IEC TS 61850-1-2

Edition 1.1   2022-07
CONSOLIDATED VERSION

TECHNICAL
SPECIFICATION

colour
inside

**Communication networks and systems for power utility automation –
Part 1-2: Guideline on extending IEC 61850**

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INTERNATIONAL
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COMMUNICATION NETWORKS AND SYSTEMS
FOR POWER UTILITY AUTOMATION –

Part 1-2: Guidelines on extending IEC 61850

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC TS 61850-1-2 edition 1.1 contains the first edition (2020-06) [documents 57/2084/DTS and 57/2145/RVDTS] and its amendment 1 (2022-07) [documents 57/2370/DTS and 57/2408/RVDTS].

IEC TS 61850-1-2 has been prepared by IEC technical committee TC 57: Power systems management and associated information exchange. It is a Technical Specification.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61850 series, published under the general title *Communication networks and systems*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under webstore.iec.ch in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 1-2: Guidelines on extending IEC 61850

1 Scope

This part of IEC 61850, which is a technical specification, is intended for any users 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. This document identifies the required steps and high-level requirements in achieving such extensions of IEC 61850 and provides guidelines for the individual steps.

Within that scope, this document addresses the following cases:

- 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:

On the technical side, this document:

- Highlights the main basic requirements (mostly referring to the appropriate parts of the series which host the requirements or recommendations)
- Lists all possible flexibilities offered by the standards
- Defines which flexibilities are allowed/possible per type of extension cases

On the process side, the document covers:

- The initial analysis of how the existing IEC 61850 object models and/or communication services may be applied and what allowed extensions may be required for utilizing them in new or specific domains (including private ones). The results of that step are expected to be documented
- The extension of the IEC 61850 object models for new domains. 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
- The purpose and process to use transitional namespaces, which are expected to be merged eventually into an existing standard namespace
- The management of standard namespaces
- The development of private namespaces

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61400-25 (all parts), *Wind energy generation systems – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models*

IEC 61850-8 (all parts), *Communication networks and systems for power utility automation*

IEC TR 61850-1, *Communication networks and systems for power utility automation – Part 1: Introduction and overview*

IEC TS 61850-2, *Communication networks and systems for power utility automation – Part 2: Glossary*

IEC 61850-5, *Communication networks and systems for power utility automation – Part 5: Communication requirements for functions and device models*

IEC 61850-6, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs*

IEC 61850-7-1, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and models*

IEC 61850-7-2, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC TR 61850-7-6, *Communication networks and systems for power utility automation – Part 7-6: Guideline for definition of Basic Application Profiles (BAPs) using IEC 61850*

IEC TS 61850-7-7, *Communication networks and systems for power utility automation – Part 7-7: Machine-processable format of IEC 61850-related data models for tools*

IEC 61850-8-1, *Communication networks and systems for power utility automation – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

IEC TS 61850-80-1, *Communication networks and systems for power utility automation – Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104*

IEC TS 61850-80-4, *Communication networks and systems for power utility automation – Part 80-4: Translation from the COSEM object model (IEC 62056) to the IEC 61850 data model*

IEC 61850-9 (all parts), *Communication networks and systems for power utility automation*

IEC 62271-3:2015, *High-voltage switchgear and controlgear – Part 3: Digital interfaces based on IEC 61850*

IEC 61869-9, *Instrument transformers – Part 9: Digital interface for instrument transformers*

IEC TR 62361-103, *Power systems management and associated information exchange – Interoperability in the long term – Part 103: Standard profiling*

IEC 62351 (all parts), *Power systems management and associated information exchange – Data and communications security*

IEEE 1815.1, *Standard for Exchanging Information between networks Implementing IEC 61850 and IEEE Std 1815™ (Distributed Network Protocol – DNP3)*

"Guidelines for code components" *document accessible at:*
https://www.iec.ch/tc57/supportdocuments

3   Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

**3.1
code component**
part of a standard document which has to be copied/modified from the IEC publication by any potential users of the standards.

Note 1 to entry: Code components are components included in IEC standards that are intended to be directly processed by a computer and also includes any text found between the markers <CODE BEGINS> and <CODE ENDS>, or otherwise clearly labelled in this standard as a code component.

**3.2
namespace**
domain in which any name and its related information is univocal

**3.3
IEC 61850 basic namespace**
data model namespace hosted in the IEC 61850 core standard (namely related to IEC 61850-7-2, IEC 61850-7-3, IEC 61850-7-4 parts)

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

Note 2 to entry: The 61850-7-4 namespace content may be revised in future in order to discriminate the elements which are generic from the ones which are substation specific.

**3.4
IEC 61850 domain namespace**
data model namespace which extends IEC 61850 with the purpose of better supporting an application domain

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

3.5
IEC 61850 product namespace
data model namespace which extends IEC 61850 with the purpose of better supporting a specific product (like switchgear) or function (like metering)

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

3.6
IEC 61850 private namespace
private data model namespace which extends IEC 61850 with the purpose of better supporting a private implementation or specification of IEC 61850

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

3.7
IEC 61850 transitional namespace
data model namespace which has the goal to expose a proposed extension of the data model to the market, before being formally embedded into a standard (product, domain or basic) namespace

Note 1 to entry: Refer to IEC 61850-7-1, "Namespace".

Note 2 to entry: Transitional namespaces are supposed to have a limited time life, their future being to be integrated into standard namespaces (or standard namespace extensions). At the time of the integration of transitional namespace into the concerned standard parts, backward compatibility may be broken to take into account market feedbacks.

3.8
IEC 61850 core standard
standard from the following list: IEC 61850-5, IEC 61850-6, IEC 61850-7-1, IEC 61850-7-2, IEC 61850-7-3, IEC 61850-7-4, IEC 61850-8-x, IEC 61850-9-x

3.9
IEC 61850 flexibility
option or user-free area stated as such in the IEC 61850 standards

3.10
IEC 61850 extension
additional element or requirement, taking advantage of the IEC 61850 flexibilities, and which therefore goes beyond the original definition/mandatory requirements of IEC 61850 as stated in the IEC 61850 standards

Note 1 to entry: Typical extensions of IEC 61850 are new namespaces, including new LNs, and/or new data objects, or more stringent requirements for presence of DOs/Attributes than required by the IEC 61850 core standards, additional rules for naming LN prefixes, LDs, IEDs, etc.

3.11
model managers team
team within the IEC in charge of handling/maintaining the IEC 61850 model throughout the different IEC publications and the different IEC entities, and in charge of preserving its consistency, as well as its backward compatibility

3.12
profile
agreed-upon subset of requirements derived from a specification

Note 1 to entry: 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.

3.13
tissue
technical issue related to an IEC 61850 part

3.14
deprecation (of an element of a given model)
action consisting in tagging this element specifically in order to discourage future usage of this element

Note 1 to entry: The deprecation of an element implies the deprecation of all included sub-elements.

Note 2 to entry: A deprecation is often the latest stage before withdrawing a given element.

Note 3 to entry: Once deprecation has applied to an element, this element is tagged as "deprecated".

Note 4 to entry: Deprecation may apply to any types of element of the model, including (but not restricted to) attribute, class, object, abbreviation, enumerated element, package, namespace.

4   Key principles reminder

4.1   General

This clause summarizes some main IEC 61850 principles needed for understanding of the rest of the document.

4.2   Namespace introduction

4.2.1   General

Considering that namespaces can be handled by multiple entities, which can evolve over time at different speeds, IEC 61850 introduced the following namespace concepts and requirements from the beginning (Refer to IEC 61850-7-1, "Namespaces" (Clause 13 in Edition 2, Amendment 1[1]):

- The concept of namespaces: namespaces are largely used and widespread in the IT world to organize the names or identifiers of data types, data objects, functions, etc. into logical sets in order to prevent name collisions that can occur when these are being defined in parallel. In the specific case of IEC 61850, namespaces are a defined but structured collection of logical nodes (LN), data objects and potentially common data classes (CDC) and attributes. Each IEC publication which extends the IEC 61850 data models shall have its own namespace. Each private extension of IEC 61850 shall also have its own namespace. Each namespace has a unique "machine" name, i.e. a name which can be used by a machine to uniquely refer to the semantic attached to a data.

- The concept of namespace owner: IEC TC 57 is the owner of the basic namespaces contained in the IEC 61850 core data object model standards.

- The ability to clearly state and tag which namespace a data object is contained in, through a specific attribute.

- Strict rules for managing/expanding namespaces: rules are provided to allow third parties to make extensions to a data object model standard in a way that does not jeopardize interoperability.

Namespaces are chained together, i.e. dependencies have been established between namespaces.

Basically, there are 5 types of namespaces (as per current IEC 61850-7-1 "Namespaces" clause content):

- **Basic namespaces** contain definitions of the basic classes from which are built all other namespaces, namely IEC 61850-7-2; IEC 61850-7-3; IEC 61850-7-4.

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[1]   Under preparation. Stage at the time of publication: IEC/TFDIS 61850-7-1/AMD1:2019.

- **Domain namespaces** include Parts 7-4xx of the IEC 61850 series, and possibly other namespaces hosted in dedicated standards or technical specifications such as IEC TS 61850-80-4 and the IEC 61400-25 series.

- **Product standard namespaces** typically contain the nameplate detailed information model but can also be broader than specific products. IEC 62271-3:2015 for switchgears or IEC 61869-9 for merging units are typical examples of product namespaces.

- **Transitional namespaces** are used in technical reports such as the 90-xx parts of the IEC 61850 series. These technical reports may extend any of the basic namespaces (IEC 61850-7-2, IEC 61850-7-3 and IEC 61850-7-4) as well as any domain namespaces. They specify extensions that are expected to be included eventually as part of the basic or domain namespaces in IEC 61850.

- **Private namespaces** are developed to provide a private data model extension (i.e. a set of non-standardized data object added to the standard one). They may be constructed to include standard common data classes from the standard namespaces or from the standard namespace extensions. They are expected to be managed by the entity (company) which produced them.

