WEBINAR

IEC61850 standard:

What for, which benefits, what pending challenges?

How is the Osmose project contributing?

AGENDA

1. Introduction: The Osmose project and its link with IEC61850

2. IEC61850: Introduction to an interoperability standard
   - Applying IEC61850
   - IEC61850 for Distributed Energy Resources

3. Work performed in Osmose linked to Interoperability

4. Conclusion

INTRODUCTION:

The Osmose project and its link with IEC61850

Yves Marie Bourien, CEA

OSMOSE PROJECT: leveraging flexibilities

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Flexibility is understood as a power system's ability to cope with variability and uncertainty in demand, generation and grid, over different timescales.

HOLISTIC APPROACH OF FLEXIBILITY

NEW FLEXIBILITY SOURCES

NEW FLEXIBILITY NEEDS

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OSMOSE PROJECT: key figures

- ✓ H2020 EU funded
- ✓ 28M€ budget
- ✓ 33 partners
- ✓ Leaders: RTE, REE, TERNA, ELES, CEA, TUB
- ✓ 2018 – 2022

OSMOSE PROJECT: project structure

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Methods and simulations

- Technische Universität Berlin – Optimal mix of flexibilities (WP1)
- Rte – Market designs and regulations (WP2)

Demonstrators

- Rte – Grid forming by multi-services hybrid storage (WP3)
- RED ELÉCTRICA DE ESPAÑA – Multi-services by different storage and FACTS devices (WP4)
- Terna GROUP – Multi-services by coordinated grid devices, large demand-response and RES (WP5)
- ELES – Near real-time cross-border energy market (WP6)

cea tech – Scaling-up & replication (WP7)

OSMOSE WP7:
Scaling up and replication

INTEROPERABILITY

TSO-DSO FLEXIBILITIES COORDINATION

BATTERY ENERGY STORAGE SYSTEM: DESIGN & CONTROL AND SHARED DATABASE

Objectives:

- ✓ Refine IEC61850 interoperability framework
- ✓ Demonstrate the engineering process of IEC61850 ENTSOE profile with different specifications tools
- ✓ Demonstrate IEC61850 interoperability framework with products from different manufacturers

Objectives:

- ✓ Provide an optimization framework taking into account different time scales for voltage control on the DSO grid in coordination with the TSO
- ✓ Demonstrate the tool and its benefits in a demo in real-time simulation

Objectives:

- ✓ Develop methods and tools for BESS design & control for a decrease of Levelised Cost
- ✓ Creation of a shared database with advanced data analytics for Energy Storage Systems in operation

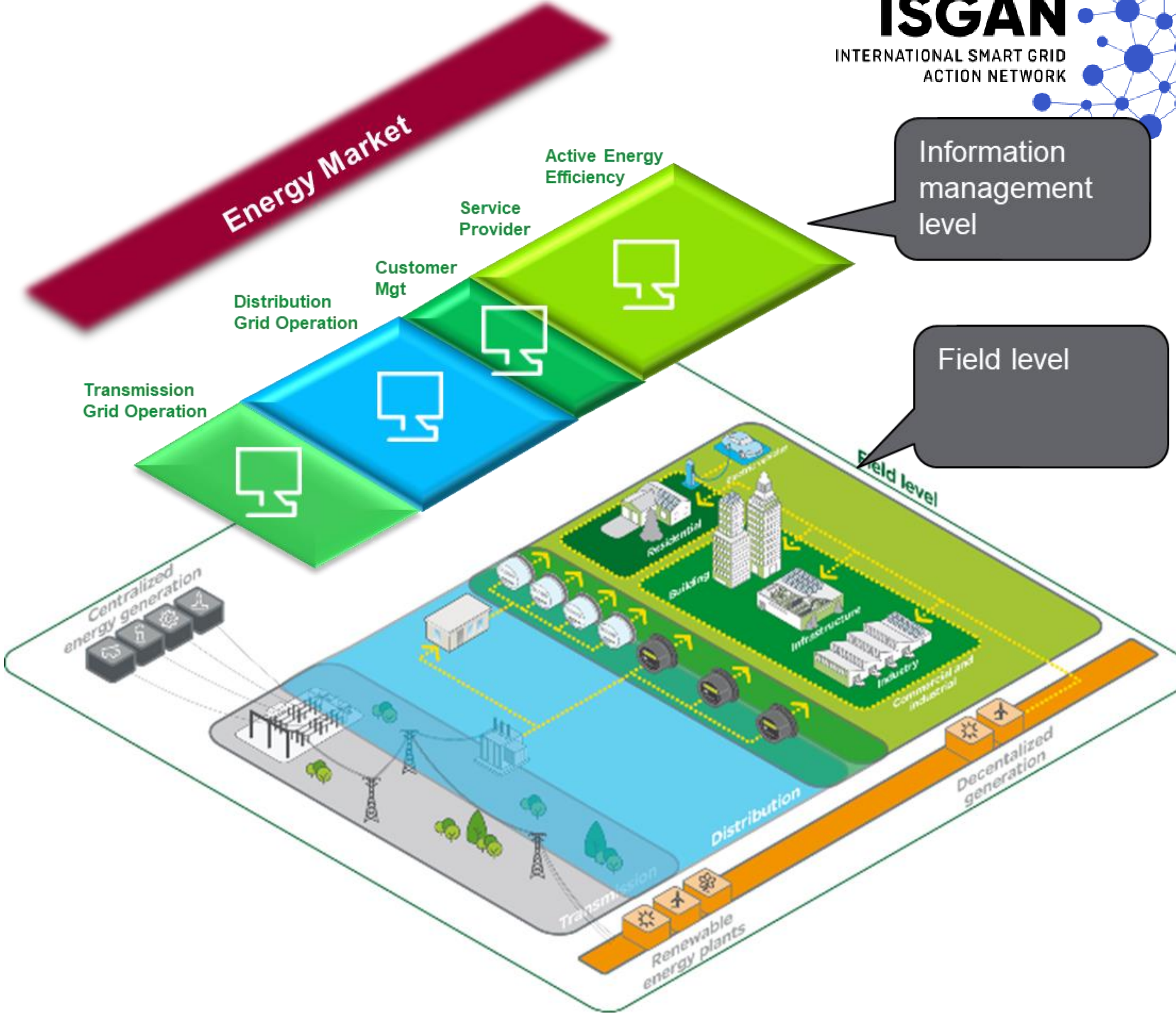
IEC 61850
Introduction to an interoperability standard

Christoph Brunner, it4power
Camille Bloch, Schneider Electric

Applying IEC61850

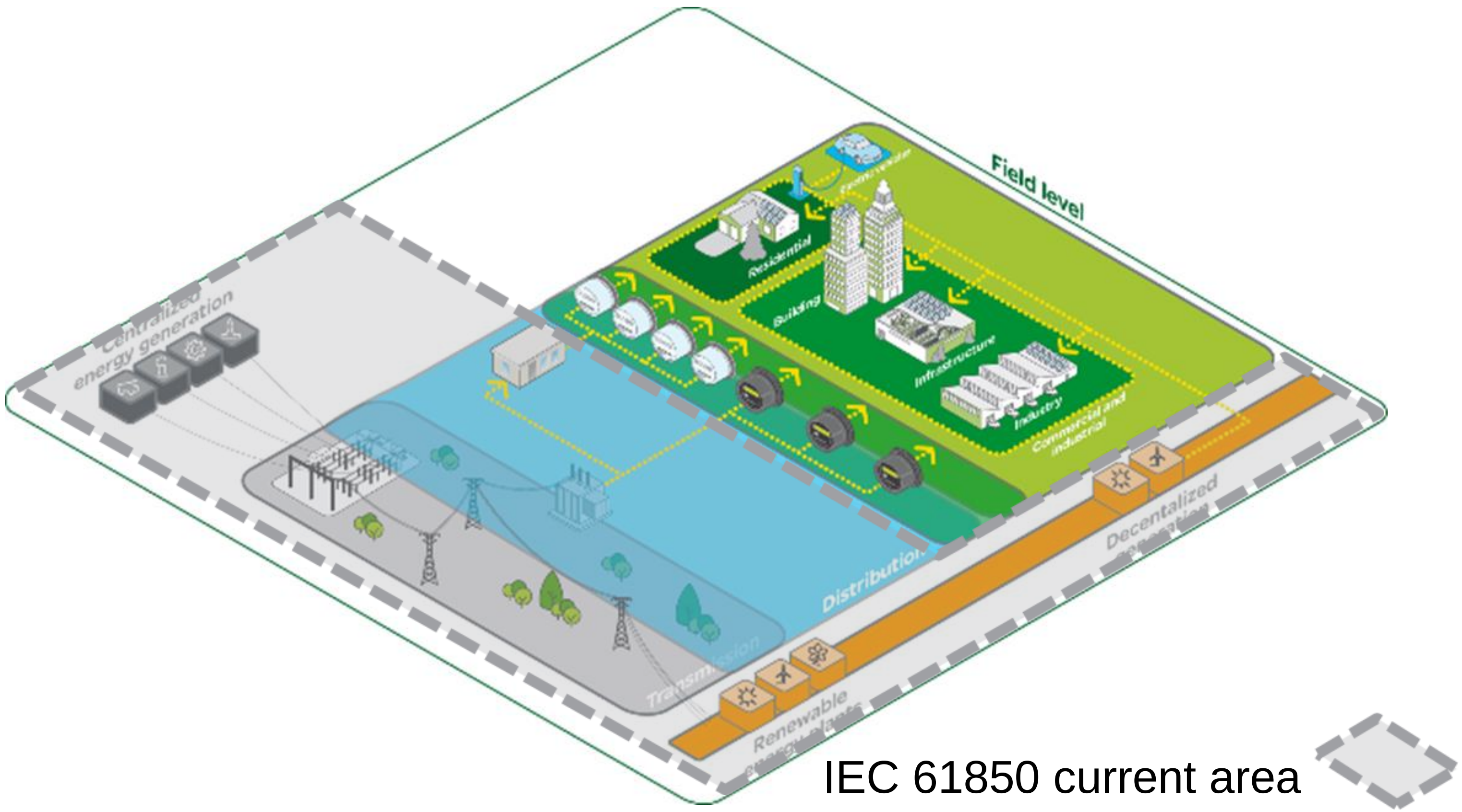
The Smart grid landscape

- Smart grid embrace the whole area from supply to demand
  - Centralized and decentralized generation
  - Transmission
  - Distribution
  - Commercial and residential users
- Smart grid address the information management level
  - Energy market management
  - Transmission and distribution operation
  - Customer management (metering and billing)
  - Service provider and energy efficiency



