



# TECHNICAL REPORT



---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 33.200

ISBN 978-2-8322-6418-8

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references .....	9
3 Terms and definitions .....	10
4 Methodology for profiling .....	11
4.1 General.....	11
4.2 IEC 61850 profiling concept .....	12
4.2.1 General .....	12
4.2.2 IEC 61850 profile definition.....	13
4.3 Basic Application Profiles (BAPs).....	14
4.4 Basic Application Interoperability Profiles (BAIOPs).....	16
4.5 Process from a use case to interoperability on SGAM function layer .....	18
4.6 Managing profiles .....	20
4.7 Implementation of BAPs in real projects.....	20
Annex A (informative) Example for BAP of distributed automation function “reverse blocking” using BAP template .....	21
A.1 Functional description.....	21
A.2 Description of use case and associated roles/actors .....	23
A.2.1 List of roles / actors .....	23
A.2.2 Use case .....	23
A.2.3 Sequence diagram of typical interactions.....	24
A.3 Logical architecture.....	25
A.4 Allocation variants (conditional) .....	25
A.5 Functional variants.....	25
A.5.1 Core functional variants .....	25
A.5.2 Noncore functional variants .....	25
A.6 Performance requirements.....	26
A.6.1 Functional related .....	26
A.6.2 Service related .....	26
A.7 Description of data model per actor.....	26
A.7.1 General .....	26
A.7.2 PTOC for blocked function (infeed bay) .....	27
A.7.3 PTOC for blocking function 1 to n (outflow bay(s)) .....	28
A.7.4 Monitoring .....	28
A.8 Communication services .....	29
A.9 Device related requirements (conditional) – Test behaviour .....	29
A.10 Engineering tool related requirements.....	29
A.11 Naming rules .....	29
A.12 Capabilities for testing .....	29
Annex B (informative) Example for BAP of “condition monitoring diagnosis functions of on-load tap changer” using BAP template .....	30
B.1 Functional description.....	30
B.2 Description of use case and associated roles/actors .....	32
B.2.1 List of roles / actors .....	32
B.2.2 Use case .....	33
B.2.3 Sequence diagram of typical interactions.....	34

B.3	Logical Architecture .....	37
B.3.1	Overview .....	37
B.3.2	Monitoring operation property .....	38
B.3.3	Monitoring operation counts.....	38
B.3.4	Monitoring contact abrasion.....	39
B.3.5	Monitoring LTC oil temperature and flow.....	39
B.3.6	Monitoring operation of oil filter unit.....	40
B.4	Allocation variants (conditional) .....	40
B.5	Functional variants.....	40
B.6	Performance requirements .....	40
B.6.1	Functional related .....	40
B.6.2	Service related .....	40
B.7	Description of data model per actor.....	41
B.7.1	General .....	41
B.7.2	SLTC .....	41
B.7.3	YLTC .....	44
B.7.4	TTRQ .....	44
B.7.5	TCTR.....	44
B.7.6	SIML.....	45
B.7.7	TTMP .....	45
B.7.8	KFIL .....	46
B.8	Communication services .....	46
B.9	Device related requirements (conditional) .....	46
B.10	Engineering tool related requirements .....	46
B.11	Naming rules .....	46
B.12	Capabilites for testing .....	46
Annex C (informative) Example for BAP of protection function “line distance protection” using BAP template .....		47
C.1	Functional description .....	47
C.2	Description of use case and associated roles/actors .....	47
C.2.1	List of roles / actors .....	47
C.2.2	Use case .....	48
C.2.3	Sequence diagram of typical interactions.....	49
C.3	Logical architecture.....	50
C.4	Allocation variants (conditional) .....	50
C.5	Functional variants.....	50
C.5.1	Core functional variants .....	50
C.5.2	Noncore functional variants (different features for testing) .....	51
C.6	Performance requirements).....	51
C.6.1	Functional related .....	51
C.6.2	Service related .....	51
C.7	Description of data model per actor.....	52
C.8	Communication services .....	54
C.8.1	General .....	54
C.8.2	Variant FA: .....	54
C.8.3	Variant FB: .....	55
C.9	Device related requirements (conditional) .....	55
C.9.1	Degraded operation behaviour.....	55
C.10	Engineering tool related requirements.....	56

