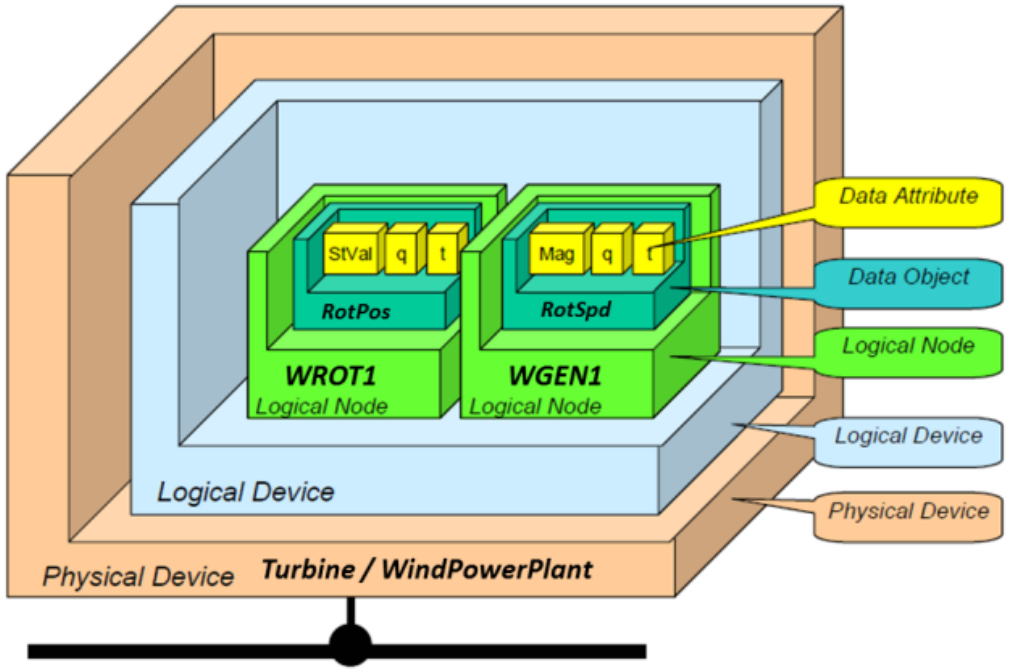
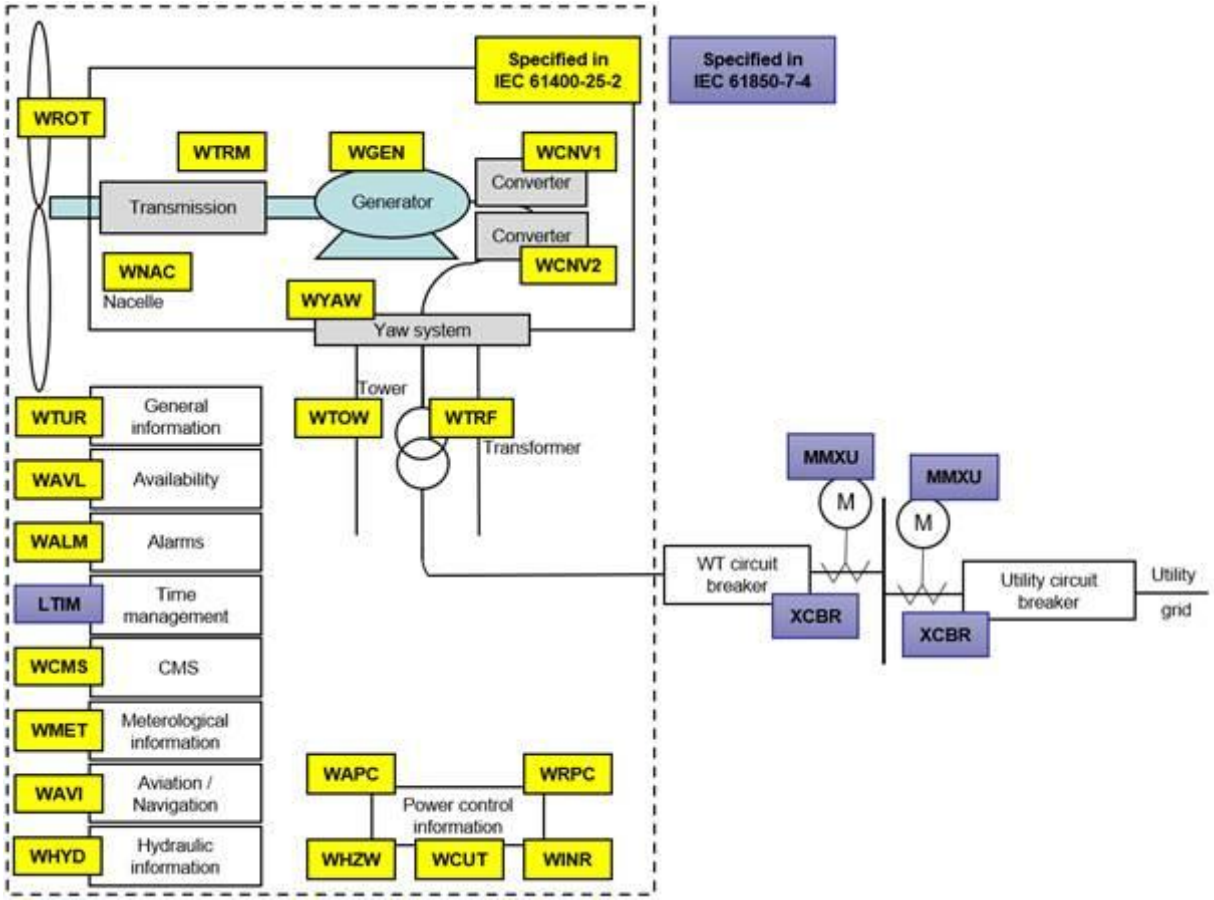


Figure 1 – Conceptual communication model of the IEC 61400-25 series

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

- Data Objects are created from a certain CDC (Common Data Class)
- A CDC, e.g. „MV – measured value“, has certain Attributes (DA)
- Other CDC types can be:
  - CMD (Command Values)
  - STV (Status Value)
  - INS (Integer Status)
  - INC (Integer Controlable)
  - ….