IEC 61850 in the smart grid

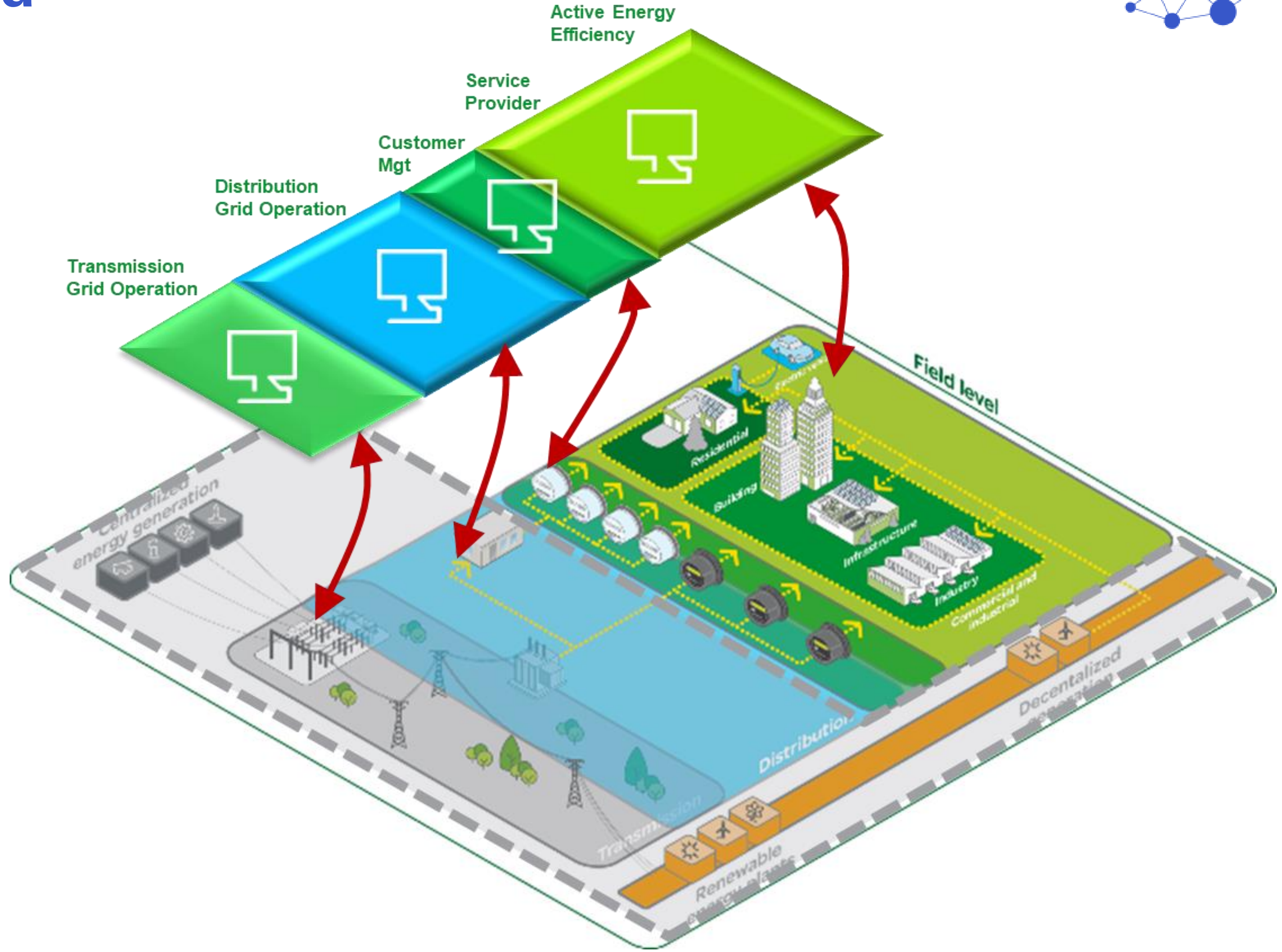
- IEC 61850 standard address interoperability for operation of smart grid
- It applies today to:
  - Production (bulk, renewable and decentralized)
  - Transmission
  - Distribution
- But IEC 61850 is also going outside smart grid:
  - Oil&Gas
  - Mininig
  - Transport
  - Datacenters



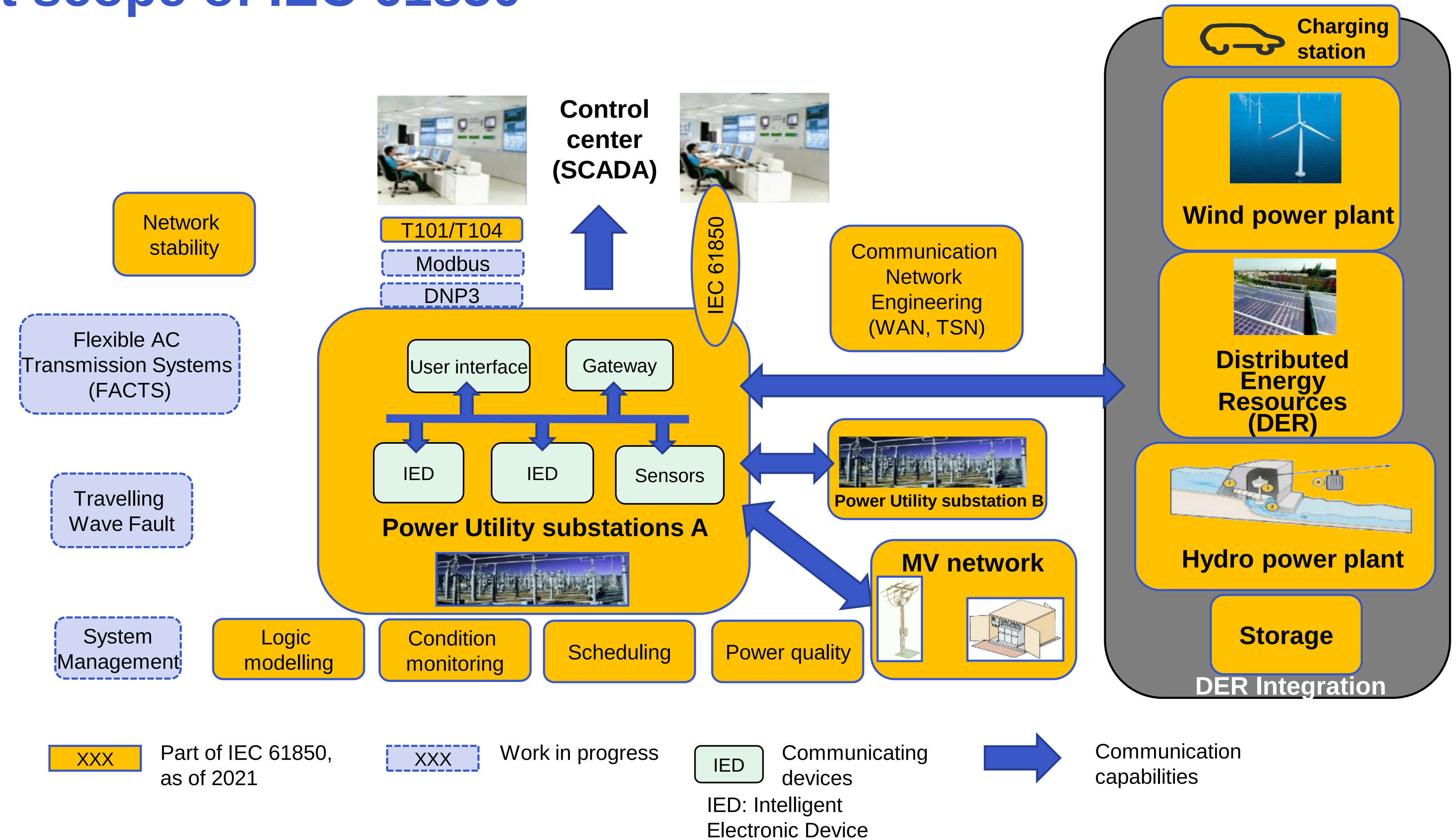
IEC 61850 current area

IEC 61850 in the smart grid

- IEC 61850 intend to standardize exchanges between different levels
  - Standardize data semantic
  - Standardize engineering process
  - Standardize communication