NOTE   Private namespaces are of great interest in the standardization process because they can often identify some standardisation gaps that should be filled. Therefore, it is expected that some portions of private namespaces will be proposed as "addendums" to the IEC process.

4.2.2   Basic namespaces

4.2.2.1   General

The basic namespaces of the IEC 61850 series, defined in Parts 7-2, 7-3 and 7-4, contain a collection of standard logical nodes, data object classes, common data classes and attributes defining at least:

- its wording (exact spelling)

- its semantic (meaning and possibly also the meaning of each of the states this data may take)

- its type and structure

- its presence conditions

4.2.2.2   Logical nodes (LNs) and their objects classes included in the basic namespace

Over 280 logical nodes (LNs) are defined in the IEC 61850 basic namespaces and cover the most common applications of the domains covered by the IEC 61850 series. While original focus has been on substation automation, the common applications also include many other functions like monitoring, measurement, control, and power quality that are important for many other domains. These logical nodes are defined in IEC 61850-7-4.

Most logical nodes provide information (data object and data attributes) that can be categorised in six categories:

- Descriptions

- Common logical node information

- Status information

- Settings

- Measured values

- Controls

The data object and attribute names are standardized ones (i.e. they are built from standardized acronyms) that have a specific semantic in the context of the IEC 61850 series.

Finally, the semantic of a logical node is represented by the data objects and data attributes it contains.

4.2.2.3   Common data classes (CDCs)

The whole set of all the data attributes defined for a data object is based on predefined types and structures called "Common Data Classes" (CDCs) which can be seen as defining the "internal data structure template" of data objects.

IEC 61850-7-3 defines common data classes for a wide range of well-known applications. The core common data classes are classified into the following groups:

- status information,
- measurand information,
- controllable status information,
- description information
- controllable analogue information,
- status settings,
- analogue settings and
- description information settings

5   Main cases of extensions of IEC 61850

5.1   Namespace extensions and associated rules

5.1.1   General

This clause lists per type of namespaces the main high-level requirements attached to the creation of such namespace.

5.1.2   Domain namespaces

Formally domain namespaces include the basic namespaces plus the needed extensions they require to meet their domain application requirements. They are produced by International Standardization Bodies. Standard namespaces have usually a status of IS or possibly TS. In order to comply with IS (or TS) stability constraint, it is highly recommended to have any new content initially exposed as transitional namespaces.

Refer to IEC 61850-7-1 "Specification of Name Spaces" (Subclause 13.5 in Edition 2, Amendment 1).

5.1.3   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.

The nature of LN extensions shall only be the addition of new optional or mandatory data objects and possibly LNs limited to:

- "Product characteristics" (typically including nameplate) related information. These extensions may be located in the LPHD LN or in any product related LNs, i.e. any LN containing the data object EEName. "Product characteristics" information should be modelled in a way it allows machine processable treatment.
- Product specific LNs to depict product specific functions interface

The new data objects classes shall be assigned to any common data class defined in IEC 61850-7-3.

5.1.4 Transitional namespaces

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.

Transitional namespaces usually have a status of TR or in some cases TS.

Refer to IEC 61850-7-1 "Specification of Name Spaces" (Subclause 13.5 in Edition 2, Amendment 1).

By nature, conformance testing will not be applied to transitional namespaces.

5.1.5 Private namespaces

Private namespaces are namespace extensions defined by third parties, i.e. not refer to IEC 61850-7-1 "Name Spaces" (Clause 13 in Edition 2, Amendment 1), as well as the clause "Private extension" of the same part (Subclause 14.3 in Edition 2, Amendment 1).

5.2 IEC 61850 profiles for domains

An IEC 61850 profile is an agreed-upon selection of flexibilities, as defined in 6.2, where some more stringent rules may apply, and which is built with the purpose of increasing the IEC 61850 interoperability in a dedicated context (refer to IEC TR 62361-103 for further elements on profiling).

Such a profile may build from building blocks called "Basic Application profile" as defined in IEC TR 61850-7-6.

Thus a profile shall define explicitly the list of selected flexibilities, and the "additional" rules associated with these one, typically:

- Consider an LN class presence as required, possibly attached with a (partially or totally) predefined prefix name and/or predefined suffix number
- Consider a DO presence as required, where the standard only defines it as optional
- Consider a DA presence as required, where the standard only defines it as optional
- Etc.

A first example is the IEC TR 61850-90-17 related to the profile defined to characterise the use of IEC 61850 in the specific context of IEC 61000-4-30 (power quality standard).

5.3 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.

6 What to extend in relation with IEC 61850?

6.1 List of basic requirements

6.1.1 General

This clause tries to identify all requirements which have to be considered whatever the considered case of extension.

6.1.2 IEC 61850 structure reminder

IEC 61850 is made of many parts which need to be clearly understood. These parts are organized as presented in Figure 1 (Figure extracted from IEC 61850-1):
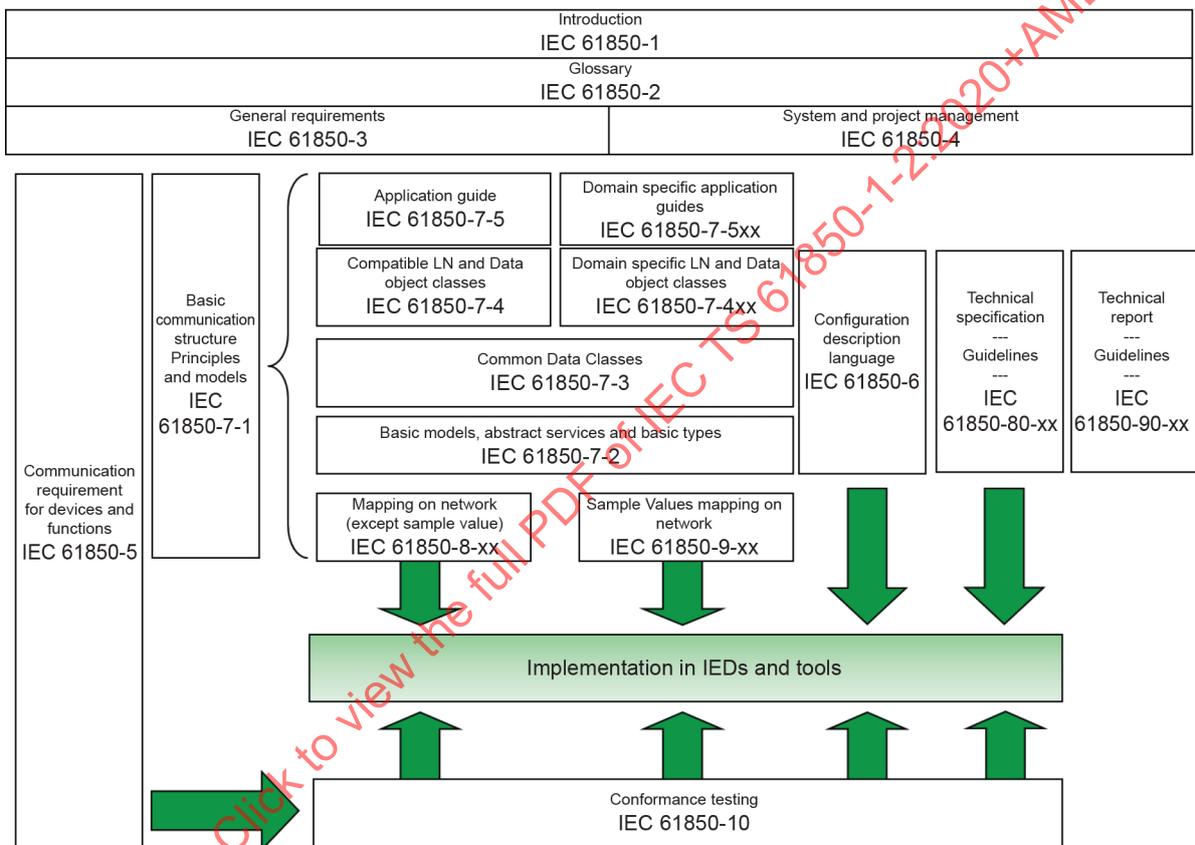
Figure 1 – IEC 61850 documentation structure

These parts may have different states depending on their level of maturity:

- Standard and available as IS or TS: the core parts together with the domain namespaces.

- Transitional and available in TR: mostly grouped into the IEC 61850-90-xx series.

- Coming: a lot of activities are on-going, and it is important to consider all the on-going works to ensure maximum consistency; a roadmap is published an internal INF document by IEC on a regular basis of on-going activities and coming extensions related to IEC 61850. An example is given in Annex A.

Already published parts may also be updated by tissues, and these fixes need also to be considered (refer to IEC TR 61850-1 for more details on IEC 61850 maintenance process[2]).