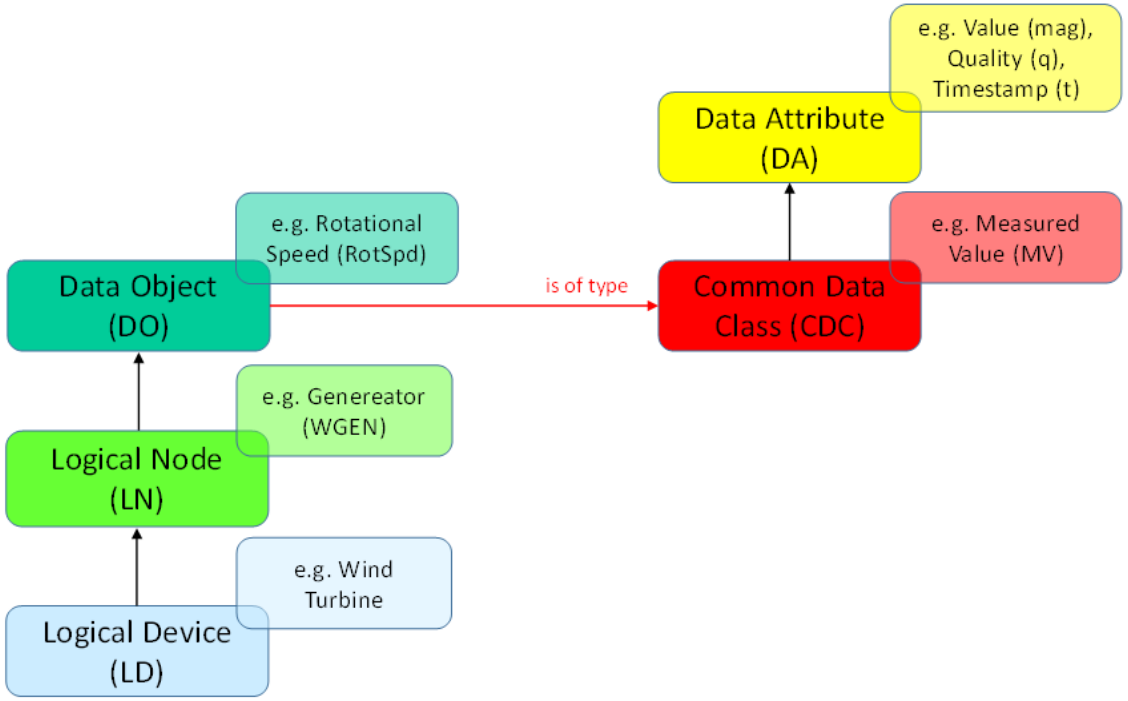


Figure 5 – Role of Common Data Classes (CDC) in WPP information model

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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- 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

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Mission & Objectives

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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

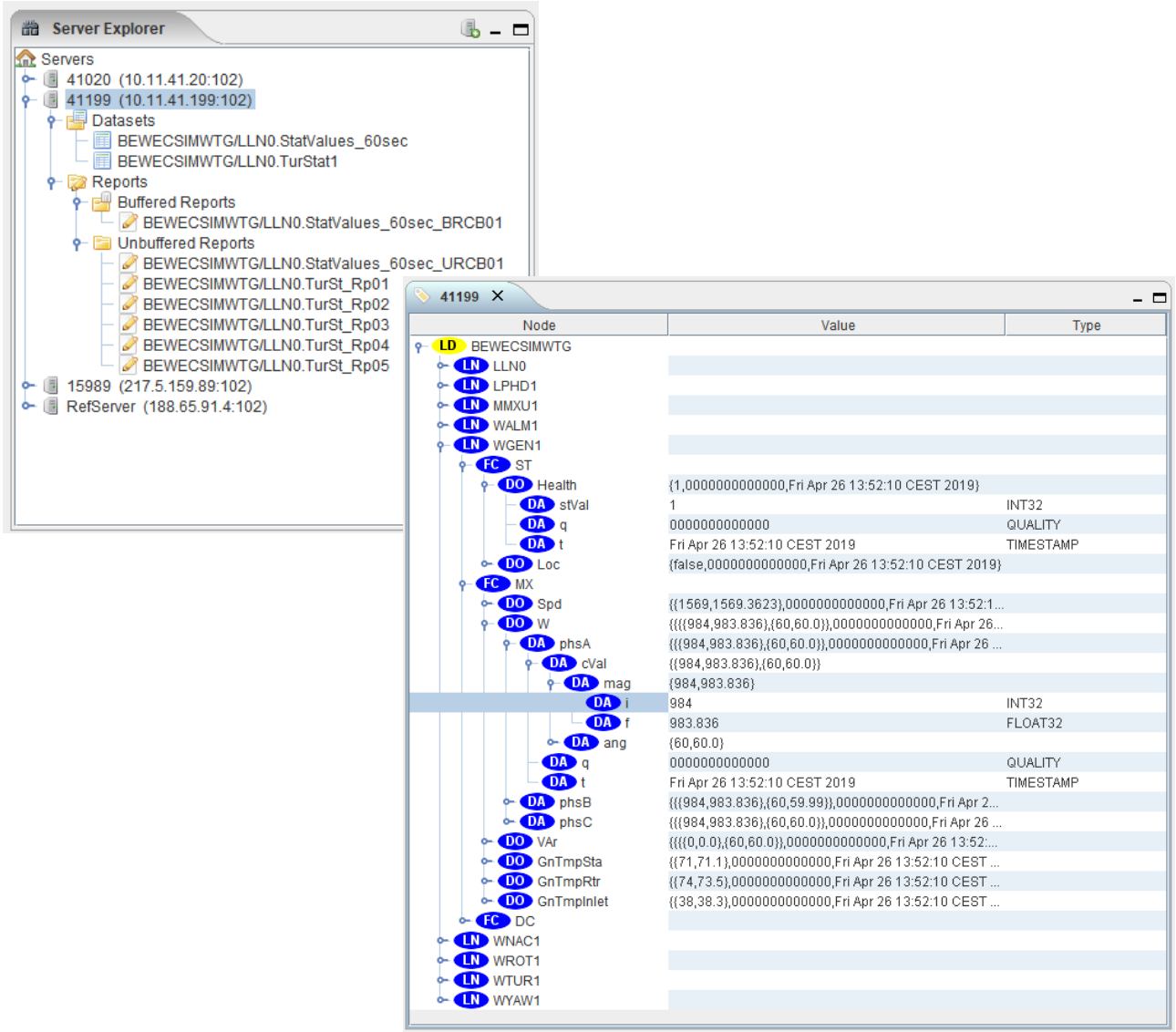
Implementation guideline and MMS Client

The implementation guideline covers the following topics:

