



INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

IEC 61850-1-2

Guidelines for extending IEC 61850 (tutorial)



L. Guise

Editor of 61850-1-2

V1.1 - 2019-10-26



Objectives, targets and scope

- **Objectives** : support extension activities of the IEC 61850 series as close as possible to where the knowledge is
- **Target** :
 - any users (including private) but primarily for standardization bodies
 - that are considering using IEC 61850 as a base standard within the scope of their work and are willing to extend it as allowed by the IEC 61850 standards.
- **Scope** : identifies the required steps and requirements in achieving extensions of IEC 61850 and provides guidelines for the individual steps.

- IEC 61850 is already a de-facto cross-TC series :
 - IEC TC57 WG10
 - IEC TC57 WG17
 - IEC TC57 WG18
 - IEC TC88/TC57 JWG25 (61400-25)
 - IEC TC69/TC57 JWG11 (61850-90-8)
 - IEC TC13/TC57 (61850-80-4)
 - IEC TC38 (IEC 61869)
 - IEC TC17 (IEC 62271-3)
 -

*But without a
comprehensive, clear and
easy-to-access framework
(technical/processes)*

- **Reminds the main basic requirements**
 - **Mostly referring to the appropriate parts of the series which host the requirements or recommendations**
 - **May introduce new requirements specific to extensions such as :**
 - **Guidelines for creating/naming LN**
 - **Guidelines for creating/naming DOs**
 - **Guidelines for creation/usage of abbreviations**
- **Lists all possible flexibilities offered by the standard**
- **Defines which flexibilities are allowed/possible per type of extension cases**



IEC 61850-1-2 content : On the process side,

- **Provides guidance for each of the standardisation steps : from the initial analysis down to the obsolescence of parts**
 - What to do - > how to maximise the re-use of existing ?
 - How to do it ? The typical associated work is to identify existing logical nodes which can be reused “as is”, to determine if existing logical nodes can be extended, or to define new logical nodes
- **It helps typically:**
 - To build transitional namespaces,
 - To manage standard namespaces (domain, product, transitional)
 - To develop private namespaces
 - To develop profiles of usage of IEC 61850

What types of extensions ?