C.11	Naming rules .....	56
C.12	Capabilites for testing .....	56
Annex D (informative)	Example of BAIOP for BAP reverse blocking (without process bus) .....	57
D.1	General.....	57
D.2	Test description .....	57
D.2.1	General .....	57
D.2.2	Normal sequence of reverse blocking .....	58
D.2.3	Functional description of test environment.....	60
D.2.4	Test reverse blocking – role blocking (without output to process).....	60
D.2.5	Test reverse blocking – role blocked.....	62
Annex E (informative)	Example of BAIOP for BAP of “condition monitoring diagnosis functions of on-load tap changer” .....	65
E.1	General.....	65
E.2	Test description .....	65
E.2.1	Overview .....	65
E.2.2	Sequence of monitoring the motor drive current value .....	66
Bibliography	.....	68
Figure 1	– Stakeholders collaborate in user groups to create a common IOP profile .....	12
Figure 2	– Framework for profiling IEC 61850 .....	13
Figure 3	– Aggregating BAPs.....	16
Figure 4	– Framework for testing a profile .....	18
Figure 5	– Relation between BAP and SGAM interoperability .....	19
Figure 6	– Device features covered by profiles depending on compatibility levels according to IEC Technical Committee 65, Industrial-process measurement, control and automation .....	19
Figure 7	– BAPs and BAIOPs as building blocks for user/project specific implementation and testing .....	20
Figure A.1	– Behaviour in the event of faults on an outflow bay .....	21
Figure A.2	– Behaviour in the event of busbar faults .....	22
Figure A.3	– List of roles / actors reverse blocking.....	23
Figure A.4	– Use case reverse blocking .....	23
Figure A.5	– Sequence diagram reverse blocking .....	24
Figure A.6	– Logical architecture reverse blocking .....	25
Figure B.1	– Structure of LTC .....	30
Figure B.2	– Overview of system configuration of LTC condition monitoring .....	31
Figure B.3	– Typical system configuration of LTC condition monitoring system .....	31
Figure B.4	– Use cases .....	33
Figure B.5	– Sequence diagram for monitoring operation property .....	34
Figure B.6	– Sequence diagram for monitoring operation counts.....	35
Figure B.7	– Sequence diagram for monitoring contact abrasion .....	35
Figure B.8	– Sequence diagram for monitoring oil temperature and flow .....	36
Figure B.9	– Sequence diagram for monitoring operation of oil filter unit.....	36
Figure B.10	– Logical architecture.....	37
Figure B.11	– Logical architecture for monitoring operation property.....	38

Figure B.12 – Logical architecture for monitoring operation counts .....	38
Figure B.13 – Logical architecture for monitoring contact abrasion.....	39
Figure B.14 – Logical architecture for monitoring LTC oil temperature and flow .....	39
Figure B.15 – Logical architecture for monitoring operation of oil filter unit.....	40
Figure C.1 – Use case distance protection .....	48
Figure C.2 – Sequence diagram distance protection .....	49
Figure C.3 – Logical architecture distance protection .....	50
Figure D.1 – Normal sequence of application function reverse blocking .....	58
Figure D.2 – Functional test environment.....	60
Figure D.3 – Test of role “blocking” .....	60
Figure D.4 – Test of role “blocked” .....	62
Figure E.1 – Sequence of monitoring the motor drive current value.....	66
Table A.1 – Selection of data attributes for PTOC of actor blocked .....	27
Table A.2 – Selection of data attributes for PTOC of actor blocking .....	28
Table A.3 – Selection of data attributes of PTOC for monitoring.....	28
Table B.1 – List of actors .....	32
Table B.2 – Selection of data attributes of SLTC .....	41
Table B.3 – Selection of data attributes of YLTC .....	44
Table B.4 – Selection of data attributes of TTRQ .....	44
Table B.5 – Selection of data attributes of TCTR .....	44
Table B.6 – Selection of data attributes of SIML.....	45
Table B.7 – Selection of data attributes of TTMP .....	45
Table B.8 – Selection of data attributes of KFIL .....	46
Table C.1 – Description of data model .....	52
Table C.2 – Services for variant FA .....	54
Table C.3 – Services for variant FB .....	55
Table C.4 – Degraded operation behaviours .....	56
Table D.1 – Description of normal operation of application function reverse blocking .....	58
Table D.2 – Description of sequence for test of role “blocking” .....	61
Table D.3 – Description of sequence for test of role “blocked” .....	63
Table E.1 – Description of the sequence of monitoring the motor drive current value .....	67