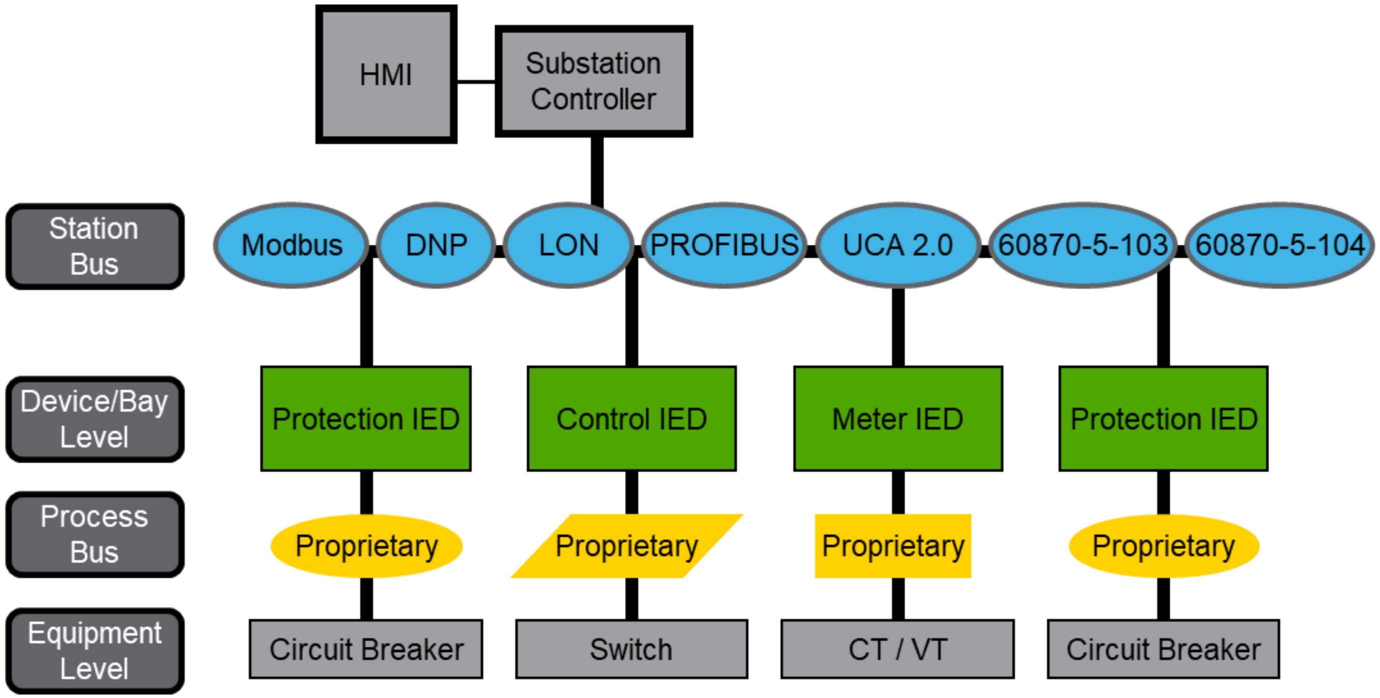


Current scope of IEC 61850



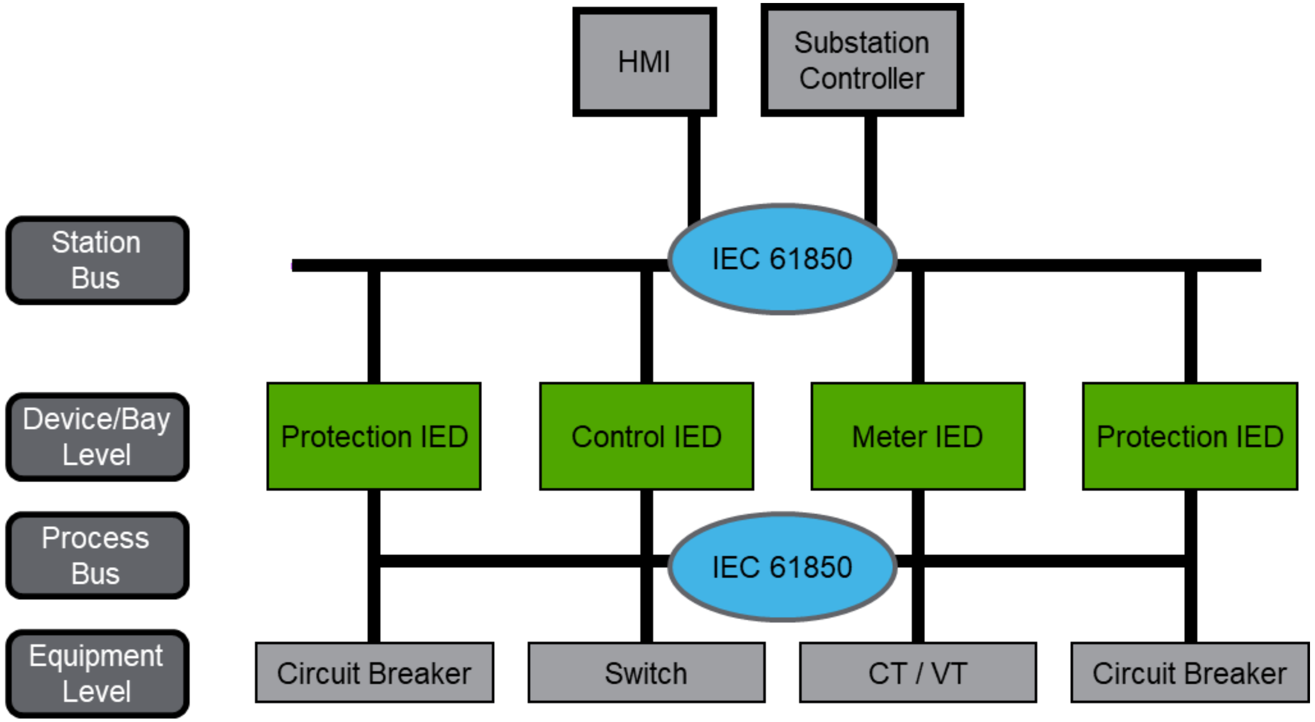
Power System based on legacy protocols

- No common standard, depending on selected device
- Proprietary communication on process level
- Lack of efficiency and higher cost for maintenance



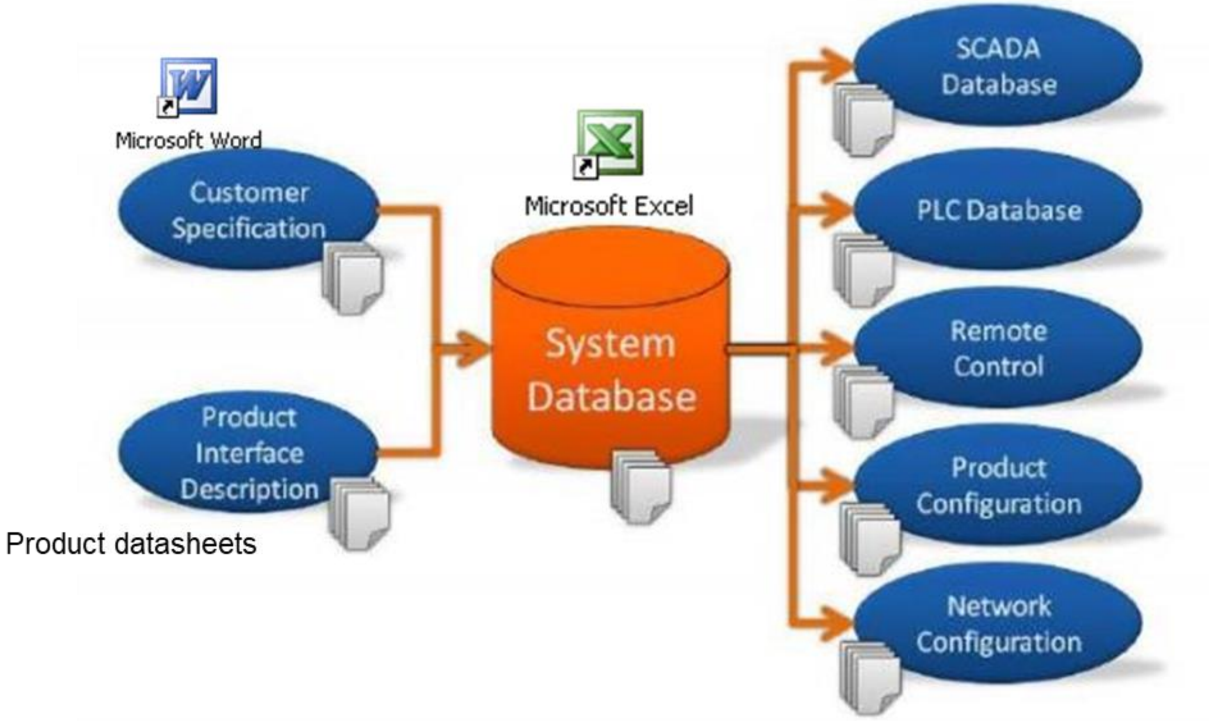
Power System based on IEC 61850

- Interoperable multi-vendors devices
- Common semantic without paper description



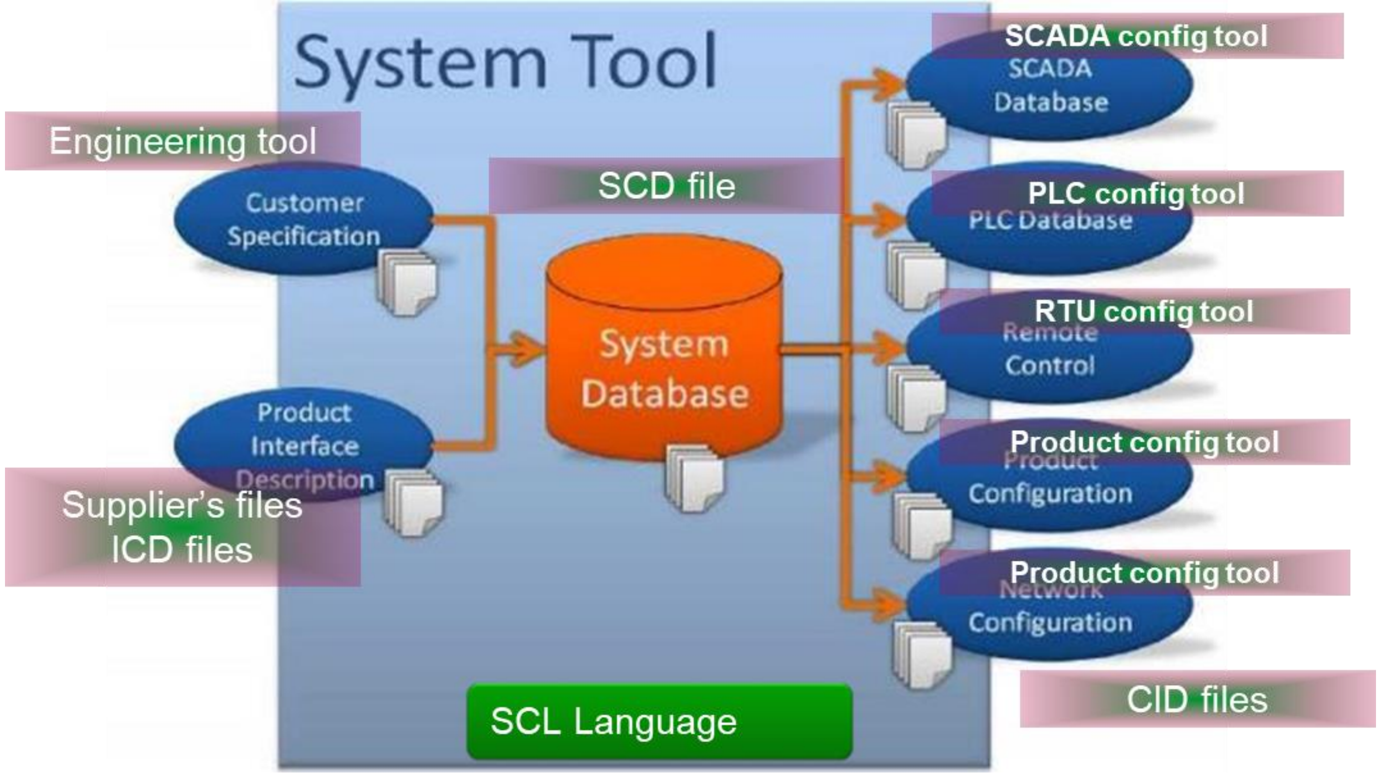
Power System engineering with legacy protocols