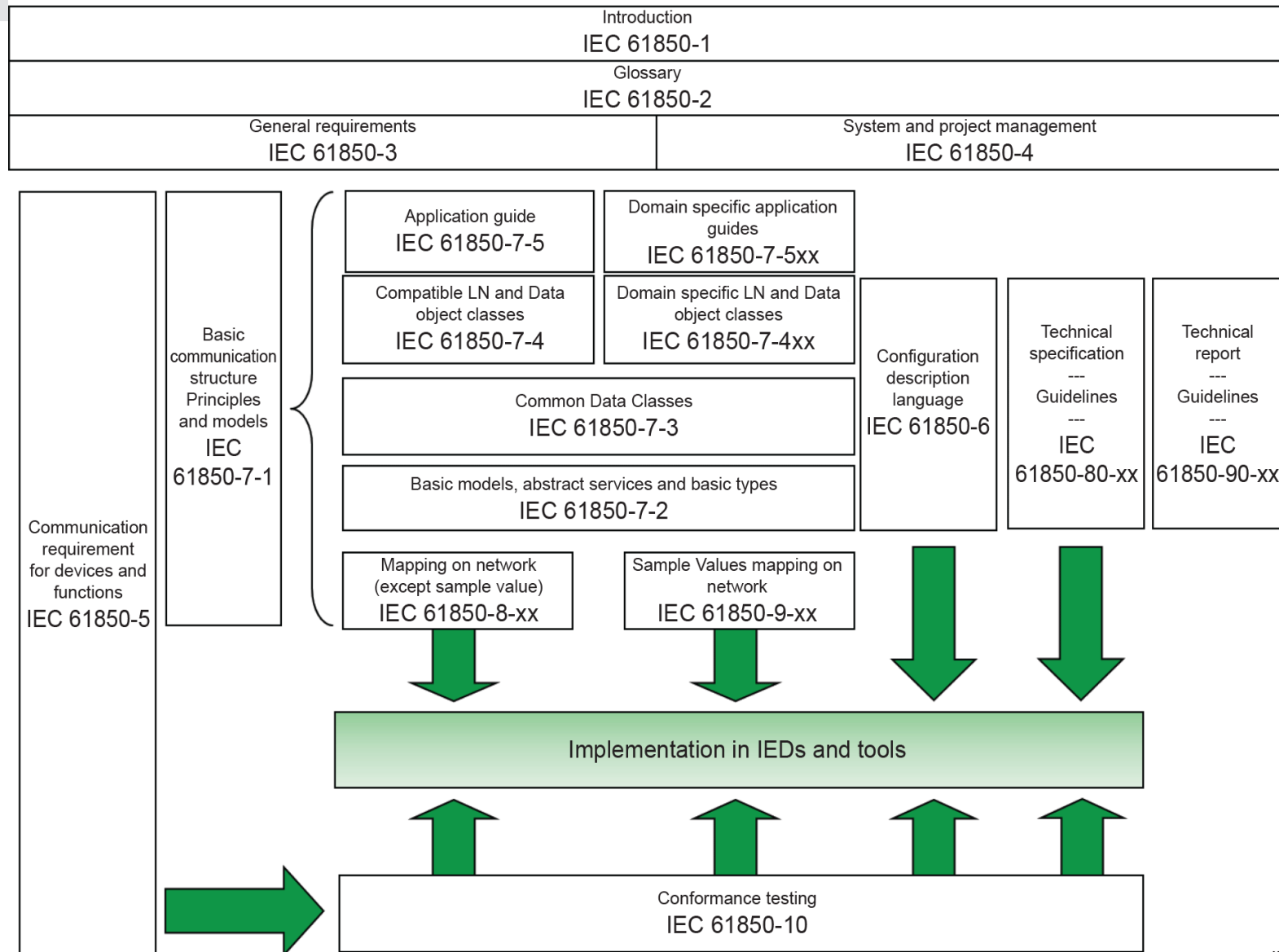


Typical cases of application

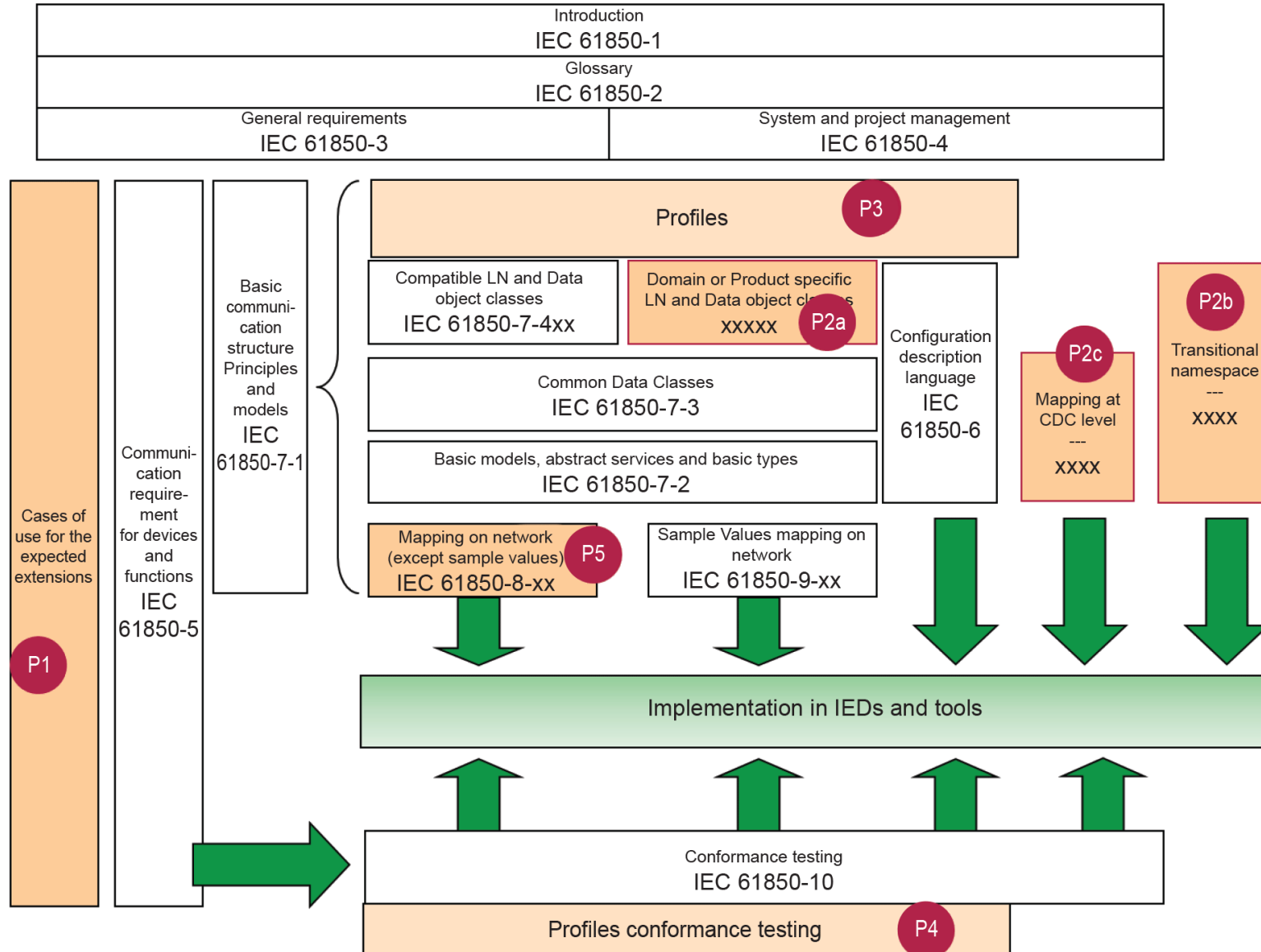
- The management of product-level standards for products that have an interface based on IEC 61850
- The management of domain-level standards based on IEC 61850
- The management of transitional standards based on IEC 61850
- The management of private namespaces based on IEC 61850
- The development of standards offering the mapping of IEC 61850 data model at CDC level
- The development and management of IEC 61850 profiles for domains (underlying the role of IEC TR 62361-103 and IEC TR 61850-7-6)

