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Communication networks and systems in substations –

Part 6:
Configuration description language for communication in electrical substations related to IEDs

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COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS –

Part 6: Configuration description language for communication in electrical substations related to IEDs

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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International Standard IEC 61850-6 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/693/FDIS	57/713/RVD

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

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

IEC 61850 consists of the following parts, under the general title *Communication networks and systems in substations:*

Part 1: Introduction and overview

Part 2: Glossary

Part 3: General requirements

Part 4: System and project management

Part 5: Communication requirements for functions and device models

Part 6: Configuration description language for communication in electrical substations related to IEDs

Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models

Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI)

Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes

Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes

Part 8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

Part 9-1: Specific Communication Service Mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link

Part 9-2: Specific Communication Service Mapping (SCSM) – Sampled values over ISO/IEC 8802-3

Part 10: Conformance testing[1]

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

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- withdrawn;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

A bilingual version of this standard may be issued at a later date.

[1] Under consideration.

INTRODUCTION

This part of IEC 61850 specifies a description language for the configuration of electrical substation IEDs. This language is called Substation Configuration description Language (SCL). It is used to describe IED configurations and communication systems according to IEC 61850-5 and IEC 61850-7-x. It allows the formal description of the relations between the substation automation system and the substation (switchyard). At the application level, the switchyard topology itself and the relation of the switchyard structure to the SAS functions (logical nodes) configured on the IEDs can be described.

SCL allows the description of an IED configuration to be passed to a communication and application system engineering tool, and to pass back the whole system configuration description to the IED configuration tool in a compatible way. Its main purpose is to allow the interoperable exchange of communication system configuration data between an IED configuration tool and a system configuration tool from different manufacturers.

IEC 61850-8-x and IEC 61850-9-x, which concern the mapping of IEC 61850-7-x to specific communication stacks, may extend these definitions according to their need with additional parts, or just by restrictions on the way the values of objects have to be used.

COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS –

Part 6: Configuration description language for communication in electrical substations related to IEDs

1 Scope

This part of the IEC 61850 series specifies a file format for describing communication related IED (Intelligent Electronic Device) configurations and IED parameters, communication system configurations, switchyard (function) structures, and the relations between them. The main purpose of this format is to exchange IED capability descriptions, and SA system descriptions between IED engineering tools and the system engineering tool(s) of different manufacturers in a compatible way.

The defined language is called Substation Configuration description Language (SCL). The IED and communication system model in SCL is according to IEC 61850-5 and IEC 61850-7-x. SCSM specific extensions or usage rules may be required in the appropriate parts.

The configuration language is based on the Extensible Markup Language (XML) version 1.0.

This standard does not specify individual implementations or products using the language, nor does it constrain the implementation of entities and interfaces within a computer system. This part of the standard does not specify the download format of configuration data to an IED, although it could be used for part of the configuration data.

2 Normative references

The following referenced documents are indispensable for the application 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 61346-1:1996, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

IEC 61346-2:2000, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 2: Classification of objects and codes for classes*

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

IEC 61850-5, *Communication networks and systems in substations – Part 5: Communication requirements for functions and device models*

IEC 61850-7-1, *Communication networks and systems in substations – Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models*

IEC 61850-7-2, *Communication networks and systems in substations – Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI)*

IEC 61850-7-3, *Communication networks and systems in substations – Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes*

IEC 61850-7-4, *Communication networks and systems in substations – Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes*

IEC 61850-8-1, *Communication networks and systems in substations – 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 61850-9-1, *Communication networks and systems in substations – Part 9-1: Specific Communication Service Mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link*

IEC 61850-9-2, *Communication networks and systems in substations – Part 9-2: Specific Communication Service Mapping (SCSM) – Sampled values over ISO/IEC 8802-3*

ISO/IEC 8859-1, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

Extensible Markup Language (XML) 1.0, W3C, available at <http://www.w3.org/TR/2000/REC-xml-20001006>

Namespaces in XML, W3C, available at <http://www.w3.org/TR/1999/REC-xml-names-19990114>

XML Schema Part 0: Primer, W3C, available at <http://www.w3.org/TR/2001/REC-xmlschema-0-20010502>

XML Schema Part 1: Structures, W3C, available at <http://www.w3.org/TR/2001/REC-xmlschema-1-20010502>

XML Schema Part 2: Datatypes, W3C, available at <http://www.w3.org/TR/2001/REC-xmlschema-2-20010502/>

RFC 1952, *GZIP file format specification version 4.3*, RFC, available at <http://www.ietf.org/rfc/rfc1952.txt>

RFC 2045, Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies, RFC, available at <http://www.ietf.org/rfc/rfc2045.txt>

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61850-2 apply.

4 Abbreviations

In general, the glossary and abbreviations defined in IEC 61850-2 apply. The following abbreviations are either special for this part of the standard, or particularly useful for understanding this part and are repeated here for convenience.