- Knowledge is spread in different non machine processable files
- Engineering is done in each tools independently
- It brings risks of human errors and system inconsistency



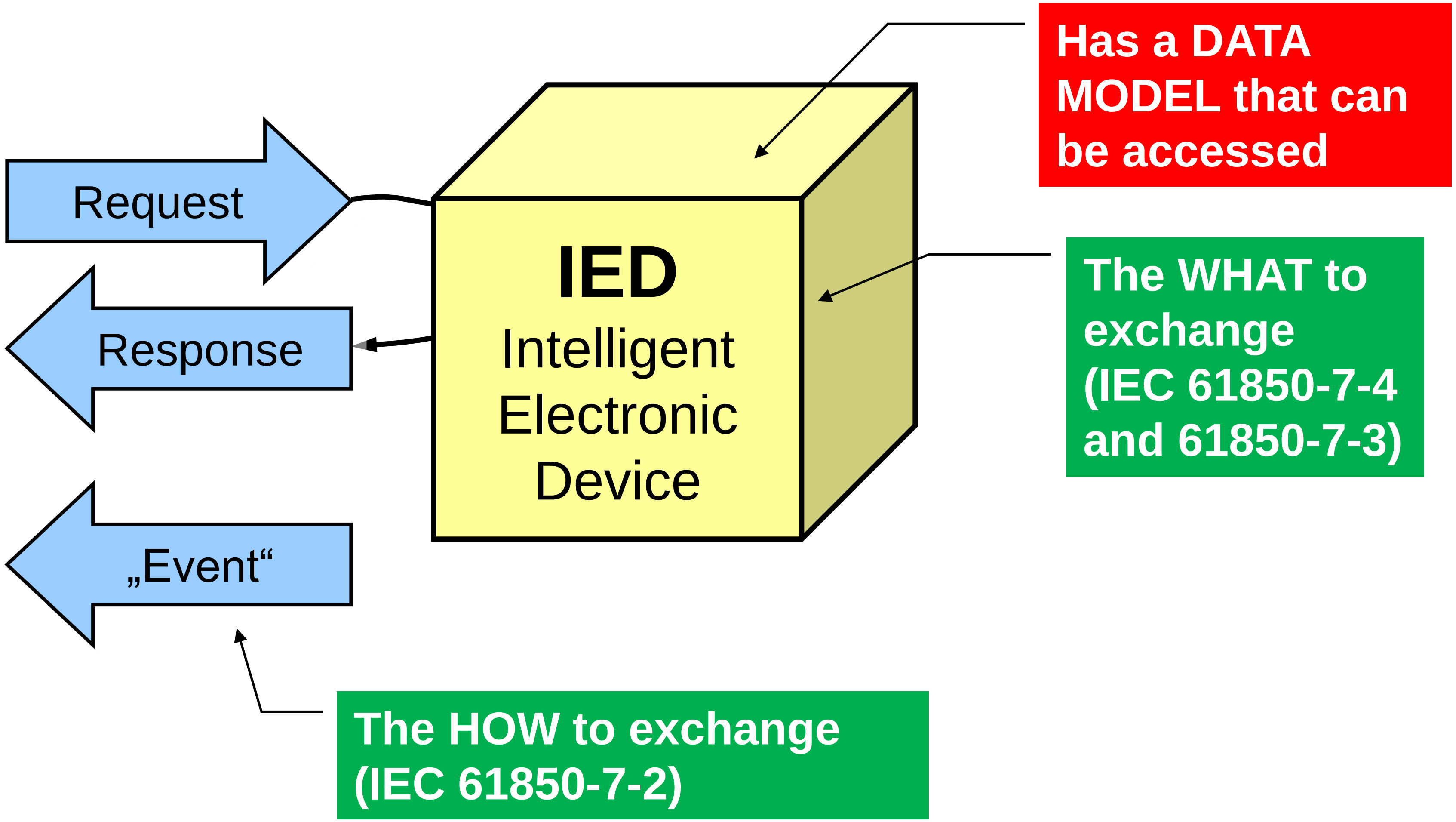
Power System engineering with IEC 61850

- One single machine processable language (SCL: System Configuration Language)
- Standardized process based on SCL file exchange
- On "single" system tool ensuring consistency of system exchanges

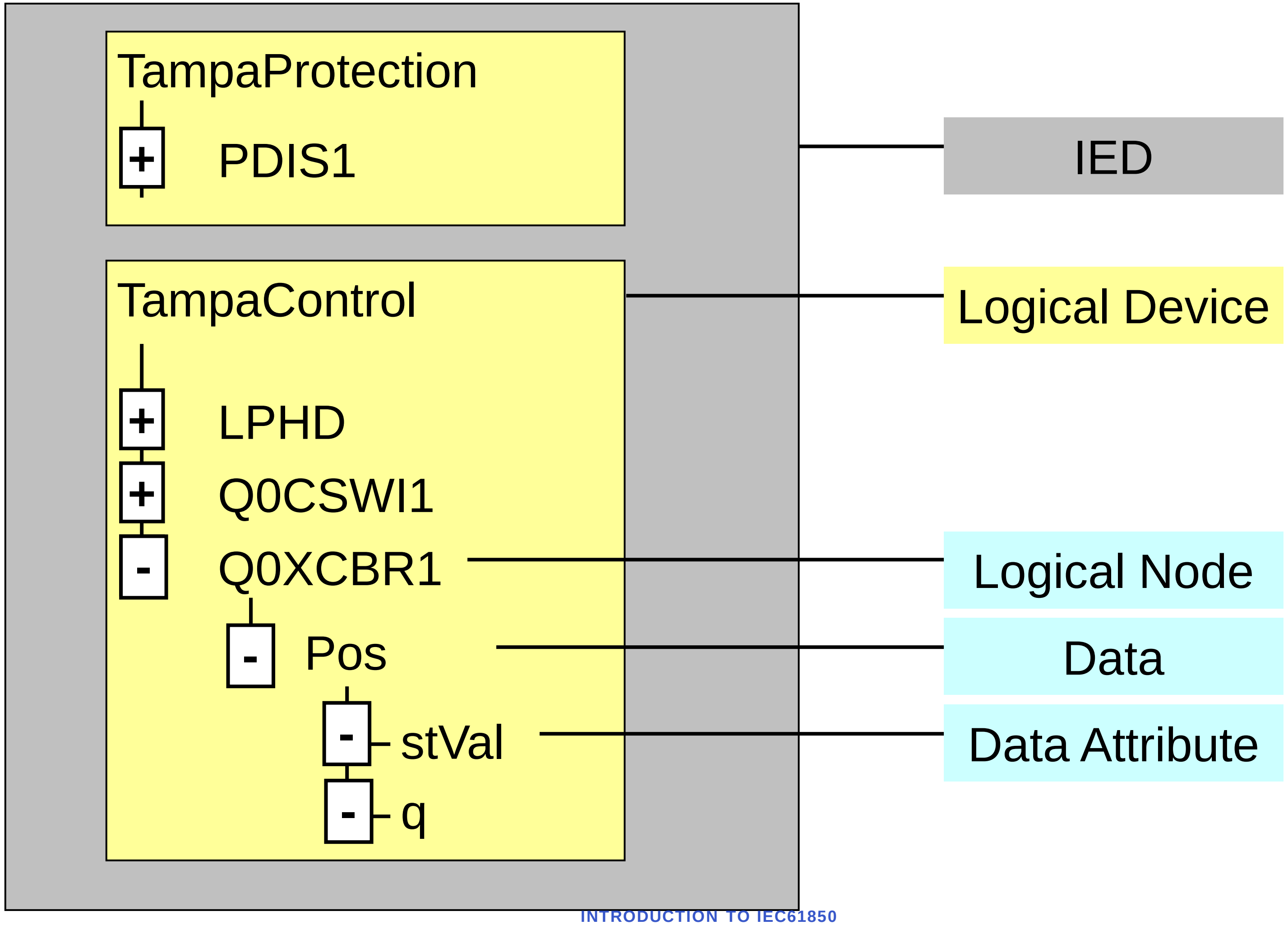


IEC 61850 for DERs (Distributed Energy Resources)

