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TECHNICAL SPECIFICATION

colour inside

Power systems management and associated information exchange – Interoperability in the long term – Part 102: CIM – IEC 61850 harmonization

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IEC TS 62361-102, which is a technical specification, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
57/1706/DTS	57/1948/RVDTS

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62361 series, published under the general title *Power systems management and associated exchange – Interoperability in the long term*, can be found on the IEC website.

In this publication, the following print types are used:

– *Associations: in italic type.*

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
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INTRODUCTION

The IEC focuses primarily on specifying the payload of various functionally oriented messages or file exchanges. This concept includes configuration files like those developed in all IEC power systems management standards. The different smart grid initiatives in the USA, Europe and Asia have all recognized the necessity to establish solid standards for communicating between all the "smart" devices. For interoperability purposes, it has been recognized, at an early stage, that widely shared semantics would be necessary. Unfortunately, the semantic models used by the technical groups have differed from the start due to the different needs for information exchange within substations and information exchange within control centres. This has led to some gaps between the models within different standards, even though they reflected the same power system entities. Various institutions have requested that we narrow the gaps:

- NIST has recommended harmonization as a mechanism to decrease cost of integration in the Smart Grid.
- CEN/CENELEC/ETSI Smart Grid Coordination Group report states: "Harmonized electronic data model and description language are missing" and strongly recommends the study of "Harmonized glossary, semantic & modelling between CIM and IEC 61850".
- ENTSO-E letter states: "There is also a need to perform a harmonization between IEC 61850 and IEC CIM (Common Information Model) Standards [...] There are applications which use both set of standards and significant improvements on interoperability and data exchange between the applications should take place."

A number of studies and reports have already been produced on the subject of Harmonization as listed in the Bibliography.

POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE – INTEROPERABILITY IN THE LONG TERM –

Part 102: CIM – IEC 61850 harmonization

1 Scope

This part of IEC 62361, which is a Technical Specification, outlines a technical approach for achieving effective information exchange between power system installations governed by IEC 61850 and business systems integrated with IEC CIM standard data exchanges, based on a selected specific set of use cases, but also with the goal of creating a framework that will extend successfully to other use cases in the future. This document includes proposals to 'harmonize' the two standards by adapting or extending existing information models and/or defining new models, where such changes will enable more effective communication. Both current and future directions of models will be considered. The report will take into account existing standards for semantics, services, protocols, system configuration language, and architecture.

It was intended to be coordinated with IEC 61850 and all affiliated subgroups as well as IEC 61968 and IEC 61970. This edition of the document was prepared based on Edition 2 of IEC 61850-6 (2009), IEC 61850-7-3 and IEC 61850-7-4 and has been updated to match the forthcoming Edition 2.1. Mapping to other parts of IEC 61850 is incomplete. Mapping has been considered for the CIM classes defined in IEC 61970-301. The mapping to CIM classes defined in IEC 61968-11 and other standards is incomplete.

This document suggests a technical approach by which two of the leading standards for software interoperability that serve the electric utility industry (the Common Information Model, CIM, and the IEC 61850 model) can cooperate in order to enable effective data exchanges between the domains covered by these standards. Both of these standards are maintained by the International Electrotechnical Committee (IEC).

A number of studies and reports have already been produced on the subject of harmonization as listed in the Bibliography.

The work leading to this Technical Specification has considered how exchanges required by commonly understood use cases might be mapped between the standard models in order to determine the harmonizing changes suggested for the relevant models. The report references any papers, reports or other documents that provided data for this harmonization.

The approach is to define a transformation of the data governed by IEC 61850 SCL XSD to data governed by CIM UML. The transformations in this document are defined based on the use cases presented in this document. Only SCL data relevant to these use cases is transformed.

The aim is to allow the development of tools that perform automatic transformation from an SCL instance file into a CIM based instance model that can then be exported using existing standards such as IEC 61970-552: CIMXML Model exchange format.

These transformations will result in CIM-side processes that can distribute the information as needed for configuration of specific CIM applications. It is also presumed that the result of this exchange will be to enable creation of real-time CIM-side clients for IEC 61850 system data.

The heart of the SCL to CIM transformation specification defined in this document is a mapping between the two information models. Wherever this mapping has been judged to be unnecessarily complex, changes have been recommended to the existing information models.

A major objective, however, has been to define a solution that does not change either SCL or CIM UML without a mechanism to supply backward compatibility.

The transformation specification is only for structural modelling. IEC 61970-301 states “CIM entities have no behaviour.” IEC 61850-5 states “the behaviour of the functions itself are ... outside the scope of this standard”.

This document is a Technical Specification – not a standard. Paragraphs introduced by the word Recommendation are recommendations for revisions to some of the IEC 61850 and CIM standards. It is anticipated that if these recommendations are accepted, then this report can be revised and elevated to a standard.