6.1.3   Main deliverables and their positioning in IEC 61850 documentation structure
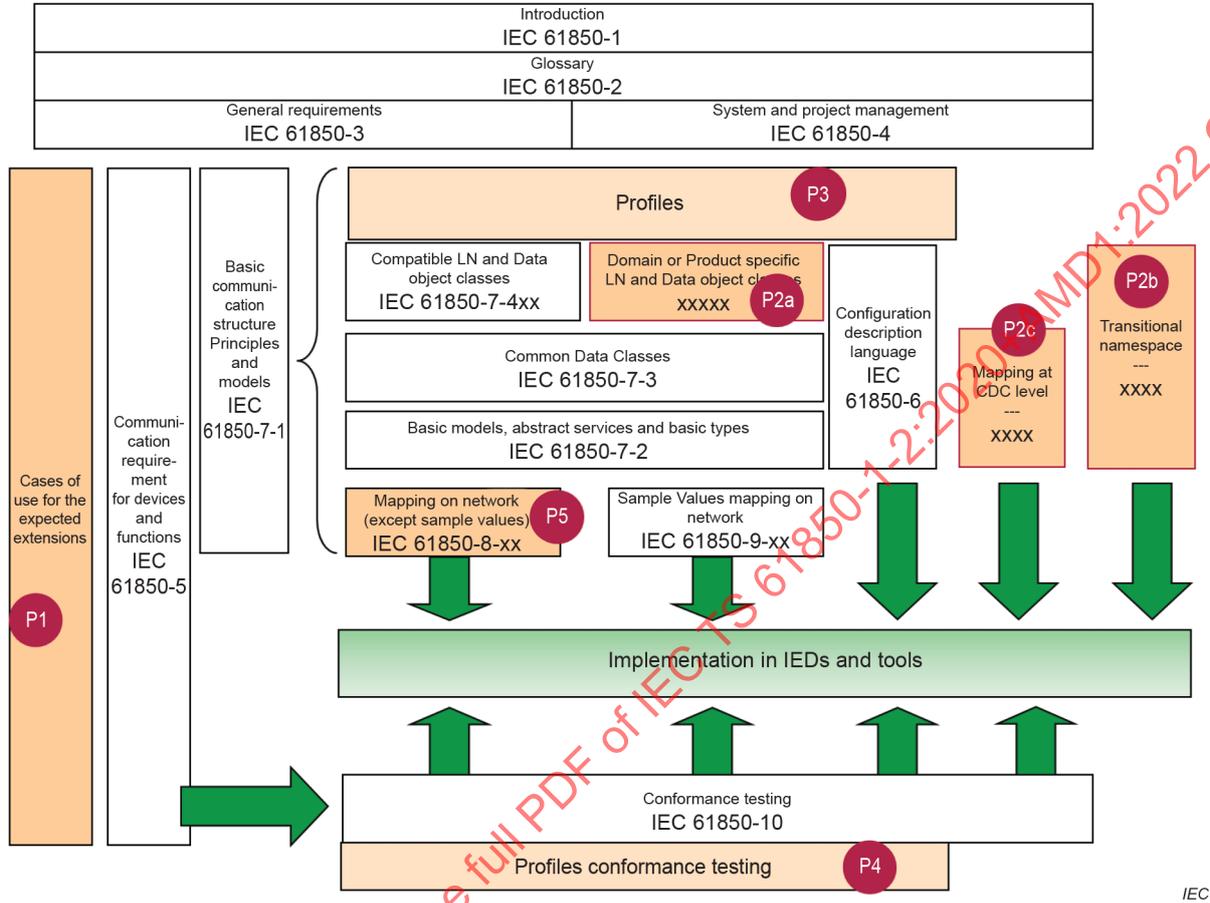
Figure 2 – Extensions deliverables positioned in the IEC 61850 document structure

The diagram shown in Figure 2 highlights the possible "extensions" as introduced in Clause 5, and their positions in the IEC 61850 documents structure.

Table 1 provides additional details for these deliverables:

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[2]   The description of the Tissue process should be part of a future IEC publication.

Table 1 – Typical deliverables attached to IEC 61850 extensions

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	

6.1.4 Intellectual property requirements

6.1.4.1 General

Intellectual Property requirements are important to be considered as soon as a work intends to start reusing IEC 61850 content totally or partially.

As is true for all IEC publications, the IEC 61850 series is copyright protected: "Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester."

6.1.4.2 Code component publication rules applying to IEC publications

Specific licensing conditions shall apply in the case where the IEC 61850 extension standard document includes code components which provide the users with extra conditions for duplicating, modifying and re-distributing these "code components". The IEC has developed these specific licensing conditions to apply to IEC 61850-related publications.

In the case of IEC publications, at the earliest feasible stage in the development process (typically at the CD or DC stage), the editor of the document should screen the contents and identify all "code components" elements contained in the targeted standard document.

Then a specific process needs to be defined and specific rules need to apply to:

- Get the authorization by IEC to apply these specific licensing conditions
- Tag properly the code components
- Include the copyright and licensing conditions in all related deliverables
- Publish the code component, possibly through separated machine processable files, possibly with free access or subscription-type access

These specific rules and processes are available within the latest version "Guidelines for code components" document accessible at https://www.iec.ch/tc57/supportdocuments.

6.1.5   Editorial Recommendations

6.1.5.1   Document structure

In order to facilitate the potential ultimate merger of namespace extensions into the IEC 61850 series, it is highly recommended that the extension publications follow the IEC 61850 document structure, i.e.:

- Clause 1 Scope

- Clause 2 Glossary

- Clause 3 General requirement
  Potentially Business use cases

- Clause 4 Project and system management (aspects related to ...)

- Clause 5 Communication requirements (detailed)
  Potentially system use cases

- Clause 6 SCL language (impacts) (XML Namespace if any)

- Clause 7 Data models (Namespace if any)

- Clause 8 and 9 SCSM related specification (if any)

- Clause 10 Testing requirements (if any)

6.1.5.2   Document introduction

As soon as code components are attached to the deliverables some "legal" specific information need to be added to the foreword (refer to section 5 of the guidelines document for handling code component as introduced in 6.1.4.2).

It is highly recommended to have namespace related information (see 6.1.6.2) included in Clause 1 of any IEC concerned publication (part of the scope).

More specifically, Clause 1 of such document should be broken down as below:

- Clause 1: Scope

- Subclause 1.1: General.

  As usual …

- Subclause 1.2:

  In Clause 1, "Scope", a Subclause 1.2 "Published versions of this standard and related namespace name" shall be added with a table that provides a reference between all IEC editions, amendments or corrigenda and the full name of the namespace as shown in Table 10.

**Table 10 – Reference between published versions
of the standard and related namespace name**

Edition	Publication date	Webstore	Namespace NSD
Edition 1.0	2003-05	IEC 61850-7-3:2003	IEC 61850-7-3:2003
Edition 2.0	2010-12	IEC 61850-7-3:2010	IEC 61850-7-3:2007

If the deliverable includes more than one namespace, additional columns shall be added.

- Subclause 1.3: Identification of the namespaces included in this IEC deliverable

  For all the namespaces, the following information shall be provided:

  - The nameplate of the namespace with identifier, version, revision and release and associated code components

  - Namespace dependencies

Depending on the namespace technology, additional information may be provided (see 6.1.6.2 for further details related to data model namespaces and to 6.1.7 for XML namespaces)

- Subclause 1.4 "Code component distribution"

As soon as at least one code component is present in an IEC deliverable, a Subclause 1.4 "Code component distribution" shall be added with some general explanations about code components and the description of the available code components per namespace (refer to section 5 of the guidelines document for handling code component as introduced in 6.1.4.2).

Typically this subclause shall start with the following generic explanation about the distribution of the code component:

"This document is associated with code components.

Each code component is a ZIP package containing at least the electronic representation of the code component itself and a file describing the content of the package (IECManifest.xml)."

If further versions/revisions may apply, due to some maintenance works, the above shall then be followed by the following:

"The life cycle of a code component is not restricted to the life cycle of the related publication. The publication life cycle goes through two stages, Version (corresponding to an edition) and Revision (corresponding to an amendment). A third publication stage (Release) allows publication of the code component in case of urgent fixes of InterOp Tissues, thus without need to publish an amendment.

Consequently, new release(s) of the code component(s) may be released, which supersede(s) the previous release, and will be distributed through the IEC web site at:

https://www.iec.ch/tc57/supportdocuments.

The latest version/release of the document will be found by selecting the file for the code component with the highest value for VersionStateInfo, e.g. IEC_61850-7-3.NSD.{VersionStateInfo}.Light.zip."

For each code component, the following shall be described:

- The reference to the schema file or any other file that describes the format of the code component
- If there is a full and light version available or only a full version
- The technical content of the code component

An example of this is as follows:

"The Code Components associated with this document are reflecting the data model specified in this document formatted in NSD files as described in IEC 61850-7-7. They are available in light and full version:

- *The full version contains definition of the whole data model defined in this standard with the documentation associated and access is restricted to purchaser of this part*
- *The light version does not contain any documentations but contains the whole data model as per full version"*

This shall be followed by a link to the code component that can be downloaded (note if the code component is only published as a full version, that will be the one that is freely downloadable; otherwise it will be the light version). An example is as follows:

"The light version is freely accessible on the IEC website for download at https://www.iec.ch/tc57/supportdocuments, but the usage remains under the licensing conditions."

Because IEC de facto publishes the same content through two channels (the document and the code component), an additional sentence shall also indicate for each code component, which publication is of highest priority in case of differences/discrepancies:

If the downloadable code is of highest priority (typically because of maintenance work):

"In case of any differences between the downloadable code and the IEC pdf published content, the downloadable code(s) is(are) the valid one; it may be subject to updates. See history files."

If the pdf published version is of highest priority:

"In case of any differences between the downloadable code and the IEC pdf published content, the IEC pdf published content is the valid one."

6.1.6 Data Model extension requirements

6.1.6.1 General

Basic rules to apply for extending the IEC 61850 namespaces are specified in "Common rules for new version of classes and for extension of object classes/Basic rules" of IEC 61850-7-1 (Subclause 14.2 in Edition 2, Amendment 1).

6.1.6.2 Namespace name, type, version and revision and dependencies requirement

Any namespace shall have a textual name and shall follow rules as defined in IEC 61850-7-1 (Clause 13 in Edition 2, Amendment 1). It assumes de facto the management of versions and revisions associated with this namespace.

In case an intermediate version of the namespace needs to be produced and used out of IEC (for pilot project for example) then version shall be set to 2099 to avoid any confusion.