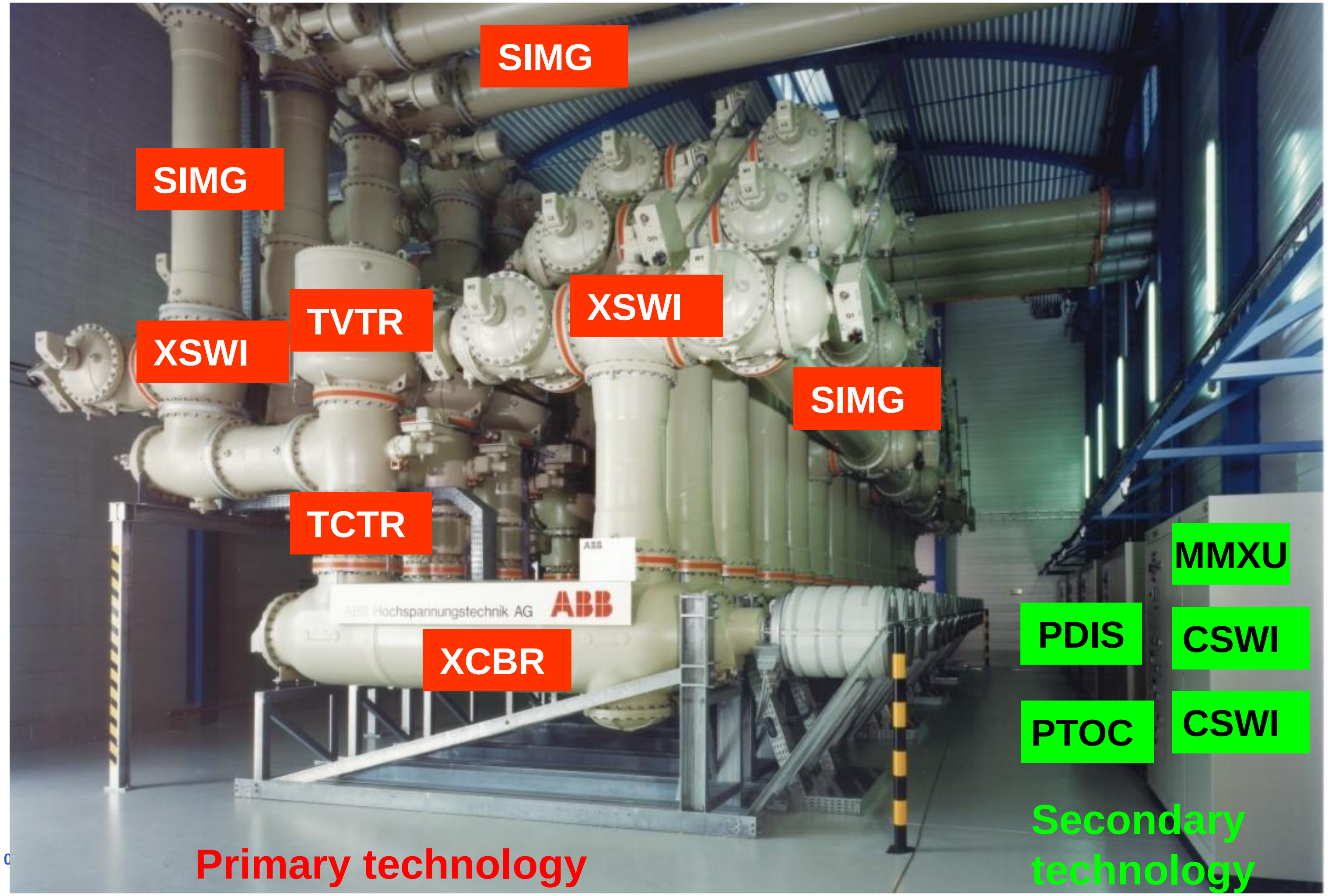
Technical concepts of IEC 61850
Data model and information exchange



Technical concepts of IEC 61850
Hierarchical data model



Technical concepts of IEC 61850
Example of Logical Nodes



Requirements for DER modeling
Distributed Energy Resources in the power system

- DER includes generation, controllable loads and energy storage
- Utilities are responsible for reliability and electrical requirements within the distribution system
  - Large amounts of DER connected to the distribution grid need to be handled
  - Utilities need information about location, capabilities and operational status of the DERs
  - DERs may have to comply to grid codes
  - DERs can assist in meeting utility requirements

Requirements for DER modeling
Stakeholders exchanging information with DERs

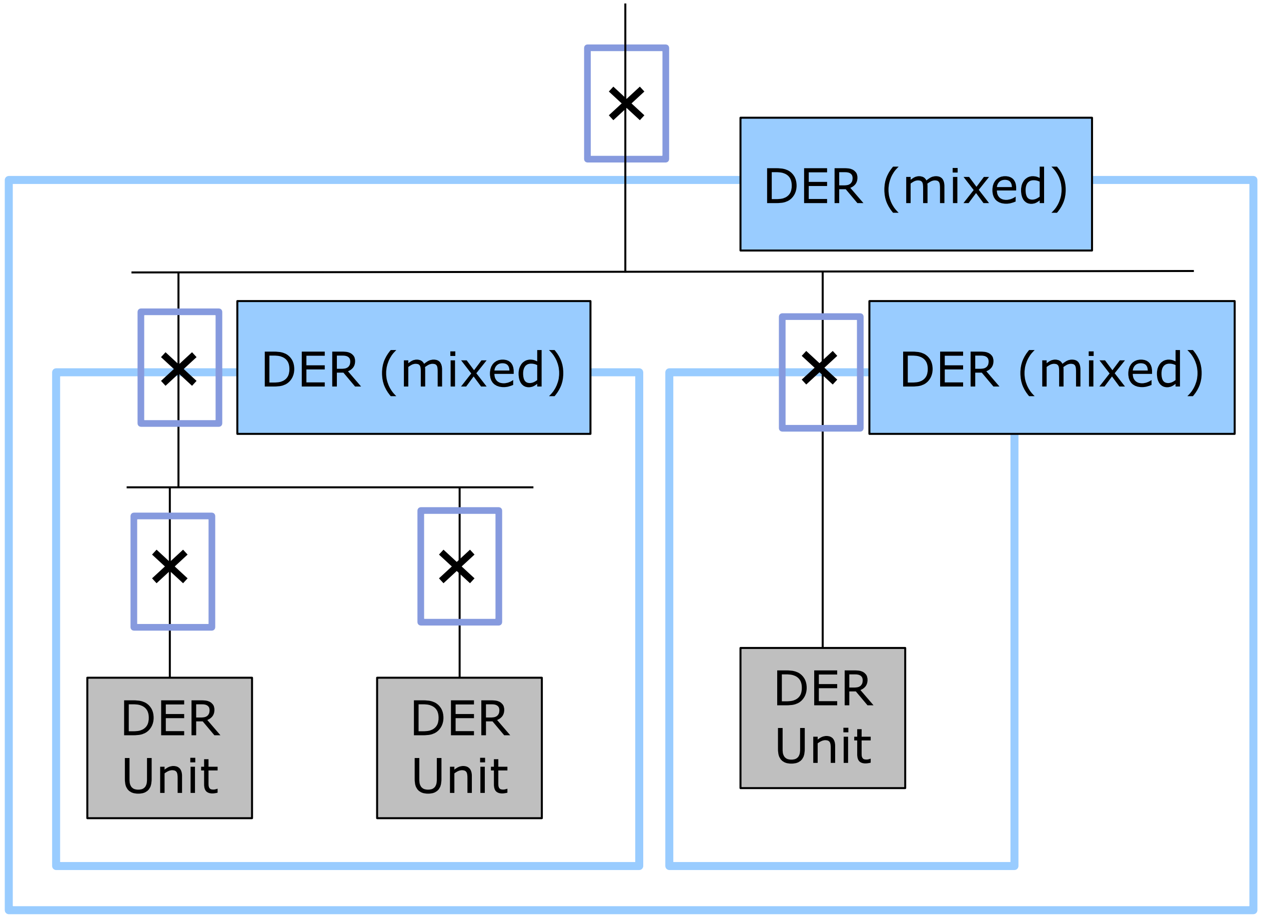
- DER controller
  - Autonomous operation of DER
- Facility DER Management
  - Management of multiple DERs at a facility
- Third parties
  - Aggregators manage multiple DERs at distributed locations
  - They can manage single DERs directly or multiple DERs through a facility management system
- Utility operational grid management
  - Utility applications may require interaction with DER both monitoring as well as control

→ ***To enable the access of those different stakeholders to a DER, a standardized semantic data model significantly reduces integration effort***

Requirements for DER modeling
Examples of information exchange with DER

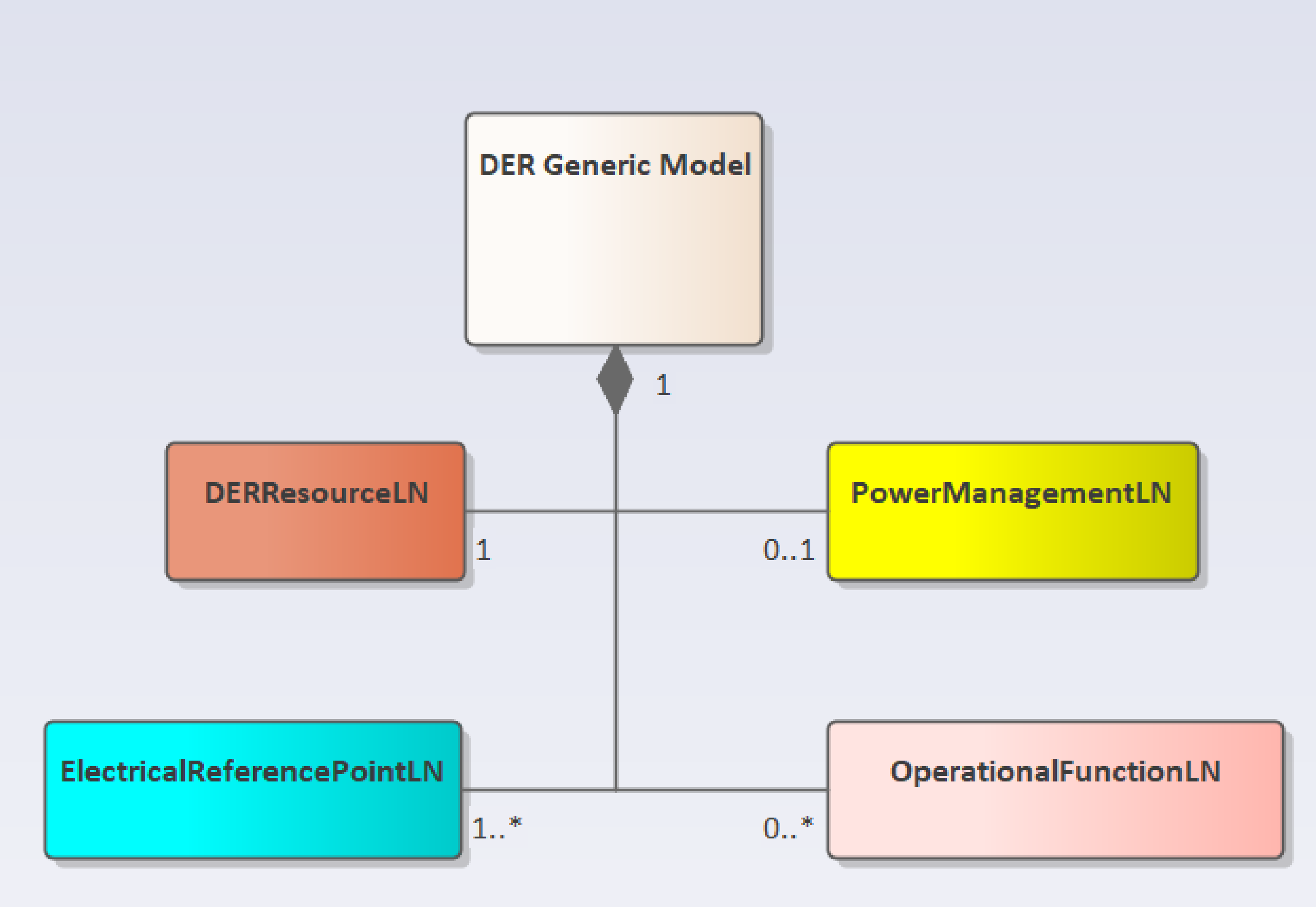
- Nameplate like capabilities or ratings
- Operational settings like parameters for grid code functions
- Real time data like real power output
- Activation of operational functions like volt-var control
- Send schedules like active power schedule for next day