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

### COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

#### Part 7-6: Guideline for definition of Basic Application Profiles (BAPs) using 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.
- 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".

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

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
57/1986/DTR	57/2034/RVDTR

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 document 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 document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

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

**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

The IEC 61850 series of standards offers a broad basis for communication networks and systems in power utility automation. Due to its broad coverage of power utility automation applications, it is up to the standard's user (utility, vendor, system integrator, etc.) to pick and choose specific options from the standard in order to meet the requirements of the intended objective. As a consequence, implementations of IEC 61850 represent specific subsets of the standard.

In the context of standards the term “profile” is commonly used to describe a subset of an entity (e.g. standard, model, rules).

Accordingly an IEC 61850 standard profile contains a selection of data models (mandatory elements), applicable communication services and relevant engineering conventions (based on the Substation Configuration Language SCL defined in IEC 61850-6) for an application function of a specific use case in the domain of power utility automation.

Depending on the scope and objective different profile types can be distinguished:

- User profile – defined subset that is valid for a specific user / organization (e.g. utility)
- Product / device profile – implemented subset in a specific vendor product /device
- Domain profile – defined subset for a specific domain and relevant use cases (e.g. monitoring of substation)
- Application / function profile – subset covering a specific application or function (e.g. substation interlocking)

These profile types target the reduction of complexity and facilitation of interoperability for their specific scope and during engineering and device / substation lifetime. In order to achieve both these goals, a properly defined profile and appropriate implementations (processes, tools, products) that support the profile are required.



## COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

### Part 7-6: Guideline for definition of Basic Application Profiles (BAPs) using IEC 61850

#### 1 Scope

This part of IEC 61850, which is a technical report, is focused on building application / function profiles and specifies a methodology to define Basic Application Profiles (BAPs). These Basic Application Profiles provide a framework for interoperable interaction within or between typical substation automation functions. BAPs are intended to define a subset of features of IEC 61850 in order to facilitate interoperability in a modular way in practical applications.

It is the intention of this document to provide a common and generic way to describe the functional behaviour of a specific application function in the domain of power utility automation systems as a common denominator of various possible interpretations/implementations of using IEC 61850.

The guidelines in this document are based on the functional definitions of

- IEC 61850-5, Communication requirements for functions and device models, which gives a comprehensive overview of all application functions needed in a state-of-the-art substation automation implementation.
- IEC TR 61850-7-500, Basic information and communication structure – Use of logical nodes for modelling application functions and related concepts and guidelines for substations, which illustrates and explains application functions for the substation/protection domain of Logical Nodes in modelling simple and complex functions, to improve common understanding in modelling and data exchange, and finally to lead to interoperable implementations.
- IEC TR 61850-90-3, Using IEC 61850 for condition monitoring diagnosis and analysis, which gives use cases and data modelling for condition monitoring diagnosis and analysis functions for substation and power grid facilities.

This document does not describe the applications and respective implementation requirements; the focus is on their typical information exchange including data and communication services and engineering conventions.

#### 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 61850-5:2013, *Communication networks and systems for power utility automation - Part 5: Communication requirements for functions and device 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 TR 61850-90-3, *Communication networks and systems for power utility automation - Part 90-3: Using IEC 61850 for condition monitoring diagnosis and analysis*

IEC TR 62361-103:2018, *Power systems management and associated information exchange - Interoperability in the long term - Part 103: Standard profiling*