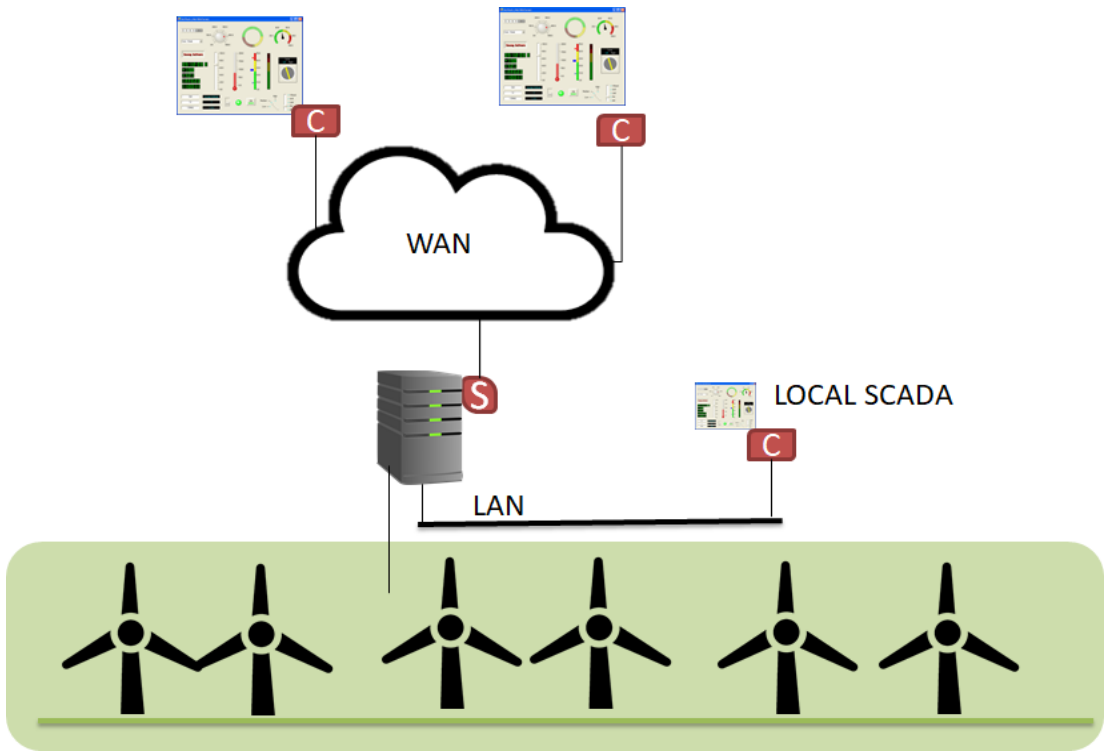
- Overview of the IEC 61400-25 standard series and the related standards
- Descriptions and examples how to read the standard
- Customization of the IEC 61400-25 models
- IEC 61400-25 as part of the wind power plant engineering process
- SCL guideline with examples

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



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

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Mapping IEC 61400-25 to OPC UA

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Why OPC UA?

- **Service-oriented** architecture (SOA)
- **Platform independent** – different hardware platforms, operating systems and programming languages
- Communication **protocol independent** - mappings to several communication protocols like TCP/IP, UDP/IP, WebSockets, AMQP and MQTT are specified

- Extensible **security profiles**, including authentication, authorization, encryption and checksums
- Extensible **security key management**, including X.509, token and password

- Supports **client/server services** and publish/subscribe models

- Standardized not only in the **OPC foundation** but also within the **IEC 62541**
- Commercial and/or open-source **stacks** are available in **many popular programming languages**
- Specifications are freely available on the OPC Foundation website
- Widely used in industrial automation

Mapping IEC 61400-25 to OPC UA – OPC UA

OPC UA for Wind Power Plants has been formed

OPC Foundation and the *IEC 61400-25 User Group* has joined forces to create OPC UA Companion specification for monitoring and control of wind power plants

Mapping IEC 61400-25 to OPC UA – Use case

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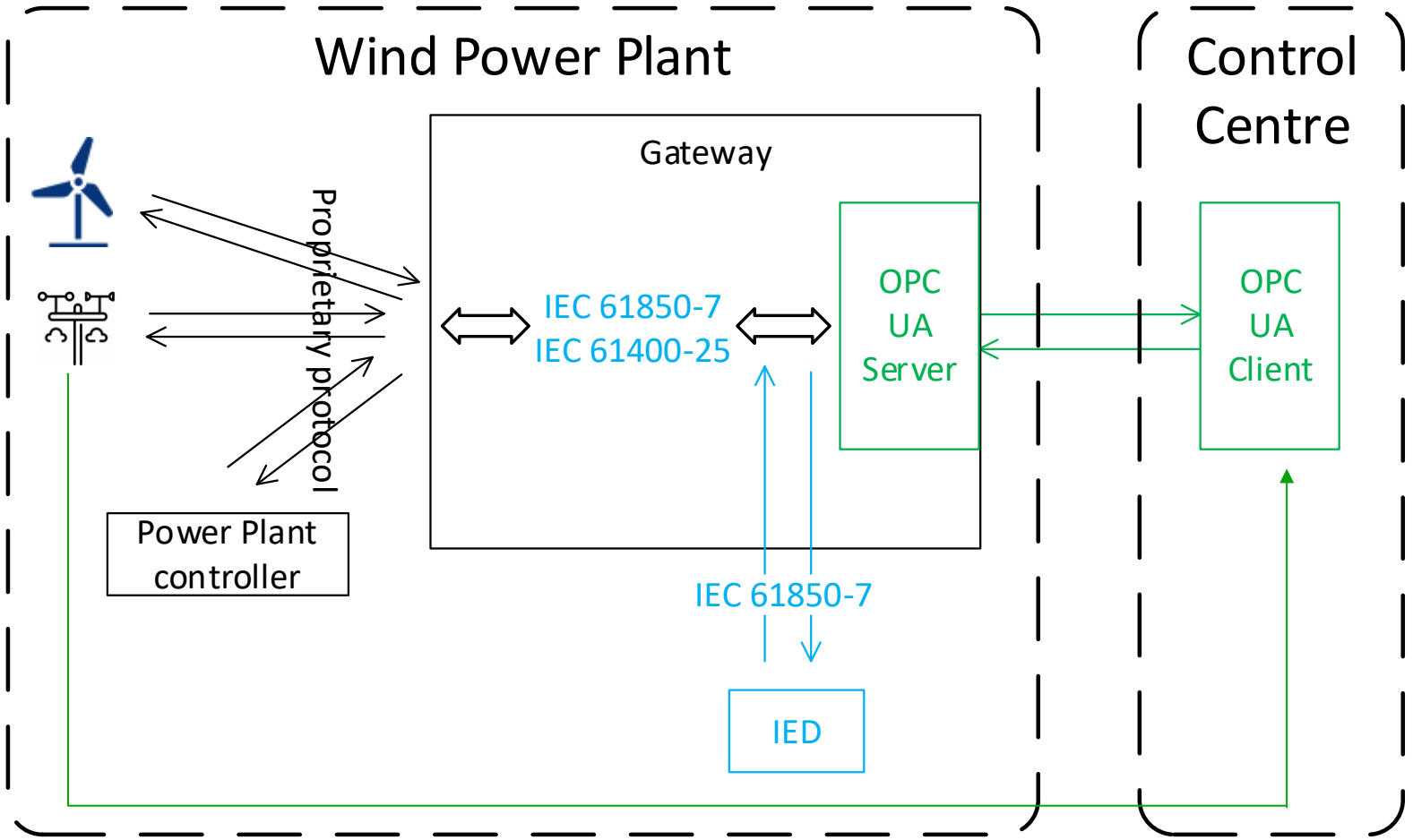
Example 1: Wind Power Plant Gateway
(IEC 61400-25, IEC 61850-7-4)



