

PD IEC/TR 61850-90-8:2016



BSI Standards Publication

Communication networks and systems for power utility automation

Part 90–8: Object model for E-mobility

National foreword

This Published Document is the UK implementation of IEC/TR 61850-