

# TECHNICAL REPORT

# RAPPORT TECHNIQUE



Communication networks and systems for power utility automation –  
Part 1: Introduction and overview

(standards.iteh.ai)

Réseaux et systèmes de communication pour l'automatisation des systèmes  
électriques – <https://standards.iteh.ai/catalog/standards/sist/0c796440-7677-4c72-80b5->

Partie 1: Introduction et présentation <https://standards.iteh.ai/catalog/standards/sist/0c796440-7677-4c72-80b5->



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2013 IEC, Geneva, Switzerland

All rights reserved. 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.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

#### Useful links:

IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...).

It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).

### A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Liens utiles:

Recherche de publications CEI - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

La recherche avancée vous permet de trouver des publications CEI en utilisant différents critères (numéro de référence, texte, comité d'études,...).

Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

Just Published CEI - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [csc@iec.ch](mailto:csc@iec.ch).

# TECHNICAL REPORT

# RAPPORT TECHNIQUE



---

**Communication networks and systems for power utility automation –  
Part 1: Introduction and overview**

**Réseaux et systèmes de communication pour l'automatisation des systèmes  
électriques –**  
**Partie 1: Introduction et présentation**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 33.200

ISBN 978-2-83220-686-7

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references .....	7
3 Terms, definitions and abbreviations .....	9
3.1 Terms and definitions .....	9
3.2 Abbreviated terms .....	11
4 Objectives .....	12
5 Approach of the IEC 61850 standard .....	13
5.1 Scope of application.....	13
5.2 IEC 61850 within the IEC Power Utility control system reference architecture .....	14
5.3 IEC 61850 within Smart Grid reference architecture .....	15
5.4 Standardization approach.....	15
5.5 How to cope with fast innovation of communication technology .....	16
5.6 Representation of functions and communication interfaces.....	16
5.7 Requirements for a physical communication system .....	20
6 Content of the IEC 61850 series .....	20
6.1 IEC 61850 general requirements (parts 1 to 5) .....	20
6.2 Three pillars of interoperability and conformance testing (Part 6 and above) .....	21
6.3 Understanding the structure of the IEC 61850 documentation .....	22
6.4 IEC 61850 data modelling .....	24
6.4.1 Main principle (explained in IEC 61850-7-1) .....	24
6.4.2 Standard name space introduction .....	25
6.4.3 Name space extension .....	26
6.5 IEC 61850 communication services .....	26
6.6 IEC 61850 SCL language .....	28
6.7 IEC 61850 data and communication security .....	29
6.8 IEC 61850 conformance testing.....	29
6.9 UCA/IEC 61850 international users group .....	30
6.10 IEC 61850 maintenance .....	30
6.11 Quality assurance process .....	30
7 IEC 61850 system life cycle.....	31
7.1 Reason for inclusion.....	31
7.2 Engineering-tools and parameters .....	31
7.3 Main tools and configuration data flows .....	32
7.4 Quality and life-cycle management.....	32
7.5 General requirements.....	32
Figure 1 – Scope of application of IEC 61850 .....	14
Figure 2 – Power utility control system reference architecture (IEC 62357).....	15
Figure 3 – IEC 61850 specifying approach.....	16
Figure 4 – Interface model within substation and between substations.....	17
Figure 5 – Relationship between functions, logical nodes, and physical nodes (examples).....	19
Figure 6 – Links between IEC 61850 parts.....	22

Figure 7 – IEC 61850 Data modelling.....	24
Figure 8 – Basic reference model.....	28
Figure 9 – Exchange of system parameters .....	31

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[IEC TR 61850-1:2013](#)

<https://standards.iteh.ai/catalog/standards/sist/0c796440-7677-4c72-80b5-f9c262638342/iec-tr-61850-1-2013>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMUNICATION NETWORKS AND SYSTEMS  
FOR POWER UTILITY AUTOMATION –****Part 1: Introduction and overview**

## 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 61850-1, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- Extended application scope of the IEC 61850 standard
  - for the power quality domain;
  - for statistical and historical data;

- for distributed generation monitoring and automation purpose;
- for feeder automation purpose;
- for substation to substation communication;
- for monitoring functions according to IEC 62271.
- Smart grid considerations.
- Extensions (and provisions for extensions) of the documentation system relating to IEC 61850, especially with part 7-5xx (Application guides) and part 90-xx (Technical report and guidelines).

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

Enquiry draft	Report on voting
57/1233/DTR	57/1304/RVC

Full information on the voting for the approval of this technical report 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.