This document includes both technical and process aspects

IEC 61850 document structure



IEC 61850 document structure – impacts of extensions





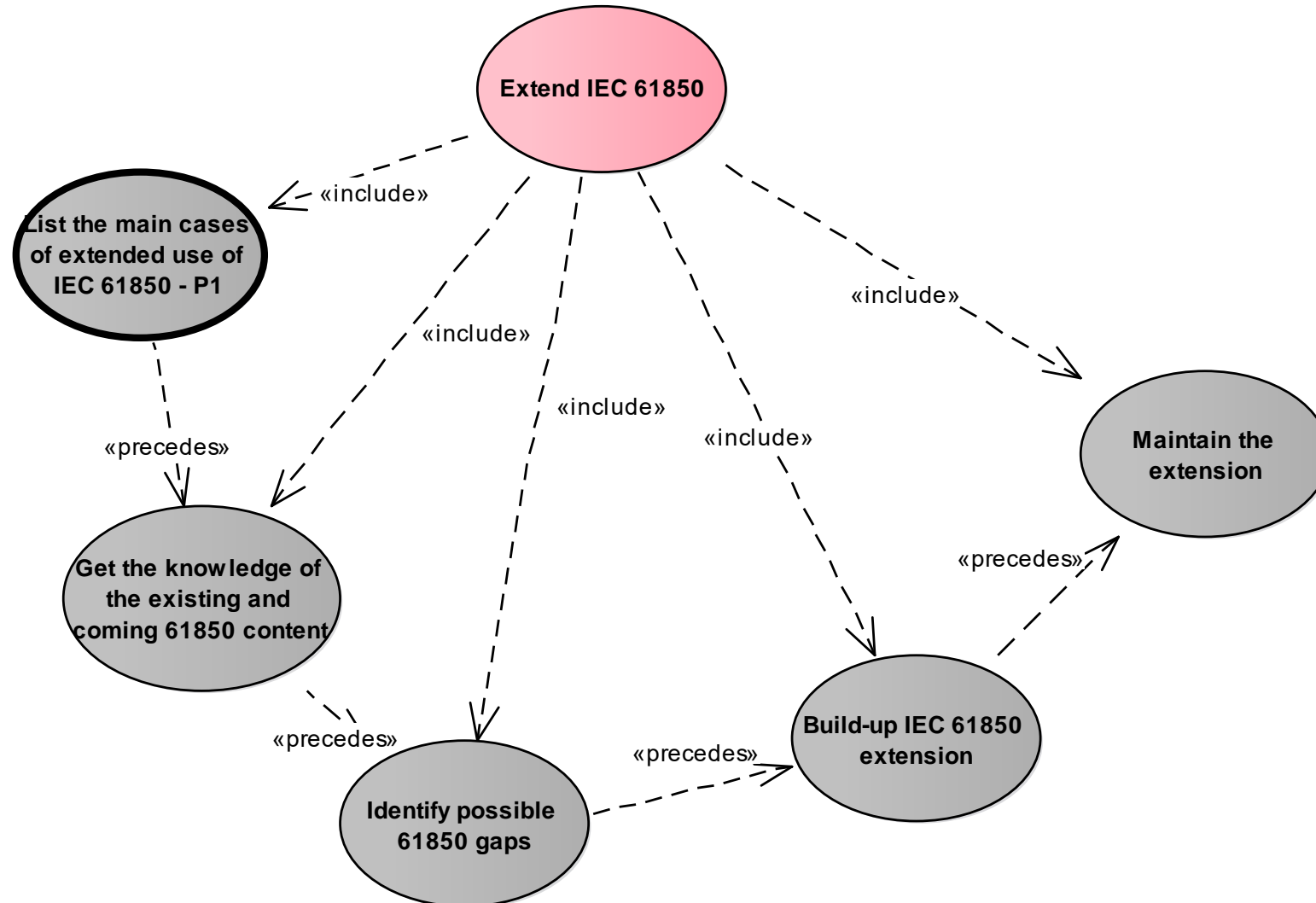
Typical IEC types associated to each extensions type

Delivery type	Typical content	Typical IEC type when delivered by IEC	Comments
P1	Cases of use of the expected extensions	TR, or informative annex	Express use cases from which to derive the extensions requirements
P2a	Domain or product specific LN and data object classes extensions (Domain or product namespaces)	IS or TS	
P2b	Transitional Namespace	TR	
P2c	Mapping at CDC level	IS or TS	May be even TR if still at “feasibility stage”
P3	Profiles of usage	IS, TS or TR	The IEC type depends on the maturity level of the expected usage of the standard
P4	Profile conformance testing	IS, TS or TR depending on the profile type	The IEC type depends on the maturity level of the expected usage of the standard
P5	SCSM	IS	



How to proceed for extending IEC 61850 ?