IED: Intelligent Electronic Device

Mapping IEC 61400-25 to OPC UA – Use case

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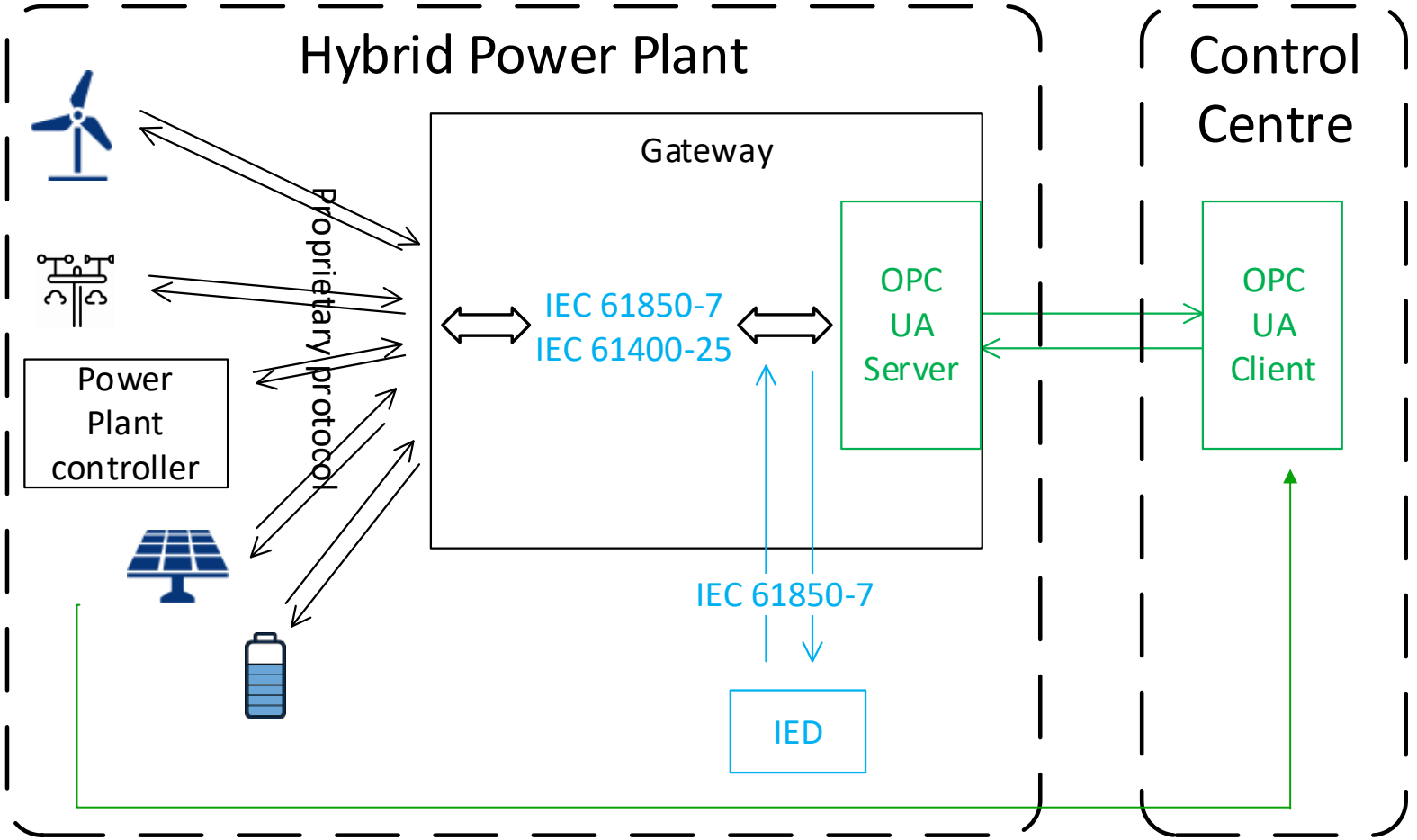
Example 2: Hybrid Power Plant (Wind Power, Photovoltaic, Battery Energy Storage)
(IEC 61400-25, IEC 61850-7-4, 61850-7-420, IEC 61850-90-7)



IED: Intelligent Electronic Device

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IEC 61850 / 61400-25 based example