Each data model namespace extensions (including the private one) shall have its type formally expressed, whether it is a domain, product, transitional, private namespace, through an enumerated attribute holding one of these values:

{"basic"|"domain"|"product"|"transitional"|"private"}

IEC 61850 data model namespaces are chained together, and since Edition, 2 Amendment 1, these dependencies have been made formal using 3 types of dependencies (also reflected in – and autogenerated from – the UML model) – refer to IEC 61850-7-1 (Subclause 13.4 in Edition 2, Amendment 1):

- "Includes" -> the considered namespace is a superset of the other. This applies exclusively to domain namespaces.

- "Depends on" -> the considered namespace depends on the other. This applies exclusively to basic namespaces.

- "Extends" -> the considered namespace extends the other one, i.e. each extended element should be tagged specifically from this namespace. This applies exclusively to product and transitional namespaces.

The information specifying the namespace referenced by a dependency shall not include the release number. It assumes that all further versions and revisions of this namespace are backward compatible as far as this dependency is concerned.

Each data model namespace extensions (including the private one) shall have its dependencies formally expressed.

- In case of standard namespaces, each UML package related to the namespace shall include a diagram expressing the namespace dependencies through package relationships

Regarding the process of merging transitional namespaces into international standards, two specific aspects need to be considered:

- As soon as a transitional namespace is decided to be withdrawn from the IEC store, it is important to tag the considered transitional namespaces as "deprecated" within the UML model (with the package stereotype) – this information shall be reflected in the UML model and in the machine processable format associated to this namespace
- Keep track of the merge in the informative part of information associated to the namespace

Table 2 introduces the typical namespace "nameplate" holding the normative information to be found at the beginning of the document:

**Table 2 – Normative information related to a namespace
(for example for IEC61850-7-499:2009B release 5)**

Attribute	Content
Namespace nameplate	
Namespace Identifier	IEC61850-7-499
Version	2009
Revision	B
Release	5
SCL Namespace Name	IEC61850-7-499:2009B
Full Code Component Name	IEC_61850-7-499.NSD.2009B.Full
Light Code Component Name	IEC_61850-7-499.NSD.2009B.Light
Namespace Type	domain
Namespace dependencies	
includes	IEC 61850-7-4:2007A version :2007 revision :A
Namespace deprecation	
Deprecation	true

In addition to the above set of information indicated in Table 2, some additional information is recommended to be indicated in the document, mostly related to changes tracking and/ or document generation for IEC.

Table 3 introduces the typical namespace information table holding the informative information to find normally outside of the core part, for example in the foreword of the document:
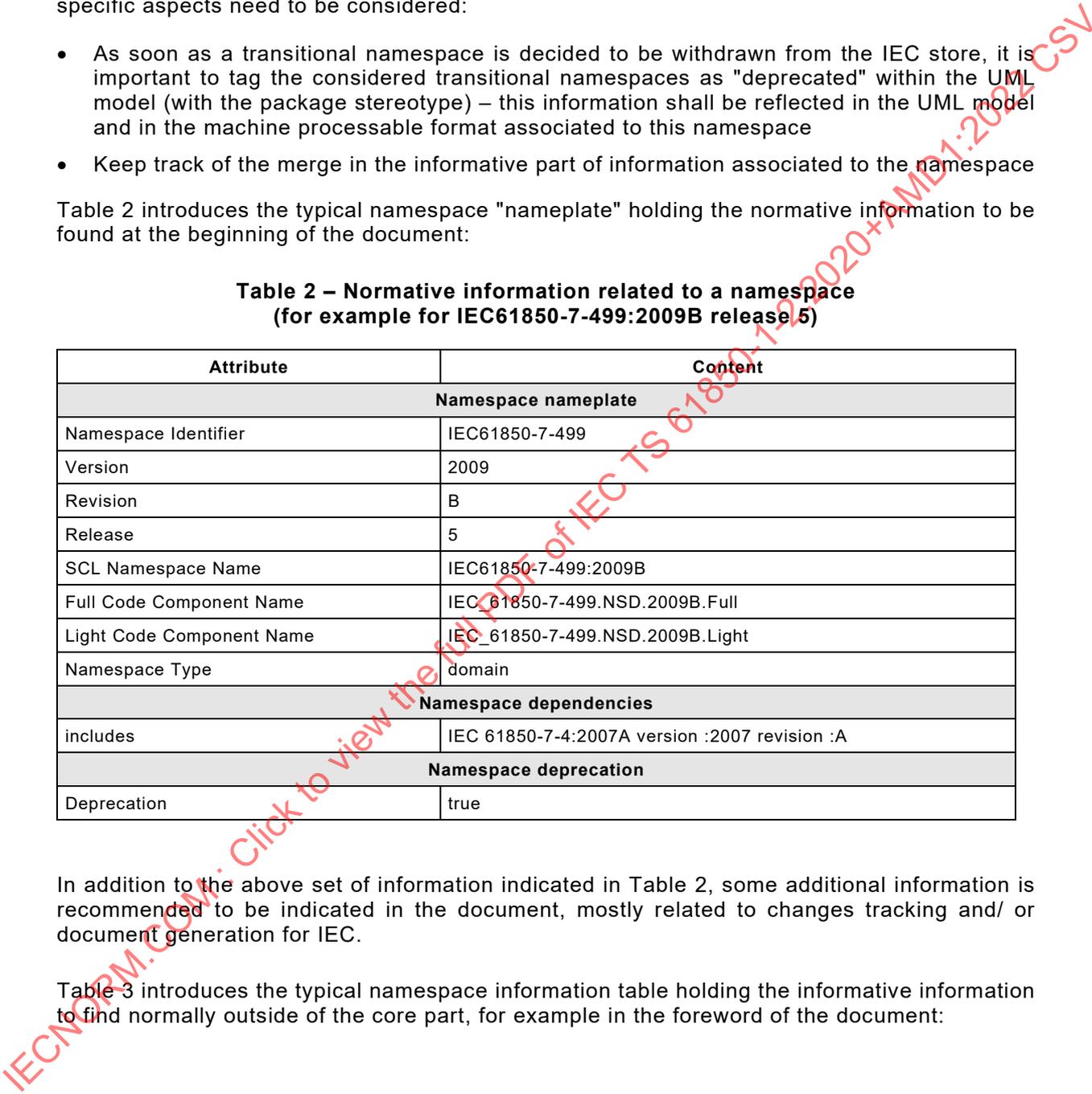
**Table 3 – Informative information related to a namespace
(for example for IEC61850-7-420:2009A release 5)**

Attribute	Content
Namespace IEC specific information	
Publication status	CD2
Version of the UML model used for generating the document (informative)	IEC61850UML02v07
Date of the UML model used for generating the document (informative)	2011-08-01
Autogeneration software name and version (informative)	j61850DocBuilder 01v01
Template file name	IEC_61850-7-420_CD2_V21.doc
Namespace Changes	
From	Version 2007, revision A, release 1
List of Applied Tissues	1,2, 3, 127,200
Namespace History	
Results_from_merge_of	IEC/TR 61850-90-7

NOTE   An amendment of IEC TS 61850-7-7 will be produced in order to reflect all these information attached to namespaces.

6.1.6.3   LN class related rules

6.1.6.3.1   LN class name and its associated group

The LN classes Groups are listed in IEC 61850-7-1 (Table 1 in Ed. 2) and are distinguished by a letter which becomes the first letter of a LN class name.

Each LN class shall be attached exclusively to one group based on its functional scope and shall use the associated Group letter as the first letter of its name.

In case of standard LN classes, the organization responsible for developing the LNs should not be considered as the "functional scope". For example, just because IEC TC 57 WG17 is in charge of DER integration does not imply that all LNs proposed in standard publications produced by this group should be from the D group.

LN class names shall follow the rules as specified in IEC 61850-7-2 "Referencing an instance of a class" (Clause 22 in Edition 2, Amendment 1).

6.1.6.3.2   LN class functional scope

NOTE   This section will migrate eventually to IEC 61850-7-1.

This clause lists some main recommendations to create a new LN (and a new LN class) or update existing LN classes:

- An LN should be identified by breaking down the application function to the smallest indivisible part while still fulfilling a specific purpose or objective:

   NOTE   Indivisible means that it would not make technical sense for the targeted domain to have the DOs of the expected LN split into parts hosted by different 61850 communicating IEDs.

- As much as possible, each **LN should have its own functioning mode and behaviour**, namely that turning on, turning off, blocking, or putting under test such an LN makes sense. In particular:
  - the behaviour interaction between this LN and other LNs should be limited – typically turning off this LN should not systematically lead to turn off another one.
  - it should comprehend all needed status(es), control(s) and setting(s) to run, i.e. to perform its function and deliver meaningful information to the rest of the system

- It should have consistent content – having heterogeneous content may mean that the target can still be divided into consistent parts.

- It should be part of the existing LN Group, as published in IEC 61850-7-1 (see 6.1.6.3.1).

- It should not replicate or embrace functions (LN scope) which are already modelled elsewhere in the IEC 61850 series (because this would demonstrate that the existing function is not indivisible)
  - An exception can take place when the modes (on/blocked/test/test-blocked/off) of the embedded function are tightly linked with other parameters, and thus having this sub-function embedded in the new LN changes the semantic of the attached parameters, at least from a functioning mode point of view.

- Abstract classes could be inherited by LNs. These LNs would include all the DOs reflecting their main unique properties but inherit common DOs from the appropriate abstract LN classes (as published in IEC 61850-7-4 Edition 2, Amendment 1).
  - At a minimum, any of the new LN classes should inherit the Function LN abstract class (except some very specific functions)
  - Inheriting the appropriate abstract class will ensure that the common set of parameters in the abstract class support the LN function in exactly the same way across all LNs that inherit that abstract class:
    1) If the LN class contains controllable object(s) it should inherit from "ControlledLN" abstract class to get the "control authority" set of DOs
    2) If it is an interface with physical equipment, it should inherit from "EquipmentInterfaceLN" abstract class to inherit the DOs to reflect the generic properties of the external equipment
    3) If this LN contains an automation function, it should inherit from "AutomaticControlLN" abstract class to inherit the DOs to activate/deactivate the automated function
    4) Etc.

