



# IEC 61850 standard update

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# Content

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- IEC 61850 parts beyond Ed 1 scope
- Ongoing work related to IEC 61850
- Improving Engineering in a multi vendor environment
- Improving the standardization processes

# The Contents of IEC 61850, Edition 1

<b>System Aspects</b> Part 1: Introduction and Overview Part 2: Glossary Part 3: General Requirements Part 4: System and Project Management Part 5: Comm Requirements for Functions and Device Models	<b>Data Models</b> Basic Communication Structure for Substations and Feeder Equipment Part 7-4: Compatible Logical Node Classes and Data Classes Part 7-3: Common Data Classes
<b>Configuration</b> Part 6: Configuration Language for electrical Substation IED's	<b>Abstract Comm. Services</b> Basic Communication Structure for Substations and Feeder Equipment Part 7-2: Abstract Communication Services (ACSI) Part 7-1: Principles and Models
<b>Testing</b> Part 10: Conform. Testing	<b>Mapping to real Comm. Networks (SCSM)</b> Part 8-1: Mapping to MMS and ISO/IEC 8802-3 Part 9-1: Sampled Values over Serial Unidirectional Multidrop Point-to-Point link Part 9-2: Sampled Values over ISO/IEC 8802-3

# Published beyond Ed 1 – new domains

## *Bulk Power Generation*

- IEC 61850-7-410 Ed 2.1 – **Hydroelectric power plants** – Communication for monitoring and control
- IEC 61850-7-510 - Hydroelectric power plants - Modelling concepts and guidelines

## *Windpower*

- IEC 61400-25 – Communication standard for control and monitoring of **wind turbine plants**

# Published beyond Ed 1 – new domains

## *PMUs*

- IEC 61850-90-5 – Using IEC 61850 to transmit **synchrophasor** information according to IEEE C37.118

## *DA and DER*

- IEC 61850-7-420 – Communications Systems for **Distributed Energy Resources (DER)**
- IEC 61850-90-7 – IEC 61850 object models for **inverter based applications**
- IEC 61850-90-8 – IEC 61850 object models for **electrical vehicles**

# Published beyond Ed 1 – modeling

## *Substation Automation*

- IEC 61850-7-500: Use of logical nodes to model applications in substations
- IEC 61850-90-3 - Using IEC 61850 for **condition monitoring**
- IEC 61850-90-17 – Using IEC 61850 to transmit **power quality data**

# Published beyond Ed 1 – communication

- IEC 61850-9-3 – Precision time protocol profile for power utility automation
- IEC 61850-90-1 – Using IEC 61850 for communication between substations
- IEC 61850-90-2 – Using IEC 61850 for communication between substation and control centers
- IEC 61850-90-4 – Network engineering guidelines (LAN in substations)
- IEC 61850-90-12 – Network engineering guidelines for WAN

# Published beyond Ed 1 – Gateways

- IEC 61850-80-1 – Guideline to exchange information from a CDC based data model using **IEC 60870-5-101 / -104**
- IEC 61850-80-3 – Mapping to web protocols - Requirements and technical choices
- IEC 61850-80-4 – Mapping between the **DLMS/COSEM** (IEC 62056) data models and the IEC 61850 data models
- IEEE 1815.1 – Mapping between **DNP3** and IEC 61850

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# WG10 ongoing work (1)

- Amendment to Edition 2
  - UML Models of IEC 61850 have been prepared
  - Amendment and associated Ed 2.1 will be published
    - Incorporating TISSUES
    - Auto generate the models from the UML model
    - Part 4, 5 and 7-1 are in preparation / circulation as CDV
    - Part 6, 7-2, 7-3 and 7-4 are in preparation / circulation as FDIS
- distribute in the future models electronically  
[www.iec.ch/tc57/supportdocuments](http://www.iec.ch/tc57/supportdocuments)
- IEC 61850-7-7: Specification of schema for namespace definition files

# WG10 ongoing work (2)

- IEC 61850-90-11: Methodologies for **modeling of logics** for IEC 61850 based applications
- IEC 61850-90-14: Using IEC 61850 for FACTS data modeling
- IEC 61850-90-16: **System Management**
- IEC 61850-90-18: **Alarm handling**
- IEC 61850-90-19: Implementation of **role based access**
- IEC 61850-90-20: Guideline for redundant IEDs with IEC 61850
- IEC 61850-90-21: Using IEC 61850 for traveling wave fault location systems

# WG10 ongoing work (3)

- IEC 61850-1-2: Guideline for Technical Committees and Working Groups on **extending IEC 61850**
- IEC 61850-7-5: Use of logical nodes to model applications – generic principles
- IEC 61850-80-5: Data Conversion between **Modbus and IEC 61850**
- IEC 61850-10-3: Methodologies for **testing of functions in IEC 61850 based systems**