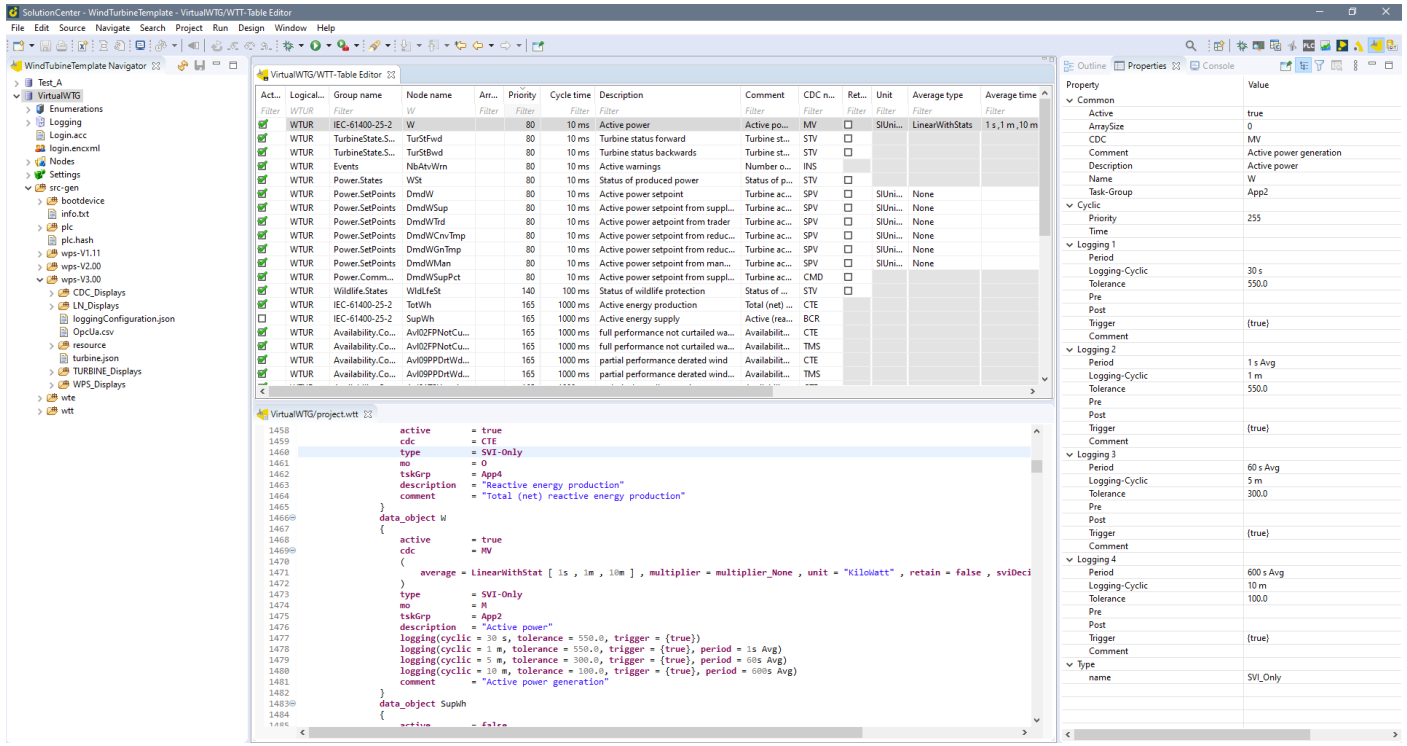
forsiteSCADA® and Wind Turbine Templates

bachmann.

How to start …

…with Wind Turbine Template configuration

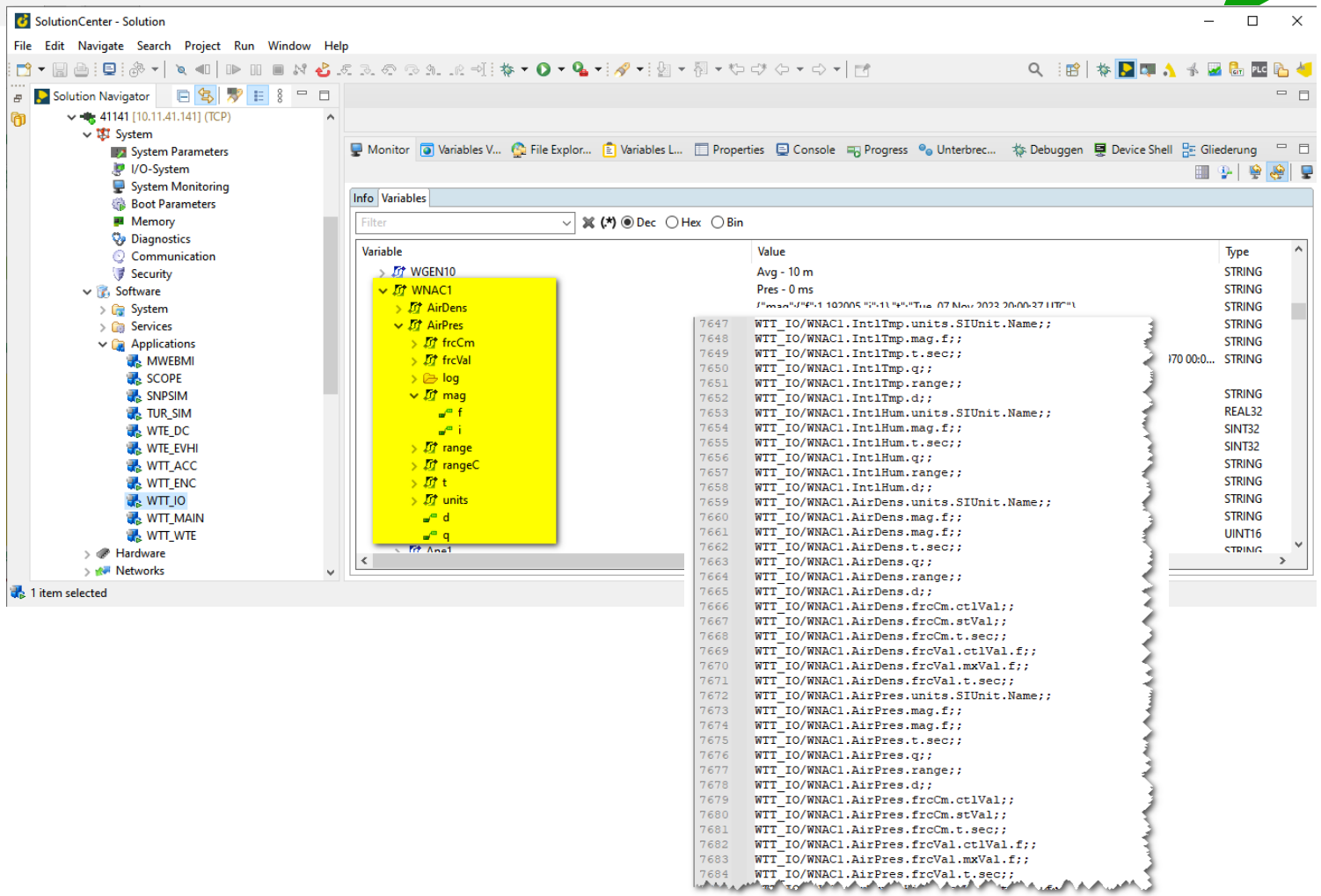
- SC configurator **plugin** installation
  - Made for modelling whole turbine (PLC Project & WTT IO)
- Focus on WTT IO:
  Only M1-Interface is necessary (!) for SCADA
- Main configuration file: **project.wtt**
- **Generation** of configuration code for forsiteSCADA /OPCUA / Snapshots / Alarming