Elements of a DER Model in IEC 61850 Recursive hierarchy



- DER model is recursive – a DER is composed of DERs
- A DER unit is of a single type – generation, storage or load
- A composed DER is of type mixed

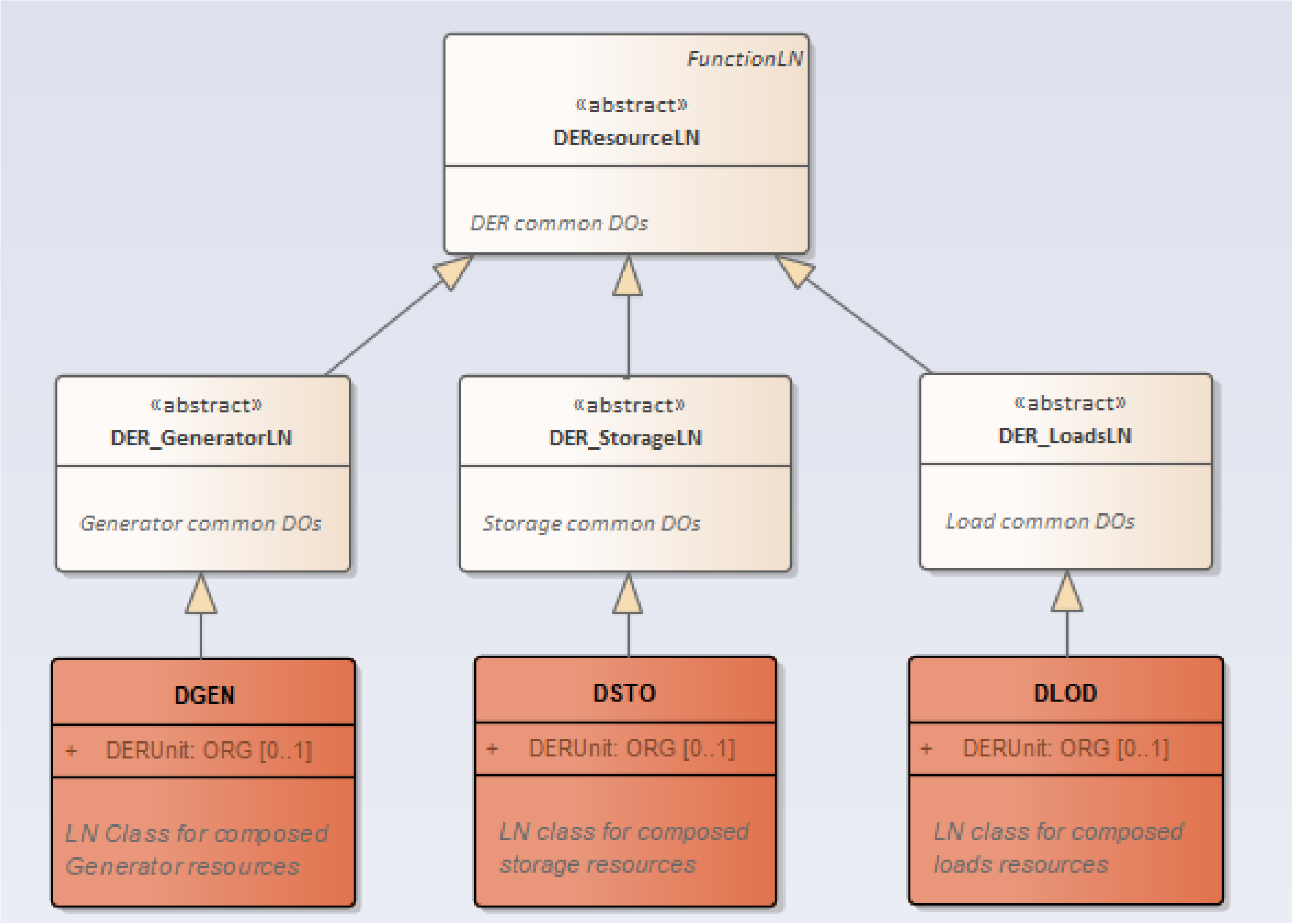
Elements of a DER Model in IEC 61850
The main components



- **Resource**
  - Generator
  - Load
  - Storage
- **Operational function**
  - E.g. Grid Code

Elements of a DER Model in IEC 61850
Generic DER resource Logical Nodes

- DGEN: Generator
- DLOD: Load
- DSTO: Storage



Elements of a DER Model in IEC 61850
DER Resource

- May be single DER or recursively aggregated DERs
- Describes aspects of the electrical resource – possibly aggregated
  - Capabilities (ratings)
  - Settings
  - Status
- Can be
  - Generator DGEN
  - Load DLOD
  - Storage DSTO
- If the resource is a single DER, it refers to the technology specific LN of that DER

Elements of a DER Model in IEC 61850
Example of DER Resource – PV

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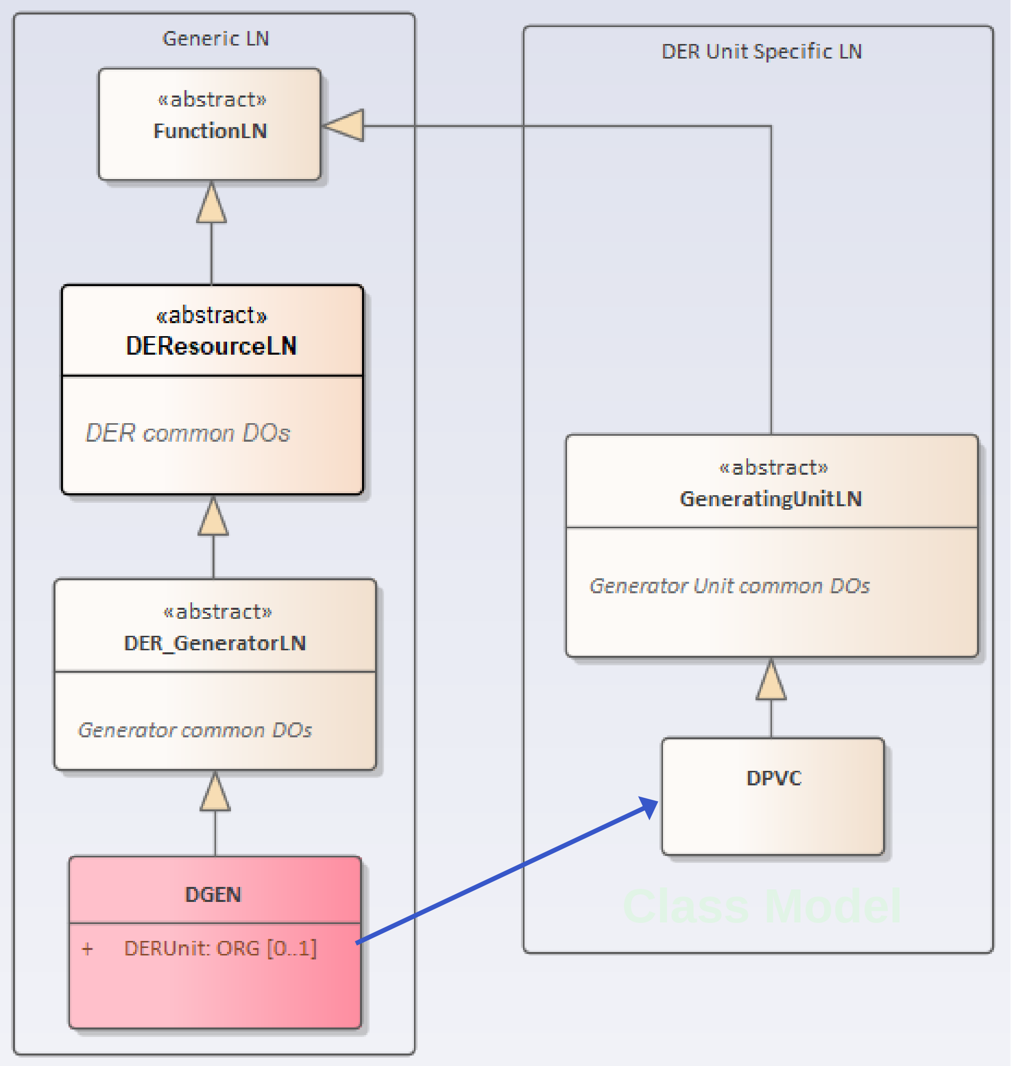
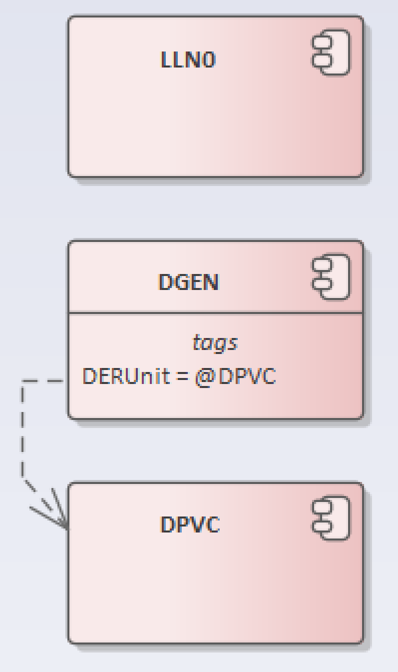