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

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

- reconfirmed, <https://standards.iteh.ai/catalog/standards/sist/0c796440-7677-4c72-80b5-f9c262638342/iec-tr-61850-1-2013>
- 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.**

## INTRODUCTION

IEC 61850 consists of the following parts, under the general title *Communication networks and systems for power utility automation* (all parts may have not been published yet).

- 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 – Principles and models
- Part 7-2: Basic communication structure – Abstract communication service interface (ACSI)
- Part 7-3: Basic communication structure – Common data classes
- Part 7-4: Basic communication structure – Compatible logical node classes and data classes
- Part 7-410: Hydroelectric power plants – Communication for monitoring and control
- Part 7-420: Basic communication structure – Distributed energy resources logical nodes
- Part 7-5: IEC 61850 – Modelling concepts<sup>1</sup>
- Part 7-500: Use of logical nodes to model functions of a substation automation system<sup>1</sup>
- Part 7-510: Use of logical nodes to model functions of a hydro power plant
- Part 7-520: Use of logical nodes to model functions of distributed energy resources<sup>1</sup>
- 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 80-1: Guideline to exchange information from a CDC based data model using IEC 60870-5-101/104
- Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3
- Part 90-1: Use of IEC 61850 for the communication between substations
- Part 90-2: Using IEC 61850 for the communication between substations and control centres<sup>1</sup>
- Part 90-3: Using IEC 61850 for condition monitoring<sup>1</sup>
- Part 90-4: Network Engineering Guidelines - Technical report<sup>1</sup>
- Part 90-5: Using IEC 61850 to transmit synchrophasor information according to IEEE C37.118
- Part 10: Conformance testing

In addition to the above parts IEC technical committee 88 has published the IEC 61850 basic communication structure for Wind Turbines as IEC 61400-25, *Wind turbines – Communications for monitoring and control of wind power plants*.

IEC 61850-1 is an introduction and overview of the IEC 61850 standard series. It describes the philosophy, work approach and contents of the other parts.

---

<sup>1</sup> Under consideration.



# COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

## Part 1: Introduction and overview

### 1 Scope

This technical report is applicable to *power utility automation systems* (PUAS). It defines the communication between intelligent electronic devices (IEDs) in such a system, and the related system requirements.

This part gives an introduction and overview of the IEC 61850 standard series. It refers to and might include text and figures coming from other parts of the IEC 61850 standard series.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60870-5-103, *Telecontrol equipment and systems – Part 5-103: Transmission Protocols - Companion standard for the informative interface of protection equipment*

IEC TR 61850-1:2013

IEC 60870-5-104, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IEC 61400-25 (all parts), *Communications for monitoring and control of wind power plants*

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

IEC 61850-3, *Communication networks and systems in substations – Part 3: General requirements*

IEC 61850-4, *Communication networks and systems for power utility automation – Part 4: System and project management*

IEC 61850-5, *Communication networks and systems in substations – 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, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61850-7-410, *Communication networks and systems for power utility automation – Part 7-410: Hydroelectric power plants – Communication for monitoring and control*

IEC 61850-7-420, *Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources logical nodes*

IEC 61850-7-510, *Communication networks and systems for power utility automation – Part 7-510: Basic communication structure – Hydroelectric power plants – Modelling concepts and guidelines*

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 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*

**iTeh STANDARD PREVIEW**

IEC 61850-9-2, *Communication networks and systems for power utility automation – Part 9-2: Specific communication service (mapping SCSM) – Sampled values over ISO/IEC 8802-3*

IEC/TR 61850-90-1, *Communication networks and systems for power utility automation – Part 90-1: Use of IEC 61850 for the communication between substations*

IEC 61850-10, *Communication networks and systems in substations – Part 10: Conformance testing*

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

IEC/TR 62357-1, *Power systems management and associated information exchange – Part 1: Reference architecture*

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

ISO 9001:2008, *Quality management systems – Requirements*

IEEE C37.2, *IEEE standard electrical power system device function numbers, acronyms and contact designations*

IEEE 100:2000, *The authoritative dictionary of IEEE standards terms seventh edition*

IEEE-SA TR 1550, *Utility Communications Architecture (UCA) Version 2.0 – Part 4: UCA Generic Object Models for Substation and Feeder Equipment (GOMSFE)*

RFC 2246, *The TLS Protocol, Version 1.0*

### 3 Terms, definitions and abbreviations

#### 3.1 Terms and definitions

For the purposes of this Technical Report, the following terms and definitions apply. However please refer to part 2 of the standard for the standard glossary of IEC 61850.