BDA	Basic Data Attribute, that is not structured
CIM	Common Information Model for energy management applications
DAI	Instantiated Data Attribute
DO	DATA in IEC 61850-7-2, data object type or instance, depending on the context
DOI	Instantiated Data Object (DATA)
DTD	Document Type Definition for an XML document
ID	Identifier
IED	Intelligent Electronic Device
LDInst	Instantiated Logical Device

LNInst	Instantiated Logical Node
MSV	Multicast Sampled Value
MsvID	ID for MSV (Multicast Sampled Value)
RCB	Report Control Block
SCL	Substation Configuration description Language
SDI	Instantiated Sub DATA; middle name part of a structured DATA name
UML	Unified Modelling Language according to http://www.omg.org/uml
URI	Universal Resource Identifier
UsvID	ID for USV (Unicast Sampled Value)
XML	Extensible Markup Language

5 Intended engineering process with SCL

Engineering of a substation automation system may start either with the allocation of functionally pre-configured devices to switchyard parts, products or functions, or with the design of the process functionality, where functions are allocated to physical devices later, based on functional capabilities of devices and their configuration capabilities. Often a mixed approach is preferred: a typical process part such as a line bay is pre-engineered, and then the result is used within the process functionality as often as needed. For SCL, this means that it must be capable of describing:

a) A system specification in terms of the single line diagram, and allocation of logical nodes (LN) to parts and equipment of the single line to indicate the needed functionality.

b) Pre-configured IEDs with a fixed number of logical nodes (LNs), but with no binding to a specific process – may only be related to a very general process function part.

c) Pre-configured IEDs with a pre-configured semantic for a process part of a certain structure, for example a double busbar GIS line feeder.

d) Complete process configuration with all IEDs bound to individual process functions and primary equipment, enhanced by the access point connections and possible access paths in subnetworks for all possible clients.

e) As item d) above, but additionally with all predefined associations and client server connections between logical nodes on data level. This is needed if an IED is not capable of dynamically building associations or reporting connections (either on the client or on the server side).

Case e) is the complete case. Both cases d) and e) are the result after SAS engineering, while case a) is a functional specification input to SAS engineering, and b) and c) are possible results after IED pre-engineering.

The scope of SCL as defined in this standard is clearly restricted to these purposes:

1) SAS functional specification (point a) above),

2) IED capability description (points b)and c) above), and

3) SA system description (points d) and e) above)

for the purpose of system design, communication engineering and the description of the engineered system communication for the device engineering tools in a standardised way.

This is reached by defining an object model describing the IEDs, their communication connections, and their allocation to the switchyard, and a standardized way to describe how this model shall be represented in a file to be exchanged between engineering tools. The resulting object model could also be the base for other engineering tasks, possibly with some additions. Therefore, and because of the additional needs of SCSMs, this standard considers the language as defined here as the core model, and defines how extensions of this core model for SCSMs as well as other (engineering) purposes can be done in a standardised way.

Figure 1 explains the usage of SCL data exchange in the above-mentioned engineering process. The shaded text boxes above the dashed line indicate where SCL files are used. The text box *IED capabilities* corresponds to a result of steps b) and c) above, the text box *System specification* corresponds to step a) above, the text box *Associations*... at the right to steps d) or e) above.

The IED Configurator is a manufacturer-specific tool that shall be able to import or export the files defined by this part of IEC 61850. It provides IED-specific settings and generates IED-specific configuration files, or it loads the IED configuration into the IED.

An IED shall only be considered compatible in the sense of the IEC 61850 series, if:

- It is accompanied either by an SCL file describing its capabilities, or by a tool, which can generate this file from the IED.
- It can directly use a system SCL file to set its communication configuration, as far as setting is possible in this IED (i.e. as a minimum, its needed addresses), or it is accompanied by a tool which can import a system SCL file to set these parameters to the IED.

The System Configurator is an IED independent system level tool that shall be able to import or export configuration files defined by this part of IEC 61850. It shall be able to import configuration files from several IEDs, as needed for system level engineering, and used by the configuration engineer to add system information shared by different IEDs. Then the system configurator shall generate a substation related configuration file as defined by this part of IEC 61850, which may be fed back to the IED Configurator for system related IED configuration. The System Configurator should also be able to read a System specification file for example as a base for starting system engineering, or to compare it with an engineered system for the same substation.