on the way to SCADA system …

…with IEC61400-25 data structure and OPC-UA

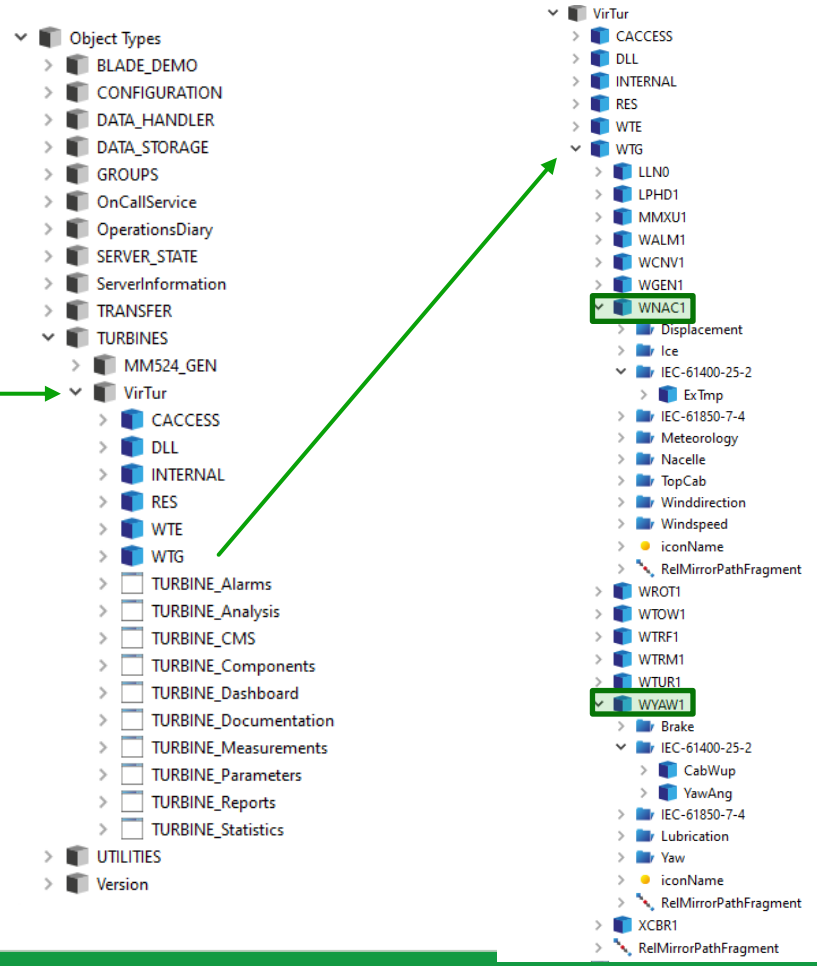
- Data structure in WTT-IO compliant to IEC61400-25
- Generated OPC-UA server configuration
- Generated forsiteSCADA configuration file imported as device type
- Automatic build data structure in SCADA system – no user action required, just import configuration file



forsiteSCADA structure

Object types and structure

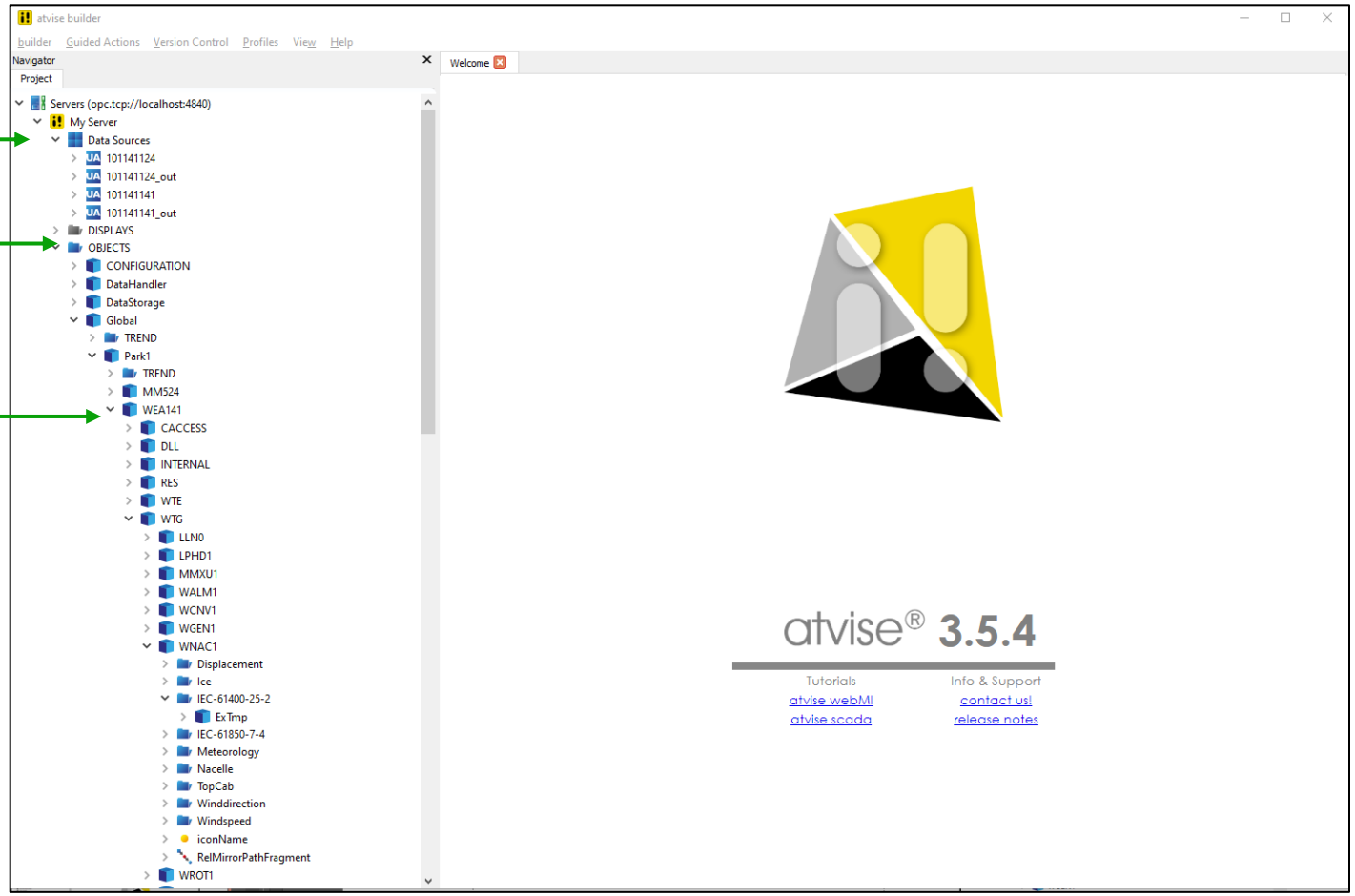
- forsiteSCADA uses the object-oriented technology from atvise© SCADA
- A wind turbine or device shown in forsiteSCADA is described throughout its object structure
- The object structure consists of fixed content and dynamic content (variables/parameters) which differs from each turbine or device type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