- LNs may be "specialized" per dedicated interested system entity (operator, maintainer, etc.). If multiple entities are considered, possibly multiple LNs could be considered as well (for example condition monitoring related DOs may be placed in a specific S logical node, because they are exclusively targeting the maintainer)

The following list proposes some basic checks that should be applied to LN models:

- Verify that all modes and behavior values operate in accordance with the generic rules provided in Clause A.2 of IEC 61850-7-4:2010

- If the LN contains alarms trigger status, it should hold the alarm trigger settings for triggering such alarms

- If the LN supports some controls (i.e. includes controllable DOs), it should include the control authority handling features (typically the way to manage local/remote through the DOs Loc, LocKey, LocSta)

- If the LN embeds an automatic function, it should include a way to activate/deactivate the automation (typically through the DO Auto)

- If the LN mirrors the interface of external physical equipment, it should support nameplate and health of this equipment (typically EEName and EEHealth)

- If the LN contains counters, it should hold what is needed to (re) initialize such counters (in most of the cases)

- If this LN contains a state machine, the modeler should ensure that:

  – The state machine can be properly initialized

  – All statuses of the machine can be exposed, and that all controllable transitions are properly defined and can be handled with no ambiguity (typically through transient control)

  – The reasons for not applying a transition control (or not applying it as expected) should be made explicit to the control sender

  – Impacts of the data object "Mod" (with value "On", "Off", "Test", etc.) on the state machine is properly specified

NOTE   Some of these rules might be automatically satisfied by inheriting from the proper abstract class.

The following list proposes some robustness checks that should be applied globally to LN modeling:

- Can the LN be reused in other contexts?

- Can the LN share more DOs which are already specified in other LNs? Is there any relevancy to create additional abstract classes to better formalize the sharing of common sets of DOs?

- What is the resulting size of the LN (quantity of DOs)? Is there a way to break it down further?

- What are the main data flow interactions with other LNs, applying the generic rules of behavior and input processing?

- What are the main interested system entities? Is there a way to specialize the content per entities and thus breakdown the proposed LN?

6.1.6.4   DO/DA related rules

6.1.6.4.1   DO/DA name uniqueness

It is not allowed (even this happened in the past) to introduce DO names which are already part of existing standards but have either a different CDC or a different semantic, i.e. there should be a unique relationship between a DO name, its CDC and the proposed semantic. The semantic may be "refined" for a specific application.

If the proposed CDC does not match the existing one, it is very probable that the semantic won't match either, then a new DO name should be considered.

6.1.6.4.2   Abbreviation re-use in DO and DA names

At the time of the DO creation, all DO or DA names should strictly reuse the existing abbreviations as listed in IEC 61850-7-4 "Abbreviated terms used in data object names" (Subclause 4.2 in Edition 2, Amendment 1) if the length of the DO name does not exceed the name length limit.

Regarding the management of list of abbreviations, it is forbidden:

- to "invent" a new abbreviation for a word or a word sequence which has already its abbreviation defined

- To add a new abbreviation for a synonym of a word already listed with abbreviation (in order to limit the number of used abbreviations)

It is highly recommended in case of abbreviation creation to start the abbreviation with upper case and have all remaining letters in lower case. Abbreviation length should not exceed 3 letters in order to combine up to 4 abbreviations to form a DO name.

It is also forbidden to re-use an existing abbreviation for a meaning different from its original meaning.

In case the DO name built by standard abbreviations exceeds the name length limit, new abbreviations could be created, with the same constraint as above.

The resulting set of abbreviations should be reviewed and approved through consensus of the model managers team.

NOTE 1   A new standardisation work item may be settled in IEC in the coming future in order to better cope with the IEC 61850 abbreviations set management, with a potential public exposure.

NOTE 2   A convenient feature to check if an abbreviation already exists and its existing usages is available for IEC members at https://iectest.iec.ch/61850/index.php – this URL may change in future. If changed this will be announced through the IEC TC 57 web page of the IEC web site.

6.1.6.4.3   DO Naming rule

DO Name should be globally formed by associating up to 4 main parts[3]:

DOName = {Entity name abbreviation(s)}{Information qualifier(s)} {Information type}{information unit if not SI}

where:

- (de facto present) Entity name abbreviation(s) specifies the main entity under focus – usually the one which holds the unit
    - In case of multiple words to express the entity name, the part which holds the unit (if any) shall be the last one
    - Typically prefer ChaW to WCha
- (optional) Information qualifier such as high ("Hi"), low ("Lo"), min("Min"), max ("Max"). As reminder this field shall not be used to express "statistical" property of the information, but only static properties such as nameplate one
- (optional) Information type such as Rating, Setpoint, Settings, Alarm trigger status, Alarm trigger threshold, Warning trigger, Warning trigger threshold, …By default, and if absent, it indicates a measurement or a status
- (optional) Information unit if not SI based, typically percentage "Pct", or time-based units. It has to be noted that this way of indicating the unit as part of the name and de facto as part of the semantic (refer to 6.1.6.6) should find in future editions of IEC 61850 a better support, especially being machine processable (typically and possibly making the Unit attribute mandatory and offering a way to express the 100 % base for percentages)

It will not be always easy to follow the rule, and for example to discriminate what is part of the entity name, vs. what is a qualifier, however one should try. Table 4 is intended to help sort abbreviations in a consistent manner.

Recommended namings: TotW, ARtg, VolHiAlm, ChaWMax, WMax

"Not recommended" DO names: HiVolAlm, LoTmpAls, RtgW, etc.

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3   This new rule is de facto not retroactive.

**Table 4 – Classification of Abbreviations in regards
of their contribution to form a DO Name (examples)**

Type	Entity name		Entity qualifier	Entity type	Entity unit
	prefix	suffix			
Typical abbreviations (extract for A abbreviations)	AC; Abs; Accm; Altn; An; Anc; App; Area; Asyn; Aux	A; Abr; Acc; Accl; Addr; Ahr; Amp; Alt; Ang; Ar;	Av	Alm; Als; Arr;	
Typical abbreviations (extract for B abbreviations)	Bac, Bar, Base, Bat, Bck, Bec, BG, Bias, Bl, Blb, Blk, Blow, Bnd, Boil, Bot, Brcb, Brg, Brk, Bsc, Bst, Bt, Bub, Bus, Byp	Beh, Ber			
Typical abbreviations (extract for C abbreviations)	C, C2H2, C2H4, C2H6, Cab, Cam, Capac, Car, CB, Cbr, Ccw, Cds, CE, Cea, Ceil, Cel, Cff, Cfg, Cg, CG, Ch, CH4, Cha, Chg, Chk, CHP, Chs, Circ, Cl, Clas, Clc, Clip, Clk, Cloud, Clr, Cls, Cmbu, Cmpl, Cmut, Cndct, Cnst, Cntt, Cnv, CO, CO2, Col, Comm, Comp, Conn, Cons, Cor, Core, Crank, Crd, Crit, Crl, Crp, Csmp, Ctr, Cut, Cvr, Cw, Cwb	Cal, Ccy, Cm, Cnt, ConfRev, Cost, Cur	Cf, Cum	Can, Cap, Chr,Cmd, Crv, Ctl	
To be completed	Tot; Gra, Rte	W; VAr; VA; Vol; V;	Min; Max; Hi; Lo;	Rtg; Spt; Set; Wrn; Wrs;	Pct; Tmh; Tmm; Tms; Tmms

NOTE   The use of Tmh, Tmm, Tms, Tmms is now deprecated (refer to 6.1.6.6).

6.1.6.4.4   Uppercase and lower-case requirements

Any DO name shall start with an uppercase letter as described in IEC 61850-7-2 (Clause 11 in Edition 2, Amendment 1)

Any DA name shall start with a lowercase letter as described in IEC 61850-7-2 (Clause 12 in Edition 2 Amendment 1)

6.1.6.4.5   Name lengths

Refer to IEC 61850-7-2 "Referencing an instance of a class" (Clause 22 in Edition 2, Amendment 1) for the detailed requirements.

6.1.6.5   Enumeration related requirements

6.1.6.5.1   General

Refer to:

- IEC 61850-7-2 "Type definition" (Clause 6 in forthcoming Edition 2, Amendment 1) for the detailed requirements,

In addition, other enumeration requirements (starting values) are specified:

- in IEC 61850-6 "Enumeration" clause (Subclause 9.5.6 in forthcoming Edition 2, Amendment 1).

- In IEC 61850-8-1 "Fixed-length GOOSE message" basic type encoding

As a reminder:

- the positive range of values is reserved for standardized value of enumerations, except for IEC 61850-7-3 multiplierKind that also standardizes values in the negative range
- The extension of the enumeration type can be done in the negative range of the values, only if none of the standardized value is providing the proper semantic
- Private enumeration types (i.e. for private DOs) can be done in the positive and negative range of values
- Values shall be in the range of -128, +127 because encoded on a single signed byte in fixed length GOOSE message.

Any standard enumeration type shall be provided with its machine-processable description (SCL or NSD[4]).

6.1.6.5.2   Managing extension of standardized enumeration types

A standardized enumeration type (i.e. as part of domain, transitional or product namespaces) may be based on an existing one under certain conditions:

- It should have a different name
- It should have at least the exact same standardized items and associated literals as the original standardized one
- Each item "based on" an original one will indicate explicitly this relationship in its literal.

This will have as main effects that any modifications of items in the original one will de facto apply on the enumeration type based on the original one, in case of:

- change of associated literal
- deprecation of the type item(s)

6.1.6.6   Semantic definition

Any semantic description describing DO and DA shall be unambiguous.

These semantic descriptions should potentially indicate the context in which the data needs to expose a bad quality information.

Table 5 summarizes the recommended frames and specific requirements for semantic description.

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4   As defined in IEC TS 61850-7-7.