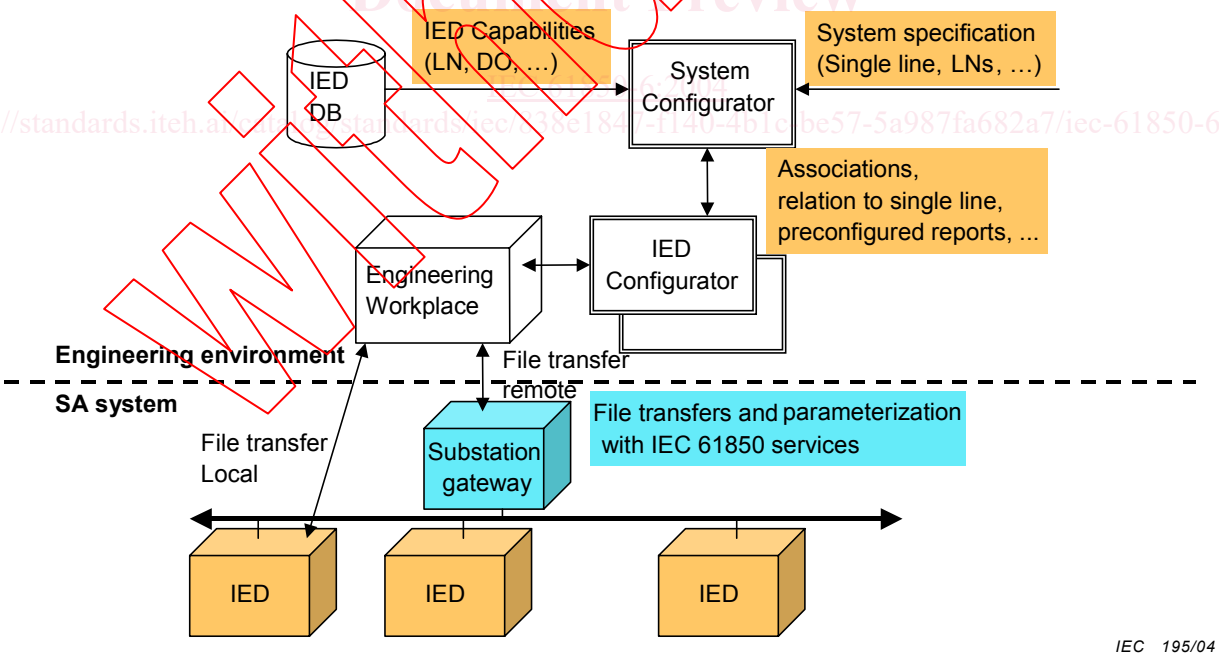

Figure 1 – Reference model for information flow in the configuration process

The part of Figure 1 below the dashed line indicates the ways in which IED configuration data produced by means of the IED configurator can be brought into the IED. This can be done by:

- local file transfer from an engineering workstation connected locally to the IED. This file transfer is beyond the scope of this standard.
- remote file transfer for example by the file transfer method of IEC 61850-7-2. The file format is not defined within this standard, but naturally SCL format is a possible choice.
- access services to parameter and configuration data defined according to IEC 61850-7-2. In this case, the standardised methods according to IEC 61850-7-x shall be used.

NOTE It is not in the scope of this standard to define any details of concrete software tools, which support an engineer in doing the intended engineering process with SCL described above. Both the system configurator as well as the IED configurator introduced above are also conceptual tools to illustrate the use of different SCL file variants in the engineering process. Each manufacturer is completely free to find the best way in supporting engineers by a specific software tool. Also completely free is the way, in which software tools for the above described engineering process with SCL will store manufacturer specific internal parameters for IEDs and SA system aspects, which are not in the scope of IEC 61850 (e.g. the relation of logical data to pins on a physical board), and how they relate them to the IEC 61850 data model.

6 The SCL object model

6.1 General

The SCL in its full scope describes a model of

- The primary (power) system structure: which primary apparatus functions are used, and how the apparatus are connected. This results in a designation of all covered switchgear as substation automation functions, structured according to IEC 61346-1.
- The communication system: how IEDs are connected to subnetworks and networks, and at which of their communication access points (communication ports).
- The application level communication: how data is grouped into data sets for sending, how IEDs trigger the sending and which service they choose, which input data from other IEDs is needed.
- Each IED: the logical devices configured on the IED, the logical nodes with class and type belonging to each logical device, the reports and their data contents, the (pre-configured) associations available; and which data shall be logged.
- Instantiable logical node (LN) type definitions. The logical nodes as defined in IEC 61850-7-x have mandatory, optional and user defined DATA (here abbreviated DO) as well as optional services, and are therefore not instantiable. In this document, instantiable LNTypes and DOTypes are defined as templates, which contain the really implemented DOs and services.
- The relations between instantiated logical nodes and their hosting IEDs on one side and the switchyard (function) parts on the other side.

SCL allows the specification of user defined DOs as an extension of standard LN classes as well as completely user-defined LNs according to the rules of IEC 61850-7-4. This means that the appropriate name space attributes shall be defined in the logical node types, and their value shall appear in the SCL file.

A SCL file describes an instance of the model in a serialized form and standardized syntax. However its semantic can only be fully understood by reference to the model itself, i.e. it is independent from the syntax. This Clause therefore gives an overview of the model by using UML notation. The next Clauses then define how an instance of the model is formally described in SCL.