forsiteSCADA 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.



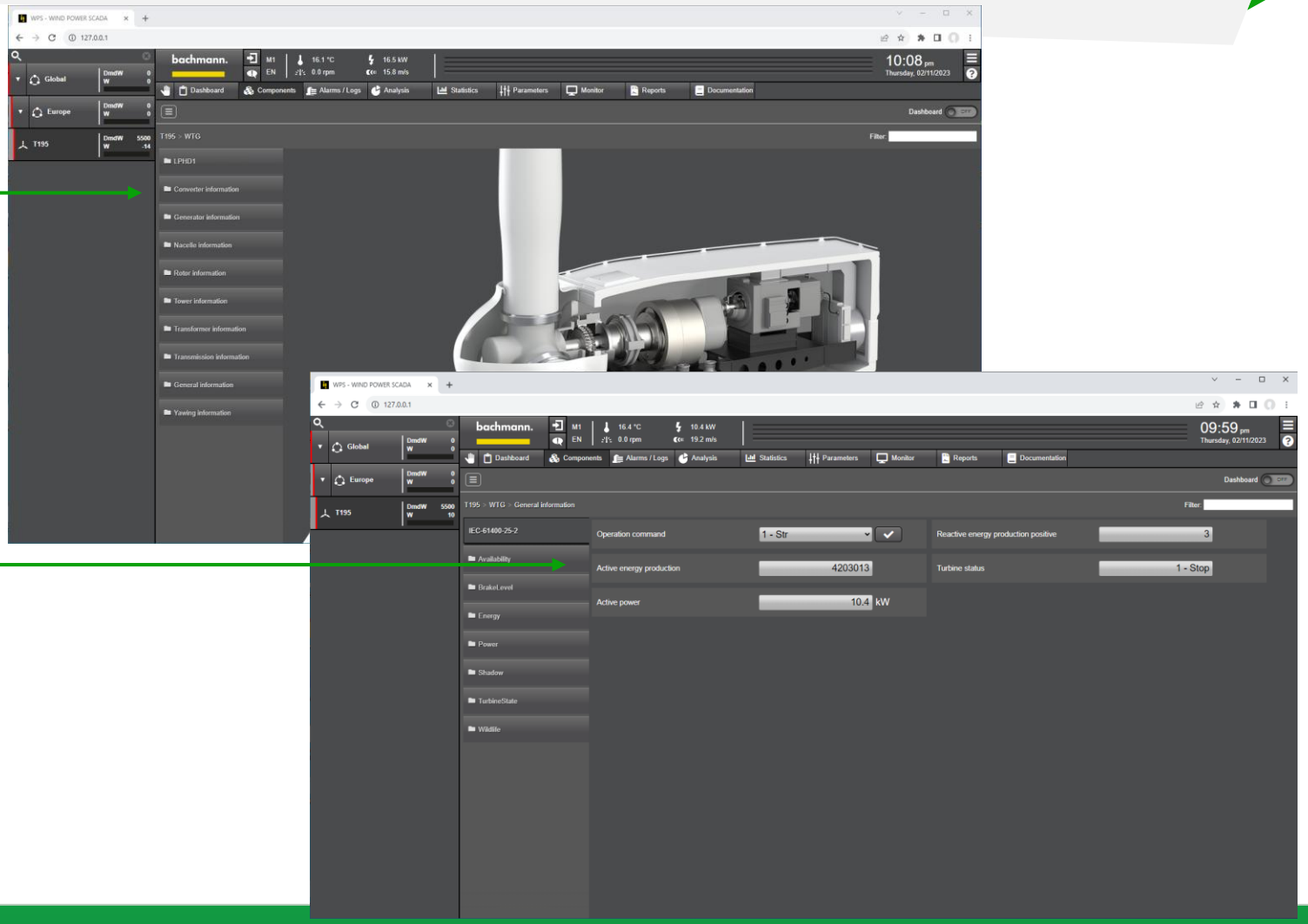
forsiteSCADA structure

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)