# WG10 ongoing work (4)

- IEC 61850-7-6: Guideline how to create Basic Application Profiles
- IEC 61850-6-100: Guideline for **function modeling in SCL** for substation automation
  - May include as well standardizing Function / Subfunctions names for SCL
  - Similar parts required for other domains
- IEC 61850-6-2: Configuration description language extension for **HMIs**
- TF "User Feedback"
- AdHoc TF "**Engineering Improvements**"

# WG17 ongoing work

- IEC 61850-90-6: Using IEC 61850 for distribution automation
- IEC 61850-90-9: IEC 61850 object models for electrical energy storage systems
- IEC 61850-90-10: Modeling of schedules in IEC 61850
- IEC 61850-90-15: IEC 61850 based DER Grid Integration
- IEC 61850-8-2: Mapping on Web Services
- IEC 61850-7-420: Preparation of Ed 2
  - Add modeling of Grid codes

# WG18 ongoing work

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- Communication network structure in hydro power plants
- IEC 61850-7-410, Amd: Extensions to include models for steam and gas turbines

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# Multivendor Systems

## ***What are the issues?***

- The main drivers for IEC 61850:
  - ... to reduce costs of implementation
  - ... to achieve interoperability using standards-based products and technologies
  - ... to enable seamless integration

***... What does "interoperability" mean?***

***... What is the impact of a multivendor system on cost reduction for implementation and seamless integration?***

# Interoperability

## ***From IEC 61850-2***

"ability of two or more **IEDs** from the same vendor, or different vendors, to **exchange information** and **use that information** for correct execution of specified functions"

# What does interoperability mean?

## Communication

- Exchange messages
- Understand the methods to configure the information exchange (e.g. control blocks)

## Semantic Data Model

- Understand the semantic of the information

## Engineering

- Exchange engineering information between tools
- Understand how to use the information (e.g. signal flow)

# Assessment of interoperability

## Communication

- Good

## Data Model

- Improve modeling of implementations
- Improve semantic of models

## Engineering

- Process allows too many variations
- Border between ICT and SCT sometimes floating

# Engineering – Options in the standard

*Options in the standard impact the flexibility of the devices / tool*

- IEC 61850 defines a comprehensive set of functionalities supporting a large flexibility on how to configure and use devices in a system
  - Flexibility means engineering effort
  - Not all devices require that flexibility; devices with a well defined functionality may be completely preconfigured
  - For the system integrator, it is important to understand constraints that exist