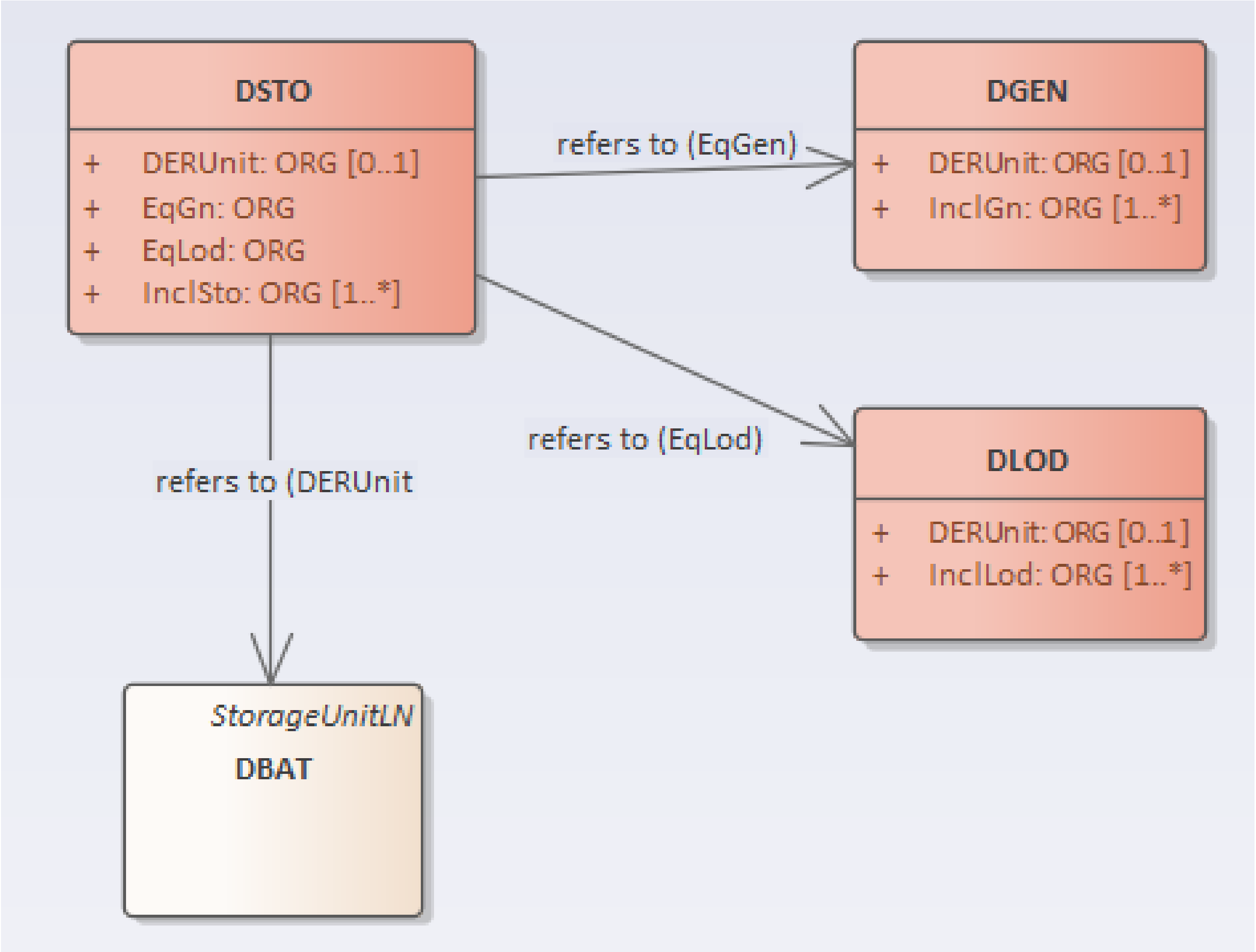
- Model consists of
  - A generic part (**DGEN**)
  - A technology specific part (e.g. **DPVC**)

Instance in a Logical Device



Elements of a DER Model in IEC 61850 Storage DER

- Generic characteristics of storage as Generator and Load are expressed with **DGEN** / **DLOD**
- Specifics of the DER unit (battery) is expressed with **DBAT**



DER modeling in IEC 61850 – Summary

- The modeling approach for DERs in IEC 61850-7-420 provides
  - A standardized generic view of a DER independent of the DER type as it may be needed for operational management of the DER by various stakeholders like aggregators or utility operational grid management
  - Type specific information as it may be needed for maintenance
  - The possibility to model aggregated DERs as a single DER with the same standardized generic view
- Additionally, IEC 61850-7-420 provides models for operational functions like Grid Codes supporting a standardized access to parameters
- For integration of devices with legacy interfaces like Modbus or IEC 60870-5-104, IEC 61850 defines mappings which allows to link information elements from the legacy protocol to the semantic IEC 61850 data model

Work performed in OSMOSE - Interoperability

Thomas Sterckx, ELIA Engineering

T7.1 Scaling Up And Replication - Interoperability

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Creating an efficient **engineering process** based on IEC61850 SCL, top down from concept and specification to application

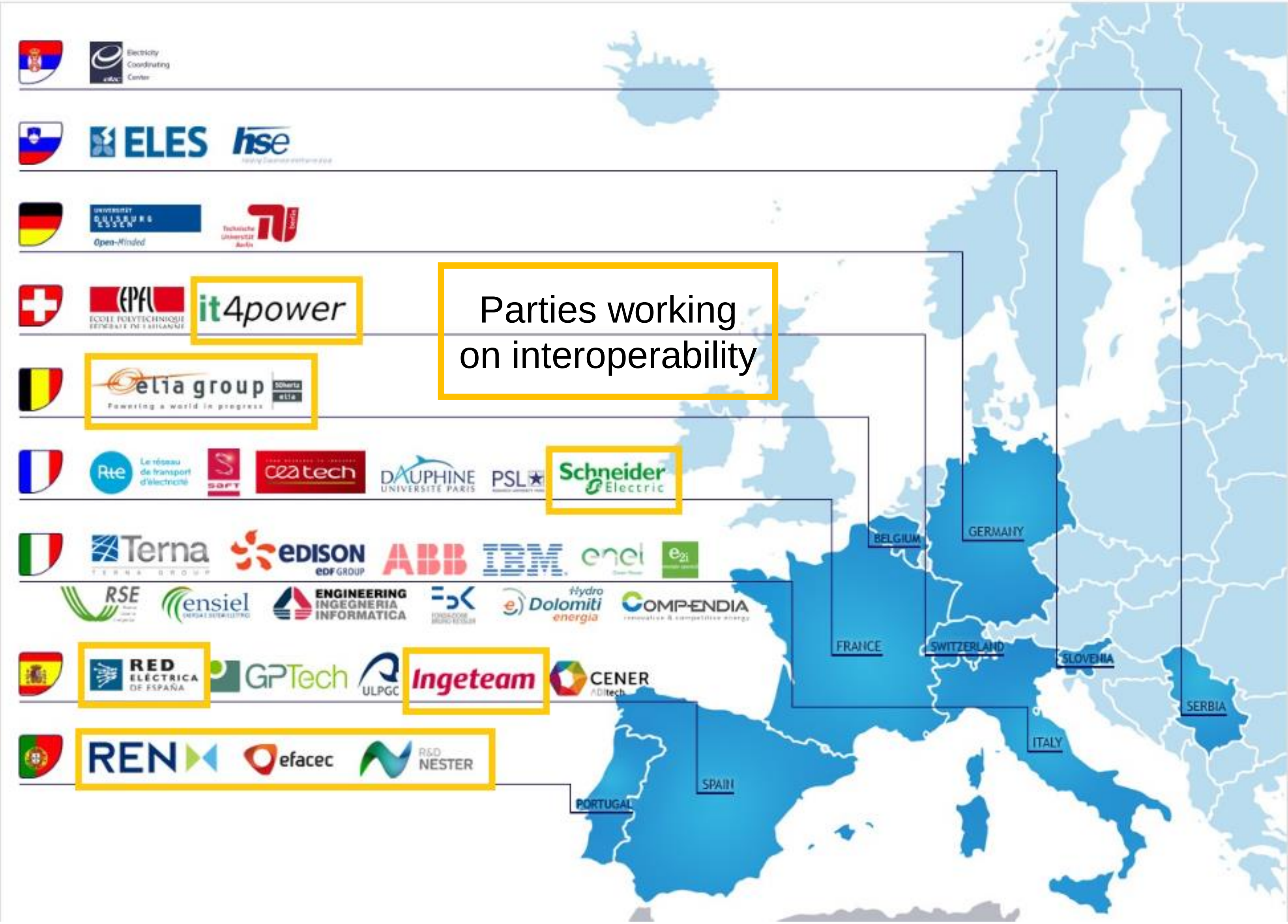
Demonstrating the engineering process in a **multivendor setup**, in a laboratory environment. Simulating 2 interconnected substations with battery storage

Providing **recommendations to IEC61850 WG10** to improve the standard from the point of views of

- Engineering process
- Data modeling GAPS detected during demonstrator engineering