Typical steps for performing extensions

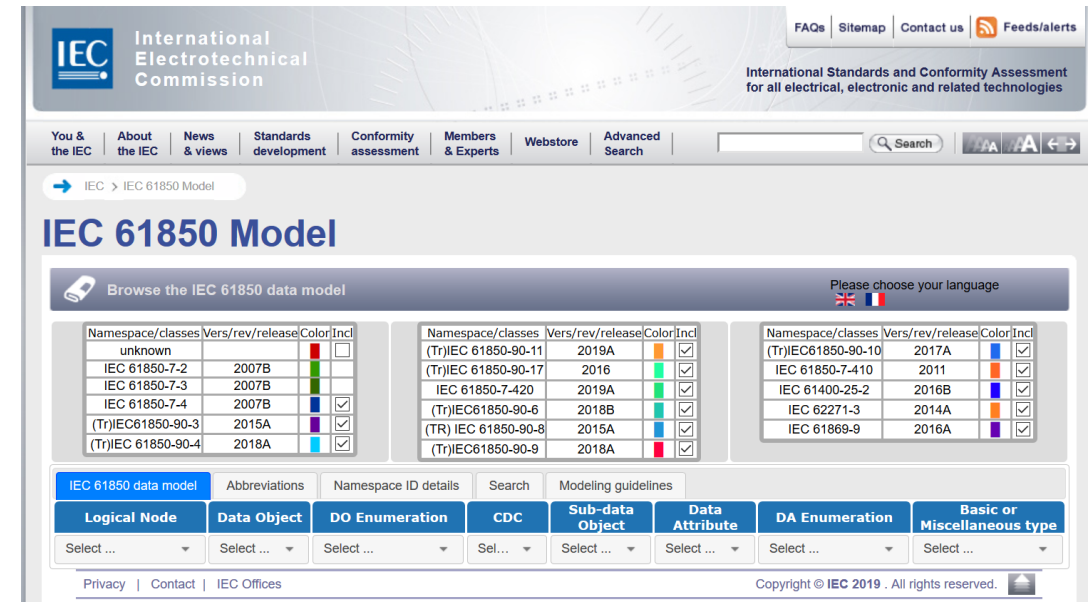


Main recommendations :

- **List the main use cases for extending IEC 61850 and derive from this the requirements :**
 - **following the IEC 62559 series approaches and tools (and the IEC 62913-1 methodology.**
 - **Such detailed description of use cases leads to better specification of the interface of the concerned products/functions/systems in the defined context.**
- **This may lead to the publication of an additional document summarizing all these use cases in a report as mentioned as P1.**

Main recommendations :



- This task is a prerequisite which may appear as common sense, but everyone should pay real attention, considering the increasing number of parts of the IEC 61850 series.
- It is important to consider that the coming standard contents may already provide preliminary answers to extensions requests, even if not yet finalized.
- In case of detection of a coming standard, the recommendation would be to liaise with the group in charge of the coming extension, and to find a way to express potentially some specific requirements
- The (future) web access may be a useful tool to perform such an assessment, enabling experts to cross all available namespaces within one tool.














International Electrotechnical Commission
International Standards and Conformity Assessment for all electrical, electronic and related technologies






IEC 61850 Model

Browse the IEC 61850 data model

Please choose your language:  

Namespace/classes	Vers/rev/release	Color	Incl
unknown			<input type="checkbox"/>
IEC 61850-7-2	2007B		<input type="checkbox"/>
IEC 61850-7-3	2007B		<input type="checkbox"/>
IEC 61850-7-4	2007B		<input type="checkbox"/>
(Tr)IEC61850-90-3	2015A		<input checked="" type="checkbox"/>
(Tr)IEC 61850-90-4	2018A		<input checked="" type="checkbox"/>

Namespace/classes	Vers/rev/release	Color	Incl
(Tr)IEC 61850-90-11	2019A		<input checked="" type="checkbox"/>
(Tr)IEC 61850-90-17	2016		<input checked="" type="checkbox"/>
IEC 61850-7-420	2019A		<input checked="" type="checkbox"/>
(Tr)IEC61850-90-6	2018B		<input checked="" type="checkbox"/>
(TR) IEC 61850-90-8	2015A		<input checked="" type="checkbox"/>
(Tr)IEC61850-90-9	2018A		<input checked="" type="checkbox"/>

Namespace/classes	Vers/rev/release	Color	Incl
(Tr)IEC61850-90-10	2017A		<input checked="" type="checkbox"/>
IEC 61850-7-410	2011		<input checked="" type="checkbox"/>
IEC 61400-25-2	2016B		<input checked="" type="checkbox"/>
IEC 62271-3	2014A		<input checked="" type="checkbox"/>
IEC 61869-9	2016A		<input checked="" type="checkbox"/>

IEC 61850 data model | Abbreviations | Namespace ID details | Search | Modeling guidelines

Logical Node | Data Object | DO Enumeration | CDC | Sub-data Object | Data Attribute | DA Enumeration | Basic or Miscellaneous type

Select ... | Select ... | Select ... | Sel... | Select ... | Select ... | Select ... | Select ...

Privacy | Contact | IEC Offices | Copyright © IEC 2019. All rights reserved.

<https://iec61850.iec.ch/webaccess/datamodel/>



Identify possible IEC 61850 gaps

- This activity reflects the needed assessment of the interface specification produced above, with the existing material provided by IEC 61850 parts, either available or coming.
- Stakeholders willing to work on IEC 61850 extensions are encouraged to get from their National Committee the latest release of the periodically published IEC 61850 publication (as INF) prior to any extensions works

WG	Title	Item	2018	2019	2020
10	x	WG 10 Meetings			
17	x	WG 17 Meetings			
18	x	WG 18 Meetings			
x		Editor Meetings			
10	x	Guideline for extending IEC 61850	CD	DTS	
10	x	System and project management			FDIS
10	x	Communication requirements for functions and device models		CDV Ed 2.1	FDIS
10	x	Configuration description language extensions for human machine interfaces	CD		DC2
10	x	Guideline for function modeling in SCL for substation automation		DC	DC2
10	x	Basic communication structure – Principles and models		CDV Ed 2.1	FDIS
10	x	Abstract communication service interface (ACSI)		FDIS	
10	x	Common data classes		FDIS	
10	x	Compatible logical node classes and data classes		FDIS	
18	x	Hydroelectric power plants - Communication for monitoring and control		PR	CD
17	x	Communications systems for distributed energy resources (DER) - Logical nodes	DC2	CDV	FDIS
10	x	IEC 61850 modelling concepts			DC1
18	x	Hydroelectric plants – Modelling concepts and guidelines			DTR Ed 2
17	x	DER - Modelling concepts and guidelines			DC2
10	x	Mappings to MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and to ISO/IEC 8802-3		FDIS	DTR
17	x	Mapping to Webservices	FDIS		
10	x	Sampled values over ISO/IEC 8802-3		FDIS	
10	x	Conformance testing			CDV Ed 2.1
10	x	Functional testing of IEC 61850 based systems		DC2	DC3
10	x	Mapping between Modbus and IEC 61850			DC2
10	x	Network engineering guidelines for substations		DTR	DTS
17	x	Object models for electrical energy storage	DC2	DTR	
10	x	Methodologies for modelling of logics for IEC 61850 based applications	DC2	DTR	
10	x	Wide area network engineering guidelines		DTR	
10	x	Deterministic network topologies			DC
10	x	Using IEC 61850 for FACTS and power conversion data modelling			DC2
17	x	IEC 61850 based DER Grid Integration			DC
17	x	Requirements for System Management	DC1		DTR
10	x	Modeling Alarmhandling for IEC 61850		DC	
10	x	Applying role based access to IEC 61850			DC
10	x	Guideline for redundant IEDs with IEC 61850		DC	DC2
10	x	Use of IEC 61850 for traveling wave fault location system		DC	DC2
10	x	Network autorouting	PWI		DC
17	x	Model extensions to IEC 61850 to support microgrids			DC
15	x	Mapping of IEC 62351-7 on IEC 61850			
10	x	Model update based on users feedback			
10	x	IED Specification description			
17	x	Model for (distributed) thermal energy		PWI	DC
x		Note: PR is the proposal to NC to start modification			



Build-up IEC 61850 extensions

- This activity reflects the need to express the identified gaps listed above into a proposal **complying with the extension basic requirements.**
- In case code components are included in the targeted publication, the IEC code components rules and processes shall apply, as described in the IEC “Guidelines for code components” document available at <http://www.iec.ch/tc57/supportdocuments>



Basic requirements for any extensions (no options)

Aspects covered by the document

- Intellectual property requirements
- Editorial Recommendations
- Data Model extension requirements
- XML namespace extensions
- Cyber-security requirements
- Conformance Testing requirements
- Maintenance of standard extension document
- Backward compatibility treatment



List of flexibilities offered by the IEC 61850 standard

■ Data Model flexibilities

- Extending existing LNs with new DOs
- Extend abstract LNs
- Create new LNs
- Deprecate existing LNs
- Re-use of existing DOs enumeration with extension
- Extending existing CDCs with new attributes (DA)
- Create a new CDC
- Extending existing DAs enumeration
- Making more stringent the DO presence conditions on existing LNs
- Making less stringent the DO presence conditions on existing LNs
- Deprecate the presence of a DO in a LN
- Making more stringent the DA presence conditions on existing LNs
- Making less stringent the DA presence conditions on existing CDCs
- Defining rules for LN prefix/suffix
- Defining rules for LD arrangements

■ Communication services

- Extending the ACSI
- Providing a new SCSM
- Extending negative control feedback for a better handling of unexpected situations

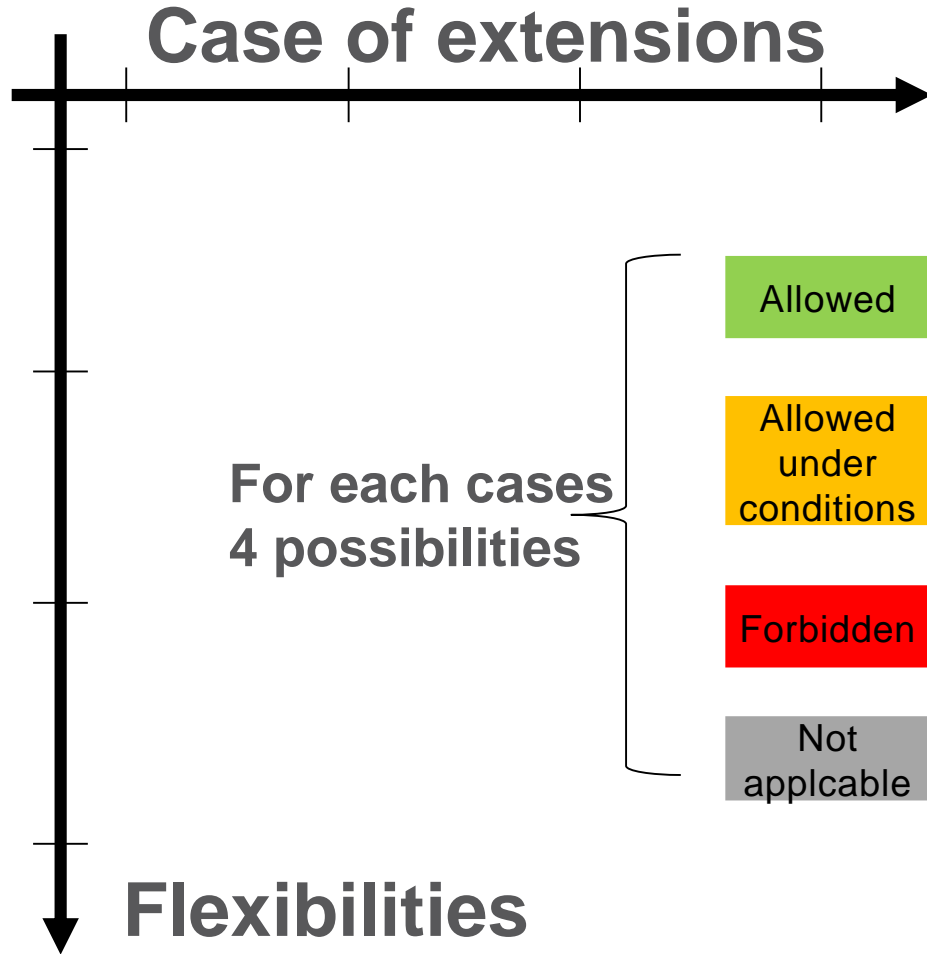
■ SCL language

- Extending the SCL grammar (XSD) with SCL new tags or attributes
- Extending the SCL grammar (XSD) through the private section
- Extending the SCL grammar (XSD) with tags or attributes coming from another XML namespace

IEC 61850 flexibility definition :
option or user-free area
stated as such in the IEC 61850 standards

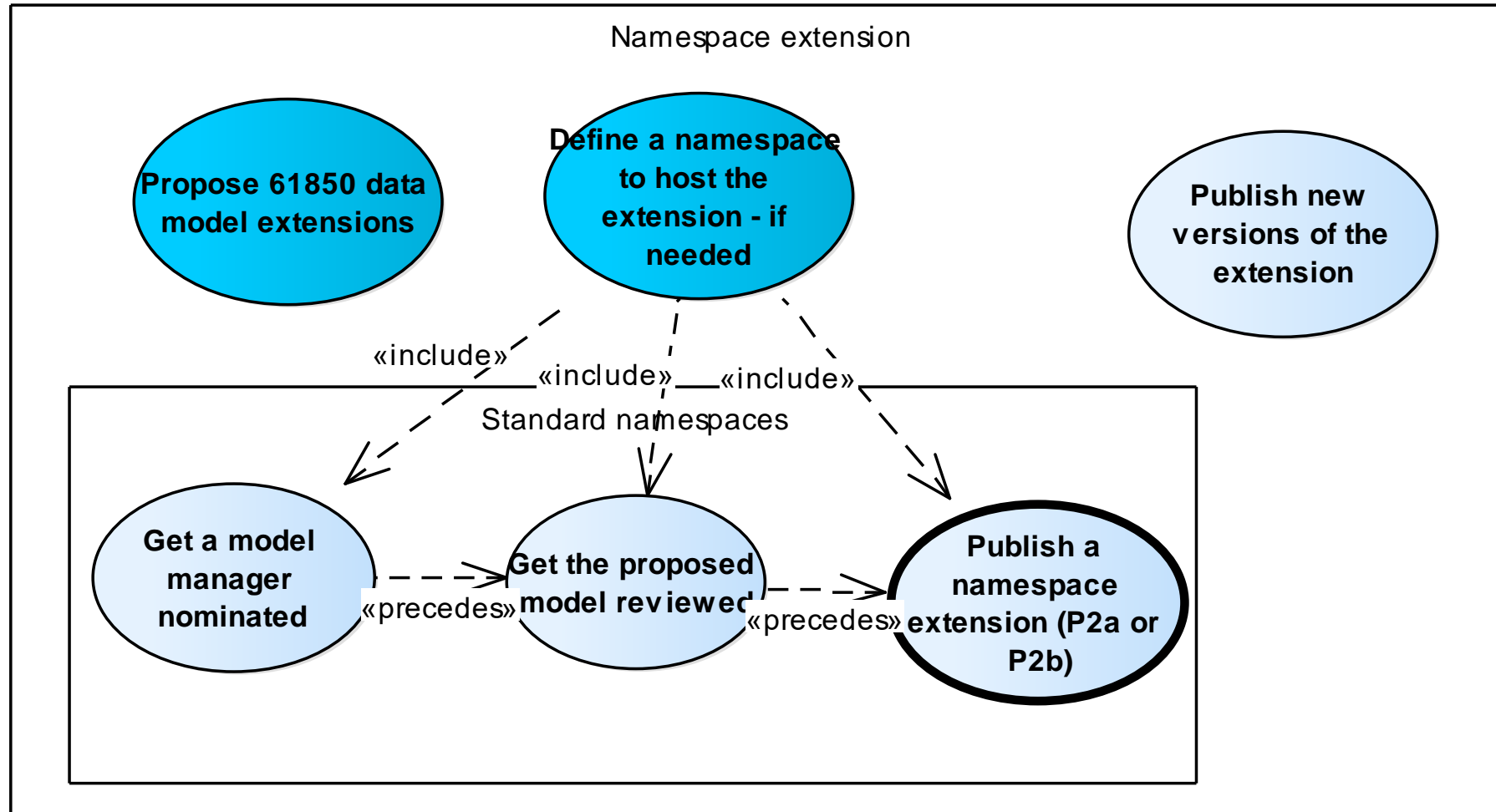


Allowed flexibilities per case of extensions

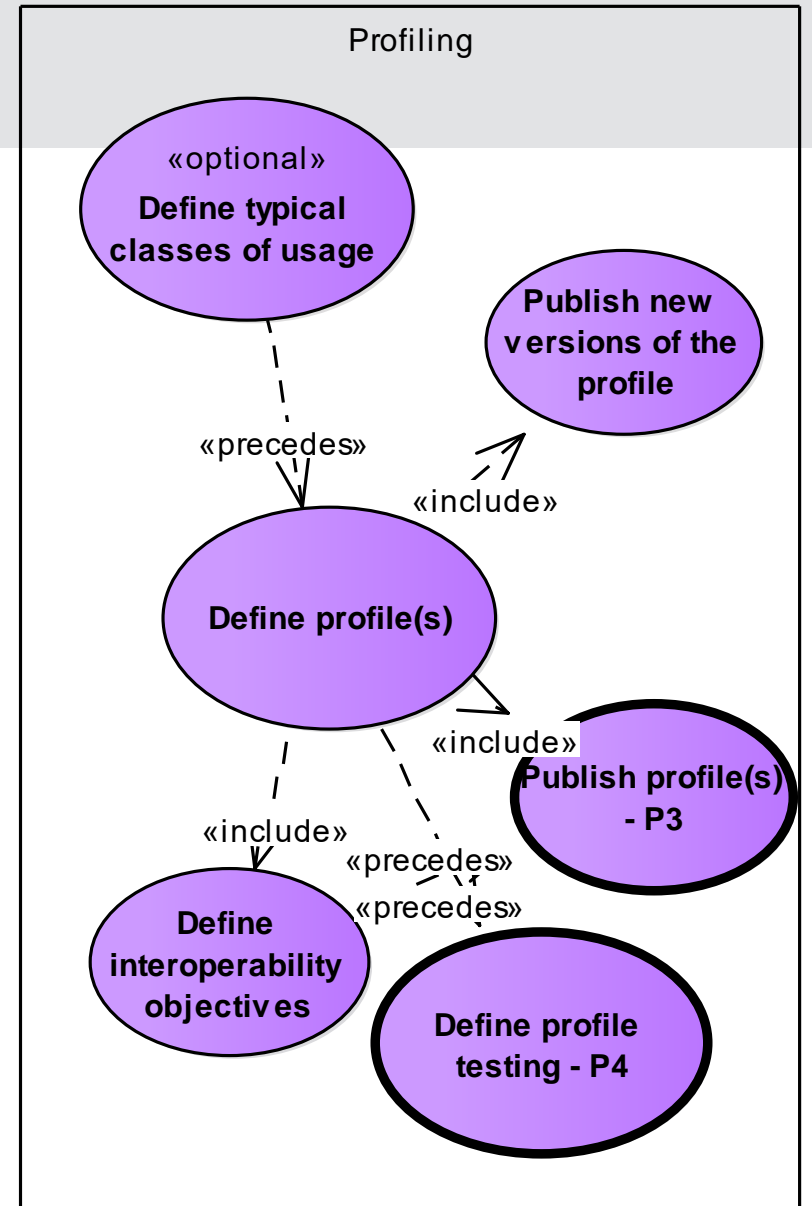


Extension case	Transitional namespaces	Domain namespaces	Private namespaces	Product-level standards	IEC 61850 profiles for domains	Mapping at CDC level
Data Model						
Extending existing LNs with new DOs	Allowed following DO naming rules	Allowed following DO naming rules	Allowed following DO naming rules	Allowed following DO naming rules within the scope of the product functions	Forbidden. If needed, refer to namespace rules	Not applicable
Create new LNs	Allowed following LN/DO naming rules	Allowed following LN/DO naming rules	Allowed following LN/DO naming rules	Allowed following LN/DO naming rules within the scope of the product functions	Forbidden. If needed, refer to namespace rules	Not applicable
Deprecate existing LNs	Allowed only by the owner of the namespace	Allowed only by the owner of the namespace	Allowed only by the owner of the namespace	Allowed only by the owner of the namespace	Forbidden. If needed, refer to namespace rules	Not applicable
Extending existing DOs enumeration	Allowed under specific conditions and a specific process ¹	Allowed under specific conditions and a specific process ²	Allowed in negative ranges	Allowed under specific conditions and a specific process ³	Forbidden. If needed, refer to namespace rules	Not applicable
Extending CDC with new attributes (DA)	Forbidden	Forbidden	Forbidden	Forbidden	Forbidden	Not applicable
Create a new CDC	Allowed under a specific process	Forbidden	Forbidden	Forbidden	Forbidden	Not applicable
Extending existing DAs enumeration	Allowed under a specific process	Forbidden	Allowed in negative ranges	Forbidden	Forbidden	Not applicable
Making more stringent the DO presence conditions on existing LNs	This DO should be tagged as "namespace specific"	This DO should be tagged as "namespace specific"	Forbidden	This DO should be tagged as "namespace specific"	Allowed	Forbidden
Making less stringent the DO presence conditions on existing LNs	Forbidden	Forbidden	Forbidden	Forbidden	Forbidden	Forbidden
Deprecating DOs from existing LNs	Allowed	Allowed	Forbidden	Allowed	Forbidden	Forbidden
Making more stringent the DA presence	In some very specific cases	In some very specific cases	Forbidden	In some very specific cases	Allowed	In some very specific cases

How to proceed with building-up a namespace extension ?



- A profile is an agreed-upon subset of derived from a specification
- Note : A common profile is required for achieving interoperability especially in those cases when a specification could have more than one interpretation and there are probably many optional features. Refer to IEC TR 62361-103 and IEC TR 61850-7-6 for more in-depth content on profiles and profiling.





Maintain IEC 61850 extensions

- a IEC 61850 extension is by nature a living one
- It needs the establishment of the appropriate maintenance process (and associated resources) of the initial content, as soon as it is published.
- the body which produces the extension shall ensure that the process(es) to receive comments (issues) from stakeholders, to improve/correct the content and therefore manage versioning and associated publication are in place at the time of the first publication.

- **Rules :**
 - **a deprecated element is shown as deprecated in the edition where the decision to deprecate is expressed,**
 - **a deprecated element should be kept present in any associated amendment and corrigenda of the same edition**
 - **a deprecated element should be removed in the editions which follows (in order to confuse the users and/or encourage some remaining usages of the deprecated element.**

- Each extension shall specify explicitly potential compatibility issues of this edition with previous editions of the same extension, or other parts of the IEC 61850 series, and explain ways to mitigate such issues.
- A global assessment should be considered based on forward and backward compatibility and from the view of the owner of user of information

Typical compatibility assessment

	Information owner	Information user
Forward compatibility		
Backward compatibility		

- **The commitment of IEC TC57 to open IEC 61850 extensions is becoming concrete :**
 - **By clear right and duties**
 - **With a clear set of technical rules**
 - **With a recommended process to follow, covering all phases from requirements to end of life**

ANY QUESTIONS ?

Annex :

**Main cases of extensions
(details)**

Per type of namespaces what are the main high level requirements attached to the creation of such namespace.

- **Domain namespaces (IS possibly TS) :** include the basic namespaces plus the needed extensions required to meet their domain specific application. In order to comply with “long” stability constraint, it is highly recommended to have any new content initially exposed as transitional namespaces.
- **Product standard namespaces :** Product standard namespaces are designed as close as possible from the product knowledge, i.e. within the product standardisation committee, with the ambition to provide through extensions the most comprehensive product data model. Extensions concerns :
 - **“Product characteristics”** (typically including nameplate) related information
 - **“Product specific LNs”** to depict product specific functions interfaces

Main cases of extensions (2/2)

Per type of namespaces what are the main high level requirements attached to the creation of such namespace (followed).

- **Transitional namespaces (usually a status of TR):** Some specific requirements are attached to transitional namespace, especially due to the fact that potential incompatibilities may occur at the time of their (possible) integration into an IS document. By nature, conformance testing does not apply to transitional namespaces.
- **Private namespaces :** Private namespaces are namespace extensions defined by third parties,

IEC 61850 profiles for domains

- an agreed-upon selection of flexibilities, as defined in technical rules, where some more stringent rules may apply -> built with the purpose of increasing the IEC 61850 interoperability in a defined context

Mapping of IEC 61850 data model to other protocols at CDC level

- These extensions provide additional rules to convey information, as modelled in IEC 61850 onto different protocols, not supporting the communication services as defined in Part 7-2. Typical examples are IEC TS 61850-80-1, IEC TS 61850-80-4 or IEEE 1815.1.