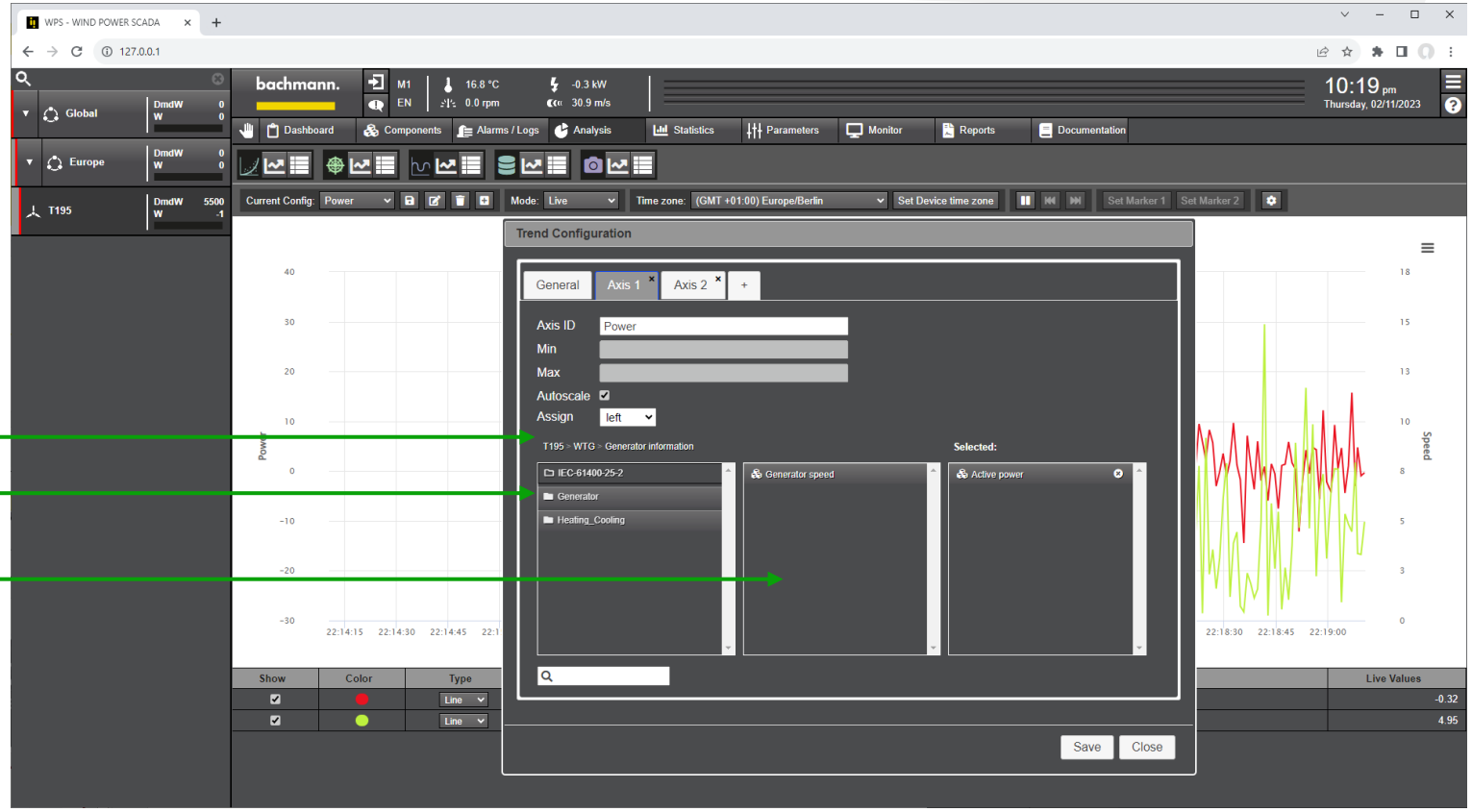
forsiteSCADA structure

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)



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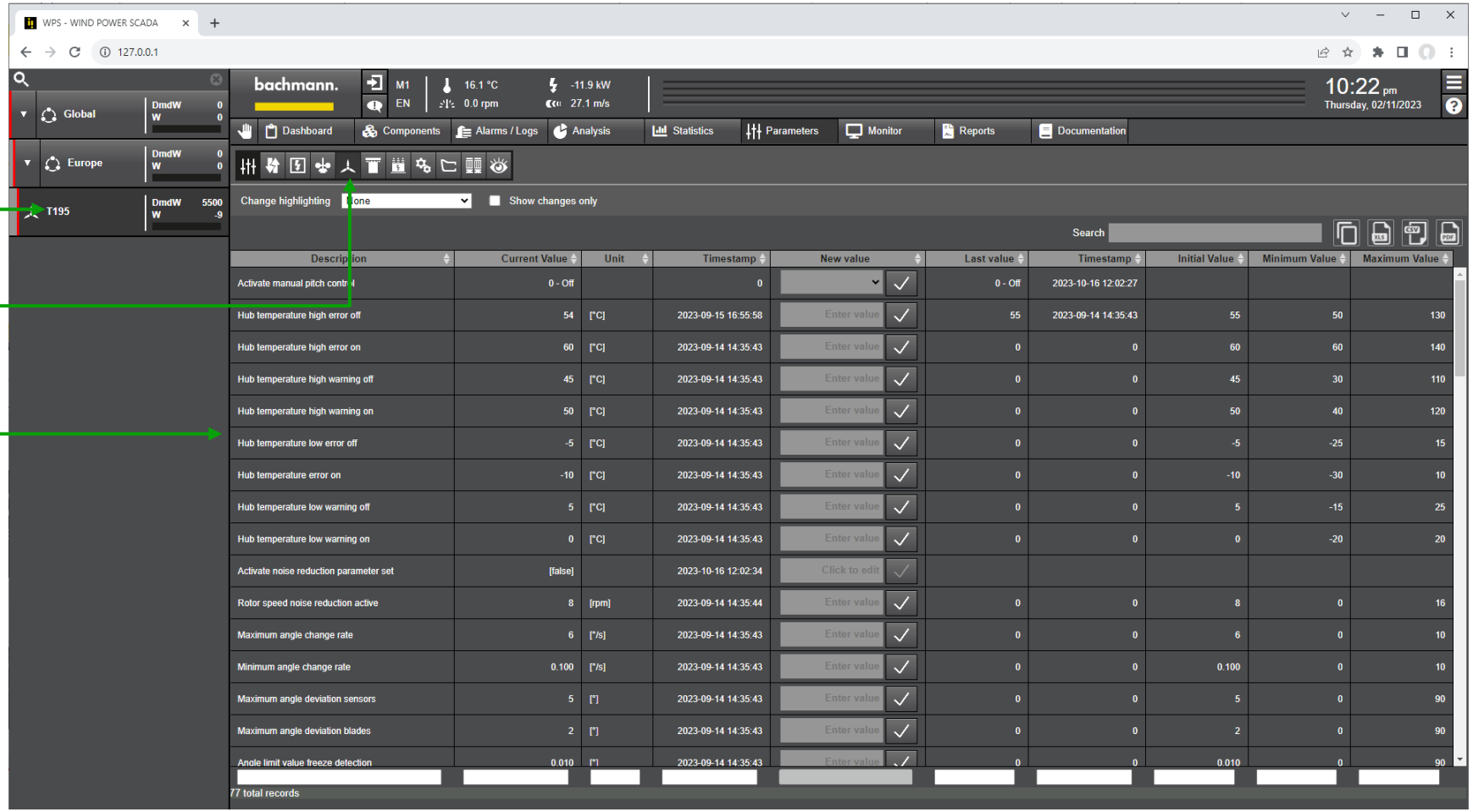
Visualization of 61400-25 standardized data - parameters

- **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)



Thank you for your attention !

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