##### 3.1.1

#### **Abstract Communication Service Interface ACSI**

virtual interface to an IED providing abstract communication services, for example connection, variable access, unsolicited data transfer, device control and file transfer services, independent of the actual communication stack and profiles used

##### 3.1.2

#### **bay**

subpart of a substation, having some common functionality, closely connected to the other subparts, and forming a substation

##### 3.1.3

#### **data object**

part of a logical node object representing specific information, for example, status or measurement. From an object-oriented point of view, a data object is an instance of a data object class. Data objects are normally used as transaction objects; i.e., they are data structures

##### 3.1.4

#### **device**

mechanism or piece of equipment designed to serve a purpose or perform a function, for example, breaker, relay or substation computer

[SOURCE: IEEE 100:2000]

##### 3.1.5

#### **functions**

tasks which are performed by the substation automation system, i.e. by application functions

Note 1 to entry: Generally, functions exchange data with other functions. The details are dependent on the functions in consideration. Functions are performed by IEDs (physical devices). Functions may be split in parts residing in different IEDs but communicating with each other (distributed function) and with parts of other functions. These communicating function parts are called logical nodes.

Note 2 to entry: In the context of this standard, the decomposition of functions or their granularity is ruled by the communication behaviour only. Therefore, all functions considered consist of logical nodes that exchange data.

##### 3.1.6

#### **Intelligent Electronic Device IED**

any device incorporating one or more processors with the capability of receiving or sending data/controls from or to an external source (for example, electronic multifunction meters, digital relays, controllers)

##### 3.1.7

#### **interchangeability**

ability to replace a device supplied by one manufacturer with a device supplied by another manufacturer, without making changes to the other elements in the system

### 3.1.8

#### **interoperability**

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

### 3.1.9

#### **Logical Node**

##### **LN**

smallest part of a function that exchanges data

Note 1 to entry: A LN is an object defined by its data and methods.

### 3.1.10

#### **Logical Device**

##### **LD**

virtual device that exists to enable aggregation of related logical nodes

### 3.1.11

#### **open protocol**

protocol whose stack is either standardised or publicly available

### 3.1.12

#### **part**

part of the IEC 61850 standard series

EXAMPLE Part 1 refers to IEC 61850-1, Part 7-2 refers to IEC 61850-7-2.

### 3.1.13

#### **Physical Device**

##### **PD**

equivalent to an IED as used in the context of this standard

[IEC TR 61850-1:2013](http://standards.iteh.ai/standards/iec-tr-61850-1-2013)

<http://standards.iteh.ai/context/iec-tr-61850-1-2013/iec-tr-61850-1-2013>

### 3.1.14

#### **process bus**

process bus is the communication network which connects the IEDs at primary equipment level to other IEDs

### 3.1.15

#### **protocol**

set of rules that determines the behaviour of functional units in achieving and performing communication

### 3.1.16

#### **Power Utility Automation System**

##### **PUAS**

set of communicating components or devices (IEDs) arranged in a communication architecture to perform any type of power utility automation functions

Note 1 to entry: Power Utility Automation System includes de facto Substation Automation system, as one possible sub-system.

### 3.1.17

#### **self-description**

a device contains information on its configuration

Note 1 to entry: The representation of this information has to be standardised and has to be accessible via communication (in the context of this standard series).

**3.1.18****station bus**

communication network which inter-connects IEDs at bay level and IEDs at station level, and connects bay-level IEDs to station-level IEDs

**3.1.19****system**

within the scope of this standard, system always refers to substation automation systems unless otherwise stated

**3.1.20****Specific Communication Service Mapping****SCSM**

standardised procedure which provides the concrete mapping of ACSI services and objects onto a particular protocol stack/communication profile

Note 1 to entry: To facilitate interoperability it is intended to have a minimum number of standardized mappings (SCSM). Special application subdomains such as “station bus” and “process bus” may result in more than one mapping. However, for a specific protocol stack selected only one single SCSM and one single profile should be specified.

Note 2 to entry: A SCSM should detail the instantiation of abstract services into protocol specific single service or sequence of services which achieve the service as specified in ACSI. Additionally, a SCSM should detail the mapping of ACSI objects into object supported by the application protocol.

Note 3 to entry: SCSMs are specified in the parts 8-x and 9-x of this standard series.