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 TS 61850-2, *Communication networks and systems in substations – Part 2: Glossary*

IEC 61850-6:2009, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs*

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

IEC TS 61850-80-1:2009, *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 61968-11, *Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution*

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

IEC 61970-301:2013, *Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base*

IEC 61970-452:2015, *Energy management system application program interface (EMS-API) – Part 452: CIM static transmission network model profiles*

IEC 81346-1, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC TS 61850-2, IEC 61850-6 and IEC TS 61970-2 and the following 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

NOTE The following terms and definitions are critical to the understanding of this document and are repeated here for convenience.

3.1 Terms and definitions

3.1.1
Common Information Model
CIM
abstract model that represents all the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility, which includes public classes and attributes for these objects, as well as the relationships between them

Note 1 to entry: The objects represented in the CIM are abstract in nature and may be used in a wide variety of applications. The use of the CIM goes far beyond its application in an EMS. This document should be understood as a tool to enable integration in any domain where a common power system model is needed to facilitate interoperability and plug compatibility between applications and systems independent of any particular implementation.

Note 2 to entry: IEC 61970-301 defines the CIM Base set of packages which provide a logical view of the functional aspects of an Energy Management System including SCADA. Other functional areas are standardized in separate IEC documents that augment and reference this base CIM standard. For example, IEC 61968-11 addresses distribution models and references this base CIM standard. While there are multiple IEC standards dealing with different parts of the CIM, there is a single, unified information model comprising the CIM behind all these individual standards documents.

[SOURCE: IEC 61970-301:2016, Introduction]

3.1.2
System Configuration description Language
SCL
file format for describing communication-related IED (Intelligent Electronic Device) configurations and IED parameters, communication system configurations, switch yard (function) structures, and the relations between them, the main purpose of which is to exchange IED capability descriptions and SA system descriptions between IED engineering tools and the system engineering tools of different manufacturers in a compatible way

3.2 Abbreviated terms

In general, the abbreviations defined in IEC TS 61850-2 or IEC TS 61970-2 apply. The following abbreviations are particularly useful for understanding this document and are repeated here for convenience:

CDC	Common Data Class [IEC 61850]
CIM	Common Information Model
DA	Data Attribute [IEC 61850]
DMS	Distribution Management System
DO	Data Object [IEC 61850]
EMS	Energy Management System
ICD	IED Capability Description [IEC 61850]
IID	Instantiated IED Description [IEC 61850]
IED	Intelligent Electronic Device [IEC 61850]
LD	Logical Device [IEC 61850]
LN	Logical Node [IEC 61850]

SCADA	Supervisory Control and Data Acquisition
SCD	System Configuration Description [IEC 61850]
SCL	System Configuration description Language [IEC 61850]
SCT	System Configuration Tool
SED	System Exchange Description [IEC 61850]
SSD	System Specification Description [IEC 61850]
UUID	Universally Unique Identifier

4 Use case summary

4.1 General

A number of use case titles were proposed. As the subject is complex, it was decided to concentrate on the use case SCADA/EMS/DMS configuration from IEC 61850 SCL. This is based on the top-down approach to substation automation design described in IEC 61850-4 and IEC 61850-6.

It is expected that the mapping rules determined by mapping from IEC 61850 to CIM will be a good base for developing mappings for other use cases that take information from CIM to IEC 61850.

The following use cases have been considered. For further details, see Annex A, Use case details.

4.2 SCADA/EMS/DMS configuration from IEC 61850 SCL

NOTE This use case is written using the example of a transmission substation automation system, but the general steps are applicable to any power system related local automation system.

- The use case starts with requirements specification determined by a planning department e.g. following a request for a new connection or a review of assets or load growth. In this use case the requirements are expected to be defined in paper form, not in a CIM electronic format. [Managing requirements in electronic format is another use case]

The next few steps of the use case use the top-down engineering process described in more detail in IEC 61850-4 and IEC 61850-6. IEC 61850-6 refers to a number of different types of software tool for creating and editing different types of SCL file. In this document the term System Configuration Tool (SCT) is used as a generic term for multi-function software tools that are capable of system specification and system configuration.

- The System Configuration Tool (SCT) is used by a System Engineer to model any SCL defined installation, for example an electrical substation. The process starts by creating a formal specification of the system requirements. The engineer inputs information on primary equipment types, names and connectivity, typically based on the station's single line diagram. The required monitoring, protection, local automation and other functions may be described as template Logical Nodes that are allocated to the equipment or container instances.
- This formal model can be exported from the System Configuration Tool as a System Specification Description (SSD) file.
- This SSD file can then be transformed and/or imported into a CIM based modelling tool for review. If necessary, comments may be provided on paper or verbally for the System Engineer to update the model in the SCT. The review cycle may be repeated several times.
- In the next phase of the design process, the System Configuration Tool is used to import descriptions of the capabilities of specific Intelligent Electronic Devices (IEDs). The System Engineer extends the automation system model by redefining the required Logical