# Engineering – Options in the standard

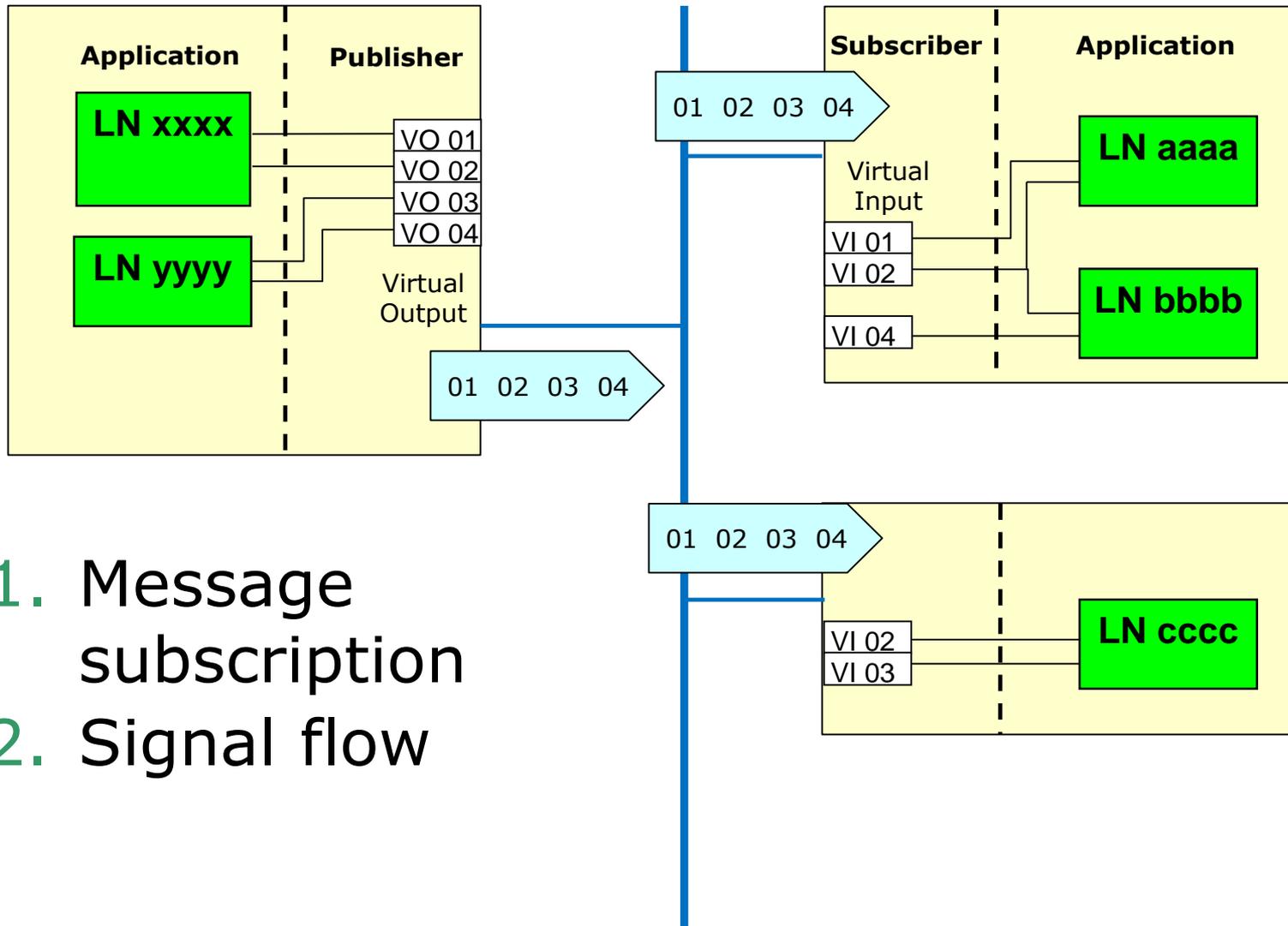
- **PICS** provide information about constraints
  - **PIXIT** provide extra information for testing
  - With Edition 1 devices, many constraints that affect the engineering were hidden in the PIXITs
    - For Ed 2, they were moved to PICS
    - Also, with Ed 2 all PICS are formally described in the ICD/IID file
- *With Edition 2, an SCT can guide the integrator with regard to what is supported by a device and what is not*
- *This does not prevent that while purchasing a device, we need to analyze if it fulfills the needs*

# Configuring the signal exchange

- Configuring the signal exchange is part of the design process and is done through the SCL
- If the IEDs are provided by **different suppliers**, distributed applications are very demanding for **interoperability** at the engineering level

*How can this be achieved in an efficient and interoperable way?*

# Two configuration steps



1. Message subscription
2. Signal flow

# Message subscription

```
- <GSEControl name="Control_DataSet1" datSet="DataSet1" confRev="1"
  appID="0">
  <IEDName>P2KA4</IEDName>
</GSEControl>
```

```
- <ConnectedAP iedName="P2KA3" apName="P1">
- <Address>
  <P type="IP">192.168.0.48</P>
  <P type="IP-SUBNET">255.255.0.0</P>
  <P type="IP-GATEWAY">10.0.0.1</P>
  <P type="OSI-AP-Title">1,3,9999,23</P>
  <P type="OSI-PSEL">00000001</P>
  <P type="OSI-SSEL">0001</P>
  <P type="OSI-TSEL">0001</P>
  <P type="OSI-AE-Qualifier">23</P>
</Address>
- <GSE IdInst="CTRL" cbName="Control_DataSet1">
- <Address>
  <P type="VLAN-ID">001</P>
  <P type="VLAN-PRIORITY">4</P>
  <P type="MAC-Address">01-0C-CD-01-00-45</P>
  <P type="APPID">0000</P>
</Address>
  <MinTime unit="s">10</MinTime>
  <MaxTime unit="s">2000</MaxTime>
</GSE>
</ConnectedAP>
```