Table 5 – Semantic description frame and requirements

CDC	Description frame/requirements
SPS, DPS	If true, ... otherwise, ...
SPS(Transient)	If true, ...
SPC	(controllable) If true, ...; otherwise ...
SPC(Transient)	(controllable) Operating with value true initiates ....; operating with value false is ignored. The change of its status value is a local issue.
INC, ENC, APC	(controllable) ....
Any CDC which include an analog value	This applies typically to MV, CMV, WYE, DEL, SEQ, HMV, HMWYE, HDEL, APC, ASG, CURVE, CSG, INS, INC, ING, etc. Requirements: The unit to be considered for expressing the analog value expressed through the CDC shall be defined with no ambiguity. By default, SI Unit shall be considered, however, there are cases where the choice of unit may be ambiguous: • In case multiple SI units may support the analog value (typically temperature) • In case the SIUnitKind enumeration of IEC 61850 offers multiple proposals (typically energy related values may be expressed in Joule or WattHour, or in case of time duration – second, minutes, hours) In case the choice of Unit is ambiguous, the Unit shall be specified as part of the semantic. A multiplier vs. the SI Unit shall not be specified as part of the semantic. For example, it is not allowed to indicate [km] as the specified unit for a proposed DO, because meter is the standard SI unit. But nothing prevents a product to expose a multiplier attribute of 3, to express its value in km.

NOTE   A naming rule used to be in place up to Ed 2 Amd 1 for integer based CDC DOs representing time duration, because of some Edition 1 gaps, filled in Edition 2, related to the ability to integer-based CDC to hold units. This rule consisted in adding to the DO name a suffix to reflect the unit (hour, minute, second, millisecond). A decision was made in June 2017 to drop this rule.

6.1.6.7   Presence conditions

Any new DO shall have its presence condition defined. These shall be preferably machine processable, i.e. picked from the set of predefined machine processable presence conditions.

Refer to the annex "Conditions for element presence" as stated in IEC 61850-7-3 (Annex E in Edition 2, Amendment 1).

6.1.6.8   Specific modelling rules or recommendations

6.1.6.8.1   Mode and behavior of the extended part

Any standard extensions of IEC 61850 should ensure that the mode and behavior principles specified in the basic part of IEC 61850 still apply. Any information shall be provided in order to guarantee that any system implementing the proposed extensions will behave consistently and in a reproducible manner (on, off, test, etc.), especially when state machines are specified.

6.1.6.8.2   Providing a model to support a state machine monitoring and control

Some recommendations may be provided in future revisions.

6.1.7   XML namespace extensions

In order to harmonize the names of these namespaces and to ensure those extensions publication including XML namespaces will withstand an efficient versioning mechanism, these XML namespaces shall comply with the requirements below:

• XML namespace name should be formed this way:

http://www.iec.ch/{series_name}/{First year of edition}/{CodeComponentName}{/{PartNumber}

where:

– CodeComponentName as defined in the guidelines document

– PartNumber **is an optional attribute which reflects** the part number of the considered IEC series part if not the core part i.e. not part 6, nor part 7-1, 7-2, 7-3, 7-4.

This leads typically to:

1) SCL

2) SCL/80-1

3) NSD

4) SCSM_8_2

– **First year of edition** designates the year of first edition of the considered part

NOTE   At the time of publication of this document all 61850 XML namespaces do not follow this naming rule.

• The XML namespaces names shall be independent from:

– Any version numbers

– Any revision numbers

– Any release numbers

The reason for it is to support the MustUnderstand/MayIgnore principles which thus lead to have XML namespace extension to have additional mean to express which version/revision/release is in use in a given XML file.

• The XML namespace "schema" tag shall introduce the version/revision/release under a single XML attribute called "version" with a value composed this way :

{version}{revision}{release}

Where version/revision/release are managed similarly to version/revision/release of data model namespaces:

– "version" reflects the year of publication of the considered edition (or close to)

– "revision" is an uppercase letter starting by "A", and incremented for each amendment or corrigendum

– "release" is an integer starting at "1" helps managing the correction of the content for interop tissues, or IEC internal draft publication (if the value equals "1" its presence is optional)

• The XML namespaces should be associated with a "reference name" to be used at the time of use, for helping merging XML files from different manufacturers. The recommended reference name should be formed this way:

eIEC{IEC document number of the namespace}{CodeComponentName}

for example: eIEC61850-90-11SCL

Consequently, in addition to the namespace naming rule expressed above, the extensions of a core XML namespace (such as IEC TR 61850-90-2 versus IEC 61850-6) shall offer a specific host for versioning related information. Such XML feature may look like – at the time of use:

<{xmlns}:xmlnsVersion version="2009" revision="A" release = "2"/>

Where {xmlns} designates the reference name of this XML namespace provided as part of the header of the XML file.

It is recommended that the resulting string expressing the XML namespace name points to an IEC website providing links to the detailed XML namespace definition of all already published version/revision.

Finally, the document shall sum-up all attributes of the XML namespace in Clause 1 as expressed in 6.1.5.2. A typical representation of this summary could be similar to the one shown in Table 11:

Table 11 – Attributes of an xsd namespace (example)

Attribute	Content
Namespace nameplate	
Namespace Identifier (xmlns)	http://www.iec.ch/61850/2019/SCL/90-11
XSD version header attribute	2019A2
Recommended reference name	eIEC61850-90-11
Version	2019
Revision	A
Release	2
CodeComponentName	IEC_TR_61850-90-11.SCL.2019A2.Full

6.1.8   Cyber-security requirements

All cyber-security related requirements for IEC 61850 are currently specified in the IEC 62351 series. No cyber-security-related extensions are allowed as part of the IEC 61850 extensions.

6.1.9   Conformance Testing requirements

Any domain and product level extension of IEC 61850 should ensure that conformance testing requirements are available to demonstrate the conformity of an implementation against the included requirements. This does not apply to transitional namespaces.

6.1.10   Maintenance of standard extension document

6.1.10.1   General

Experience shows that any documents related to IEC 61850 extensions will have to be maintained, as soon as they are published. This aspect is a high-level requirement to ensure that interoperability will be effectively met and in a sustainable way. This comprises:

- Semantic refinement
- Model "corrections"
- Presence conditions refinement

It is absolutely key that people and process in charge of maintenance:

- Are in place at the time of the publication,
- Will remain active until the publication is discarded.

- Will follow the "TISSUE" process[5] as already set up for the basic namespaces. (IEC is in the process to support this process officially with adequate web and software tools.)

6.1.10.2   Handling versions, revisions and releases of extensions update

6.1.10.2.1   General

The purpose of this clause is to define how to handle versioning related information depending on the different cases of maintenance of the considered extension. Typically, it defines how to handle IEC 61850 versioning attributes in regards of IEC publication information (IEC edition/amendment/tissues fix) such as:

- Version
- Revision
- Release
- UmlVersion (of the entity level package – WGxx)
- UmlDate (of the entity level package – WGxx)
- Publication status

6.1.10.2.2   Handling versioning related to official IEC publication

Figure 3 shows how to handle and expose versioning information related to official IEC publication.

These information (version, revision, release number, Umlversion, Uml date) shall also be reported within the "pdf" document and within the code components as defined in IEC TS 61850-7-7.

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5   The description of the Tissue process will be part of a future IEC publication.
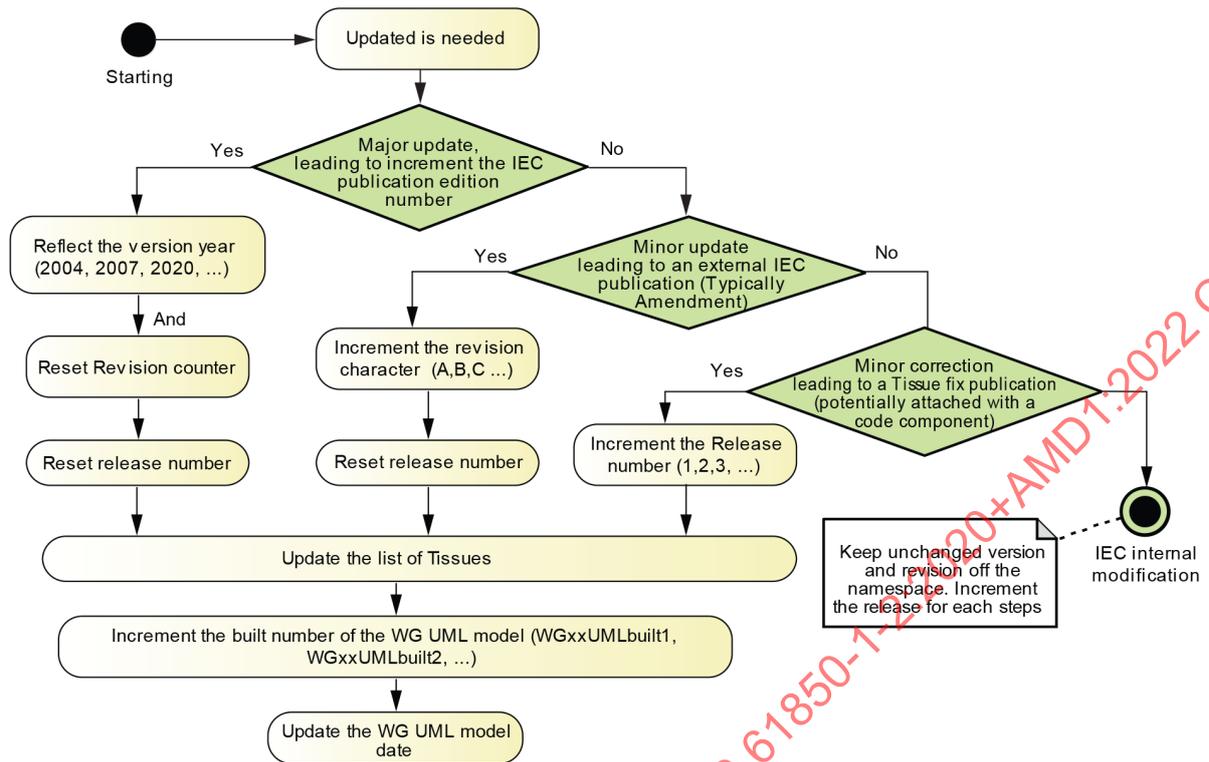
Figure 3 – Handling versioning information for official IEC publication

6.1.10.2.3   Handling versioning during the internal IEC writing process

Figure 4 shows how to handle and to expose versioning information during the internal IEC writing process.