**3.2 Abbreviated terms**

ACSI	Abstract Communication Service Interface
CDC	Common Data Class
CIM	Common Information Model
DA	Data Attribute
DER	Distributed Energy Resource
DO	Data Object
EMC	Electromagnetic Compatibility
GSE	Generic Substation Event (communication model)
GSSE	Generic Substation State Event (communication model)
GOOSE	Generic Object Oriented System Event (communication model)
IED	Intelligent Electronic Device
LN	Logical Node
LD	Logical Device
PD	Physical Device
PUAS	Power Utility Automation System
SCL	System Configuration description Language
SCSM	Specific Communication Service Mapping
TLS	Transport Layer Security
VLAN	Virtual Local Area Network
XML	eXtensible Markup Language

## 4 Objectives

The possibility to build Power Utility Automation Systems (PUAS) rests on the strong technological development of large-scale integrated circuits, leading to the present availability of advanced, fast, and powerful microprocessors. The result was an evolution of substation secondary equipment, from electro-mechanical devices to digital devices. This in turn provided the possibility of implementing Power Utility Automation System using several intelligent electronic devices (IEDs) to perform the required functions (protection, local and remote monitoring and control, etc.). As a consequence, the need arose for efficient communication among the IEDs, especially for a standard protocol. Initially specific proprietary communication protocols developed by each manufacturer were used, requiring complicated and costly protocol converters when using IEDs from different vendors.

The industry's experiences have demonstrated the need and the opportunity for developing standard semantics, abstract communication services that can be mapped to different protocols, configuration descriptions and engineering processes, which would support interoperability of IEDs from different manufacturers. Interoperability in this case is the ability to operate on the same network or communication path sharing information and commands. There is also a desire to have IED interchangeability, i.e. the ability to replace a device supplied by one manufacturer with a device supplied by another manufacturer, without making changes to the other elements in the system. Interchangeability would also require standardisation of functions which is beyond this communication standard. Interoperability is a common goal for electric utilities, equipment vendors and standardisation bodies.

The objective of PUAS standardisation is to develop a communication standard that will meet functional and performance requirements, while supporting future technological developments. To be truly beneficial, a consensus must be found between IED manufacturers and users on the way such devices can freely exchange information.

The communication standard must support the operation functions within the substation and distributed throughout the power grid. Therefore, the standard has to consider the operational requirements, but the purpose of the standard is neither to standardise (nor limit in any way) the functions involved in substation operation nor their allocation within the Power Utility Automation System. The application functions will be identified and described in order to define their interface and then their communication requirements (for example, amount of data to be exchanged, exchange time constraints, etc.). The communication standard, to the maximum possible extent, should make use of existing standards and commonly accepted communication and engineering principles.

This standard aims to ensure, among others, the following features:

- That the complete communication profile is based on existing IEC/IEEE/ISO/OSI communication standards, if available.
- That the protocols used will be open and will support self-descriptive devices. It should be possible to add new functionality.
- That the standard is based on data objects related to the needs of the electric power industry.
- That the communication syntax and semantics are based on the use of common data objects related to the power system.
- That the communication services can be mapped to different state-of-the art protocols.
- That the communication standard considers the implications of the substation being one node in the power grid, i.e. of the Power Utility Automation System being one element in the overall power control system.
- That the complete topology of an electrical system (single line diagram), the generated and consumed information, and the information flow between all IEDs is specified, using a machine readable language.

## 5 Approach of the IEC 61850 standard

### 5.1 Scope of application

The main parts of the IEC 61850 standard were first published from 2002 to 2005. The standard was the result of nearly ten years of work within IEEE/EPRI on Utility Communications Architecture (UCA) (IEEE-SA TR 1550) and within the working group “Substation Control and Protection Interfaces” of IEC Technical Committee 57. The initial scope of IEC 61850 was standardisation of communication in substation automation systems.

The first edition of the standard was primarily related to protection, control and monitoring. From 2009 onwards the original parts of the IEC 61850 series have been updated and extended to cover also measurement (including statistical and historical data handling) and power quality. New parts of the standard will also be added to handle condition monitoring.

The concepts defined in IEC 61850 have been applied beyond the substation domain:

- The modelling of hydropower plants (see IEC 61850-7-410) distributed energy resources (see IEC 61850-7-420) are also covered by the IEC 61850 series.
- The modelling of wind turbines has been standardized, according to IEC 61850, within the IEC 61400-25 series, *Communications for monitoring and control of wind power plants*.
- The communication has also been extended to substation to substation communication (see IEC 61850-90-1).

IEC 61850 is planned to be applied to new areas such as:

- Communication to network control centre (IEC/TR 61850-90-2)<sup>2</sup>
- Feeder automation domain

Harmonization of IEC 61850 modelling with the IEC Common Information Model (CIM, IEC 61968/61970) is also considered as a high priority item to fulfil Smart Grid objectives.

Given the extended scope, today's naming of the IEC 61850 standard is *Communication networks and systems for power utility automation*. The final scope of application of IEC 61850 (and affiliates) is described in Figure 1.

---

<sup>2</sup> To be published.