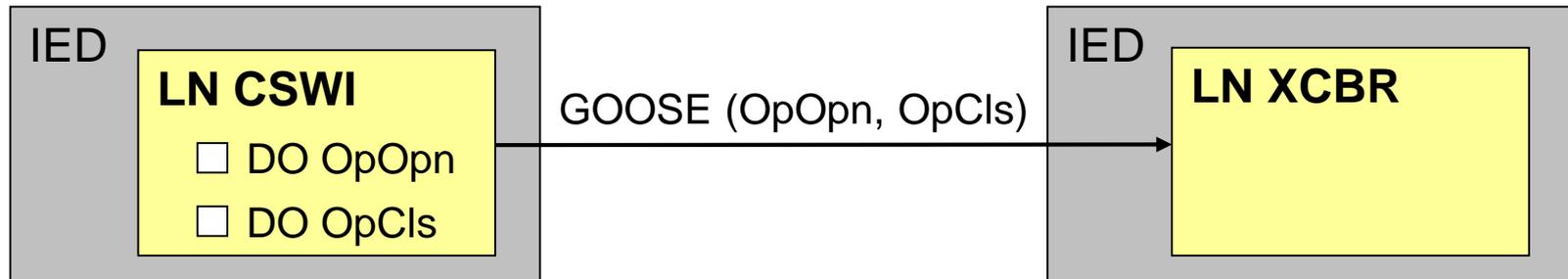
Subscribing IED

# Signal flow

- Signal flow is configured in SCL through **ExtRef** elements in the **Input** section of logical nodes
- A fully configured ExtRef is **on the DA level** and includes
  - Object reference to the source signal
  - Indication how the signal is communicated (**service type** and reference to **control block**)
  - Description of the semantic at the input
  - Internal address of the receiving device

# Principle of later binding

- IED declares required inputs by
  - Indicating expected type with a DO name at pDO
  - Indicating semantic of the input in the description



```
<LN lnType="BayControllerQ.QA1XCBR1" prefix="QA1" lnClass="XCBR" inst="1">
  <Inputs>
    <ExtRef intAddr="OpOpn" desc="Breaker Open" pDO="OpOpn" pServT="GOOSE" />
    <ExtRef intAddr="OpCls" desc="Breaker Close" pDO="OpCls" pServT="GOOSE" />
    <ExtRef intAddr="Tr" desc="Trip" pDO="Tr" pServT="GOOSE" />
  </Inputs>
</LN>
```

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# Problem statement

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- Standardization processes have been designed for mainly HW based products
- Standards describing large SW systems like IEC 61850
  - are subject to more frequent changes
  - include SW components (**Code components**) that need to be distributed and maintained

# Versioning of code components

- Model namespace identification
  - Edition 1: IEC 61850-7-4:2003
  - Edition 2: IEC 61850-7-4:2007
- SCL Schema at publication
  - Edition 1: Version 1
    - *Release 2003/09/19 in annotation*
  - Edition 2: Version 3.0 (Language version “2007”)
    - *Release 2009/03/19 in annotation*
- SCL Schema today
  - Edition 1: 1.7
  - Edition 2: 2007B

# Versioning of code components

## ■ Requirements

- Relation to IEC process
- Identify changes due to TISSUES
- Identify intermediate drafts circulated within WG

## ■ Future Versioning

- Starts to be used in Ed 2.1
- Will be consistently implemented with Ed 3

<i>Example: SCL schema</i>	<b>Version</b>	<b>Revision</b>	<b>Release</b>
<b>Formal ID</b>	2007	B	3
<b>IEC Standard</b>	Edition 2	Amd 1 Ed 2.1	CDV

# Distribution of code components

- Code component in Ed 1 and Ed 2
  - SCL schema file
- Distribution by IEC when standard is bought
  - You get the version that IEC has when you buy the standard
- Latest version for Ed 1 and Ed 2 has been distributed with **57/1604/DC** on July 31, 2015

# Information about schema versions



For IEC use only

57/1604/DC

2015-07-31

**INTERNATIONAL ELECTROTECHNICAL COMMISSION**

**TECHNICAL COMMITTEE 57: POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE**

**Latest version of SCL schema and planned publication of a Technical Corrigendum to IEC 61850-6 Ed. 1 and Ed. 2**

Introductory note: The present document has been developed in TC 57 WG 10 (Power system IED communication and associated data models) and submitted by the WG 10 Convenor. In agreement with the TC 57 Secretariat this document is circulated to IEC national committees for comments.

## **1. Background**

An important part of IEC 61850-6 is the XML schema file that describes the format of the SCL file. This file is currently included in each standard edition as an Annex. However, this file is subject to revisions due to errors and corrections across the whole standard. The latest version of the file is distributed with the electronic version of the standard. There is however no official mechanism through IEC in place for distribution of updates of that file nor is it possible, that a user of the standard knows which is the latest version, per editions, to be used. To improve that situation, the process described in this DC is proposed.

# Distribution of code components

- Distribution as zip file
  - Manifest – xml file describing the content of the package
  - The component file(s)
  - History.txt
- A guideline “Handling of Code Components in IEC Standards Including Copyright Licensing” is in preparation
- “Light” and “Full” version

# IEC process for code components

## ■ Website

[www.iec.ch/tc57/supportdocuments](http://www.iec.ch/tc57/supportdocuments)

- Public access
- Website will contain all versions
- Proposed / approved

## ■ Notification of the national committees with a **DC** document

- NCs may raise concerns

## ■ Process has already been described in principle in 57/1604/DC



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