This information (version, revision, release number, publication stage, Umlversion, Uml date) is also reported within the "pdf" document and within the code components as defined in IEC TS 61850-7-7.
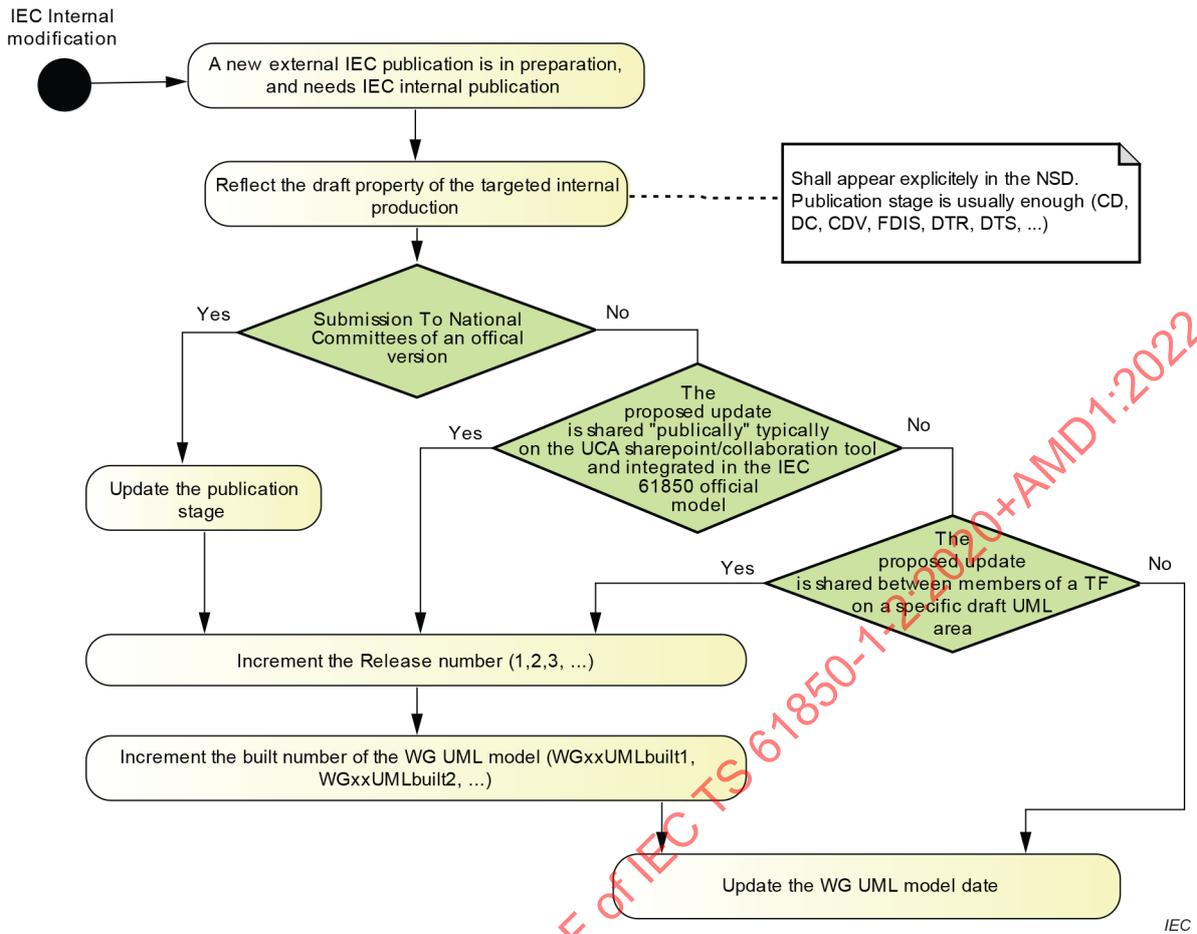
Figure 4 – Handling versioning information during the internal IEC writing process

6.1.10.2.4   Example of managing version during a tissue(s) fix

Figure 5 gives an example of managing version during a tissue(s) fix.
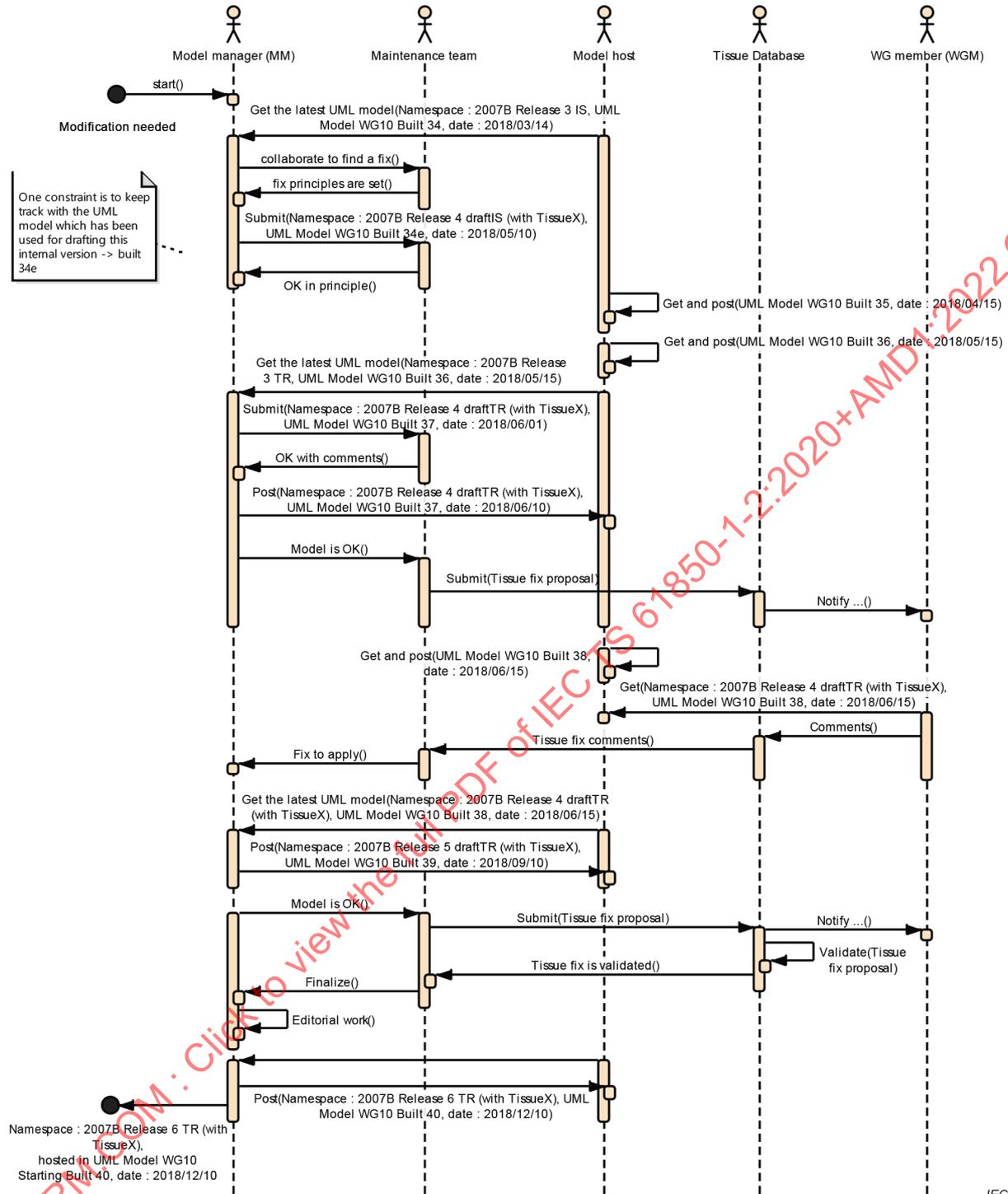
Figure 5 – Example of tissue fix sequence and its impact on versioning information

6.1.10.3 Deprecation management rules

6.1.10.3.1 General

Deprecation of an element is expressed by applying the stereotype "deprecated" to the given element of the IEC 61850 UML model (with no upper case letter).

6.1.10.3.2 Deprecation of an element in an IEC 61850 namespace

The following rules apply for managing deprecation of an element in an IEC 61850 namespace.

- a deprecated element is shown as deprecated in the edition where the decision to deprecate it is made,
- 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 follow (in order not to confuse the users and/or encourage some remaining usages of the deprecated element).

6.1.10.3.3 Deprecation of a namespace

Deprecation of namespaces mostly happens to namespaces of "transitional" type. This is implied to the process by which they were built and due to their announced limited life span.

It may also happen to past versions of any namespaces.

Deprecation shall at least happen when the publication of the given namespace is withdrawn from the IEC library, but this could also happen through amendment related to the considered namespace.

However, in order to still support existing projects having used namespaces now deprecated, those namespaces should/may remain present, as deprecated, in the UML Model, in available NSD files and as well as part of the webaccess service.

In all cases, a deprecated namespace shall be tagged explicitly as "deprecated".

6.1.11 Backward compatibility treatment

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.