Dissemination of the results and developments to the market in order to raise awareness and speed up **market integration**

OSMOSE PARTNERS



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Team of technical experts from different domains

- Utilities (Elia, REE, REN)
- IED manufacturers (Siemens, Efacec, Ingeteam)
- Software vendors (Helinks, Schneider)
- IEC61850 WG10 members (it4power, Helinks, Schneider, …)

IEC61850 Engineering process Extension

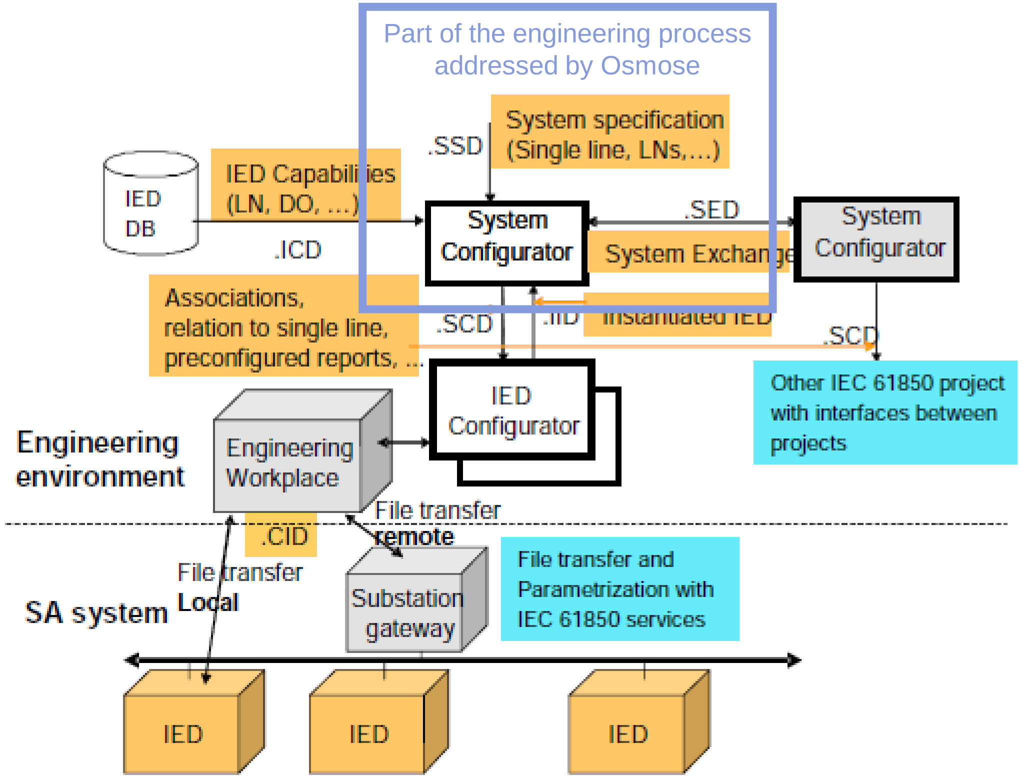


Figure 1 – Reference model for information flow in the configuration process

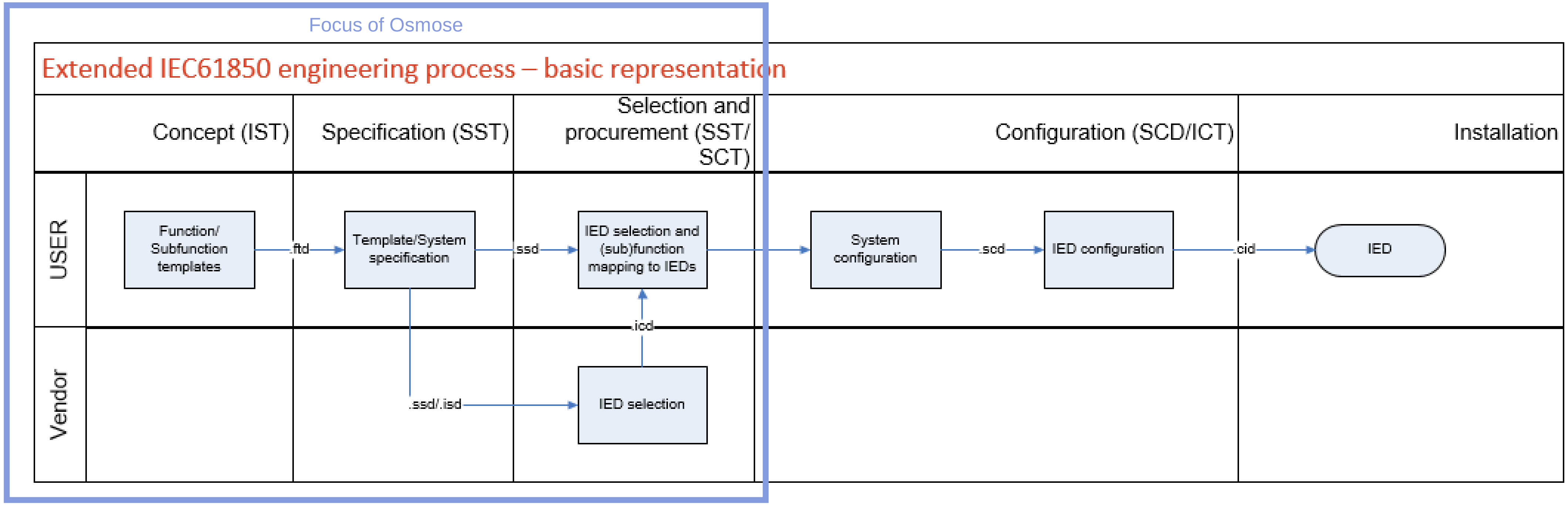
- **SCL = Substation Configuration Language**
- **XML** based configuration language
- Language used for configuring IEC61850 compatible systems
- Achieving **interoperability** between engineering tools

- **Osmose Task 7.1 addressing**
- Providing the SCL extensions to introduce **vendor independent specification** step to the engineering process and trace it throughout the different process steps
- Providing **tools** to enable this process
  - Creating function / subfunction specification templates
  - Defining dataflow
  - Mapping real IED datamodels to specified IED datamodels and comparing them

Why is this work important?

Extending IEC61850 engineering process by centralising all steps of the engineering process to SCL

- Improving the overall **engineering process efficiency** by using and extending files with additional data in each step
- Allows to communicate **machine readable specification** to vendors avoiding interpretation errors
- Allowing **traceability** of the specification throughout the process
  - Enabling automation in updates of project files when specification changes
  - Improving version management



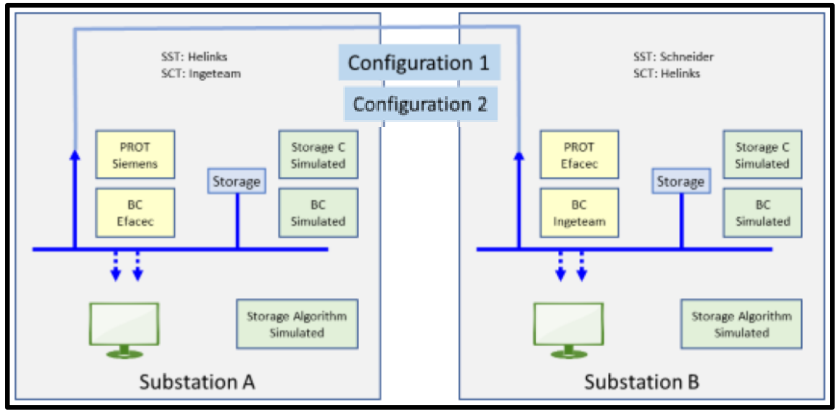
Demonstrator

- @ R&D Nester Lisbon

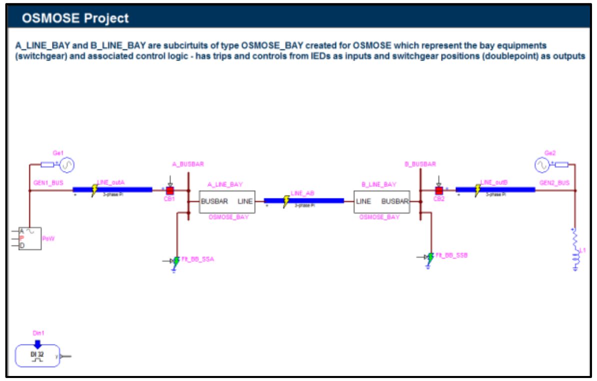
- Providing the required multi-vendor hardware to support the SCL engineering process

- Engineered with a combination of tools from different vendors (SST, SCT, ICT)

- In a laboratory environment equipped with the necessary tools to allow efficient testing and configuration



Power grid model



RTPSS
Real-Time Power System Simulator

Substation A

Substation B

Protection and control units

Providing recommendations for IEC61850 taskforces

Providing recommendations to improve IEC61850 interoperability:

- Improving the engineering process
  - SCL namespace extensions
  - SCL file content within different engineering steps
  - Engineering tool features

- Improving the datamodel
  - Identifying datamodel gaps during execution of the demonstrator

Dissemination of the work

Raising awareness and speeding up market integration

In the past:

- IEC61850 Global conference 2019 (Elia presentation on engineering process)
- Pacworld magazine December 2020 (From Specification to the Substation)
- Osmose Deliverable 7.1.1 IEC61850 ENTSO-E Profile introduction and Engineering Process Refinement (Available)

Upcoming:

- Webinar with the EU-SYSLFEX project on TSO/DSO interaction: June 16th, 10h CEST
- 2nd webinar on IEC61850 planned Q3 2021 (deeper dive)
- Smart-Grid forums IEC61850 Global Conference 18-22/10/2021

CONCLUSION

Conclusion

- IEC61850 standard enables interoperability between different
  - Energy market levels
  - Engineering process steps (from specification to application)
  - Manufacturer devices

- Osmose helps pushing forward the IEC61850 standard on different levels by providing recommendations
  - Linked to engineering process enhancements
  - Linked to datamodel enhancements

Thanks for your attention

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The OSMOSE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773406