Two aspects should be considered:

a) A global assessment should be considered based on cases as described in Table 6 and Table 7, but in most of the cases this general compatibility assessment may rely on the generic compatibility limits observed for any extensions as specified in IEC 61850-7-3 (Annex E in Edition 2, Amendment 1) – As soon as a compatibility rule is defined, it shall remain present in any further revision of the considered extension.

Table 6 – Typical compatibility assessment

	Information owner	Information user
Forward compatibility		
Backward compatibility		

**Table 7 – Typical compatibility assessment and associated compatibility rules –
detailed discussion**

Concerned entity	Impact / recommendations
Client	*Forward compatibility:* *Backwards compatibility:*
Server	*Forward compatibility:* *Backwards compatibility:*
Subscriber	*Forward compatibility:* *Backward compatibility:*
Publisher	*Forward compatibility:* *Backwards compatibility:*
IED tool of information user	*Forward compatibility:* *Backwards compatibility:*
IED tool of information owner	*Forward compatibility:* *Backwards compatibility:*
System tool	*Forward compatibility:* *Backward compatibility:*

b) **A specific compatibility** assessment for the release of this extension. A table shall be
provided covering all known compatibility cases. An example of such table is described in
Table 8. This table shall cover the history of compatibility cases since the first publication
of the document.

Table 8 – Typical compatibility table

Adding elements	
Adding new LNs	
Namespace	Adding a new LN with DO of existing CDC
Namespace (Ed 2)	(Abstract classes which are intermediary constructions are not considered here) DMDR, DLOD, DSTO, SBAT, DECP, DPCC, DVER, DPMC, DHVT, DLVT, DHFT, DLFT, DAGC, DTCD, DVWC, DWFL, DWGC, DWMN, DWMX, DVVR, DVAR, DWVR, DRGS, DHFW, DLFW, DFPF, DCTE
Adding elements of existing CDC	
Namespace	Adding a new optional DO with existing CDC in existing LN
Namespace (Ed 2)	
Namespace	Adding a new mandatory DO with existing CDC in existing LNs
Same as above	
Namespace	Adding a new optional DO of CDC ENx (enumeration)
Same as above	
Namespace	Adding a new mandatory DO of CDC ENx (enumeration)
Same as above	
Adding elements of new CDC	
Namespace	Adding a new LN with DO of new CDC
Same as above	
Namespace	Adding a new optional DO with new CDC in existing LNs
Same as above	
Namespace	Adding a new mandatory DO with new CDC in existing LNs
Same as above	

Changing elements	
Modifying elements	
Namespace	Rename an existing DO
Same as above	
Namespace	Adding a new value of a standardised enumeration at DO level
Same as above	
Namespace	Modifying literals of a kind of enumeration values
Same as above	
Namespace	Modifying of the associated CDC of existing DO
Same as above	
Namespace	Adding a new value of a standardised enumeration at CDC level
Same as above	
Changing elements presence condition	
Namespace	Changing presence condition to less stringent one: Mandatory/Forbidden to Optional/Conditional (M/F→O/C)
Same as above	
Namespace	Changing presence condition to more stringent one: Optional/Conditional to Mandatory/Forbidden (O/C→M/F)
Same as above	

Namespace	Changing presence condition Forbidden to Mandatory or reverse (F→M, M→ F))
Same as above	

Deprecating elements	
Namespace	Deprecation of LNs
Same as above	
Namespace	Deprecation of mandatory DO
Same as above	
Namespace	Deprecation of optional DO
Same as above	
Namespace	Deprecation of enumeration values
Same as above	

Removing elements	
Namespace	Remove of LN
Same as above	
Namespace	Remove of DO
Same as above	
Namespace	Removing a value of a standardised enumeration at DO level
Same as above	
Namespace	Removing a value of a standardised enumeration at CDC level
Same as above	

6.2   List of IEC 61850 flexibilities

6.2.1   General

This clause tries to identify all flexibilities which could lead to further work in order to specialize the application of IEC 61850 to the targeted application.

6.2.2   Data Model flexibilities

6.2.2.1   Extending existing LNs with new DOs

Refer to IEC 61850-7-1 "Common rules for new version of classes and for extension of object classes" (Clause 14 of Edition 2, Amendment 1).

As a reminder a LN extension shall not modify the semantic definition of a considered LN.

Specific rules apply to the L Group due to the fact that LNs from this group are system-related: only the owner of the basic namespace as defined in 4.2.1 (IEC 61850-7-4 in that case) can provide standard extensions to the LNs from the L Group.

6.2.2.2   Extend abstract LNs

This can only be done by the owner of the namespace.

If such an extension is needed outside of the owner case, a new abstract class needs to be defined, possibly inheriting from the original one.

6.2.2.3   Create new LNs

Refer to IEC 61850-7-1 "Common rules for new version of classes and for extension of object classes" (Clause 14 of Edition 2, Amendment 1)

6.2.2.4   Deprecate existing LNs

An extension cannot deprecate a LN from another namespace. This can only be done by the owner of the namespace.

6.2.2.5   Re-use of existing DOs enumeration with extension

Refer to 6.1.6.5.2.

6.2.2.6   Extending existing CDCs with new attributes (DA)

Refer to IEC 61850-7-1 "Common rules for new version of classes and for extension of object classes" (Clause 14 of Edition 2, Amendment 1)

6.2.2.7   Create a new CDC

Refer to IEC 61850-7-1 "Common rules for new version of classes and for extension of object classes" (Clause 14 of Edition 2, Amendment 1)

6.2.2.8   Extending existing DAs enumeration

Refer to 6.1.6.5.2.

6.2.2.9   Making more stringent the DO presence conditions on existing LNs

Through a profiling activity, i.e. with the objective to increase the interoperability, it is possible to consider that a presence condition of a DO set to optional (or conditional) becomes "required" in the considered context of the profile.

Otherwise a new standard (standard namespace or transitional namespace) may override an optional/conditional presence condition of a DO of an existing namespace, to mandatory, by explicitly consider the targeted DO as part of the new namespace with the new presence condition (more stringent than the previous one).

Mandatory and forbidden presence conditions cannot be changed either through profiling or through namespace extensions or mapping at CDC level.

6.2.2.10   Making less stringent the DO presence conditions on existing LNs

A new standard may not override a mandatory/forbidden presence condition of a DO of an existing namespace, to a less stringent condition, because of the potential interoperability issues this can create.

6.2.2.11   Deprecate the presence of a DO in a LN

A new standard (domain/product namespace or transitional namespace) may deprecate the use of DOs from LNs from namespaces, by overriding the concerned DO from the original namespace with a deprecated one from the extension namespace.

NOTE   This might apply typically when a domain namespace considers a DO not appropriate for the considered domain and recommends the use of another set of DOs from the considered domain namespace. This might also apply to transitional namespace to recommend as transitional a new modelling approach, versus published basic or domain namespaces.

6.2.2.12 Making more stringent the DA presence conditions on existing LNs

Through a profiling activity, i.e. with the objective to increase the interoperability, it is possible to consider that a presence condition of a data attribute, set to optional (or conditional) becomes "required" in the considered context of the profile.

Otherwise a new standard may in some very limited cases request an attribute to be explicitly present, such as the Unit attribute.

6.2.2.13 Making less stringent the DA presence conditions on existing CDCs

In the context of IEC 61850 communication, a new standard or profile shall not override a mandatory/forbidden presence condition of a DO of an existing namespace, to a less stringent condition, because of the potential interoperability issues this can create.

6.2.2.14 Defining rules for LN prefix/suffix

Through a profiling activity, i.e. with the objective to increase the interoperability, it is possible to consider rules for more precisely constrain the way to form prefix and suffix of LNs. It may help refining the meaning of a LN in a given context.

This shall not take place as part of namespaces extensions.

6.2.2.15 Defining rules for LD arrangements

Through a profiling activity, i.e. with the objective to increase the interoperability, it is possible but not recommended to consider that rules for defining LDs and LN arrangements (i.e. ways to allocate LNs in LDs). Even if possible, this possibility should be used with care because potentially limiting any innovation.

This shall not take place as part of namespaces extensions.

Informative examples of LD arrangements may be included in profiles

6.2.3 Communication services

6.2.3.1 Extending the ACSI

Even if made possible through the IEC 61850 model structure, extension of IEC 61850 ACSI is the strict exclusivity of IEC TC 57 WG10.

6.2.3.2 Providing a new SCSM

Even if made possible through the IEC 61850 model structure, providing a new SCSM to IEC 61850 is the strict exclusivity of IEC TC 57 WG10 or to groups mandated by WG10.

6.2.3.3 Extending negative control feedback for a better handling of unexpected situations

At the current time, in case of negative acknowledgment of control, the server recipient shall provide the reason of failure back to the client through the AddCause attribute. Extension of this AddCause enumeration by standard extensions is at the current stage forbidden. This may be further investigated.

6.2.4 SCL language

6.2.4.1 Extending the SCL grammar (XSD) with SCL new tags or attributes

Refer to IEC 61850-6 "XML name spaces" (Subclause 8.3.5 in Edition 2, Amendment 1).

6.2.4.2   Extending the SCL grammar (XSD) through the private section

Refer to IEC 61850-6 "Private data" (Subclause 8.3.6 in Edition 2, Amendment 1).

6.2.4.3   Extending the SCL grammar (XSD) with tags or attributes coming from another XML namespace

Refer to IEC 61850-6 "XML name spaces" (Subclause 8.3.5 in Edition 2, Amendment 1) and to 6.1.6.8.2 for additional requirements.

6.3 Allowed flexibilities per extension cases

Table 9 identifies all possible "extensions" and depending on the extension case what is allowed or not based on the rules defined in IEC 61850-7-1.

Table 9 – Allowed flexibilities per extension cases

NOTE A colour code reinforces the visualisation of the rule: green = allowed; red = forbidden; yellow = anything in between

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[6]	Allowed under specific conditions and a specific process[6]	Allowed in negative ranges	Allowed under specific conditions and a specific process[6]	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

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6 Refer to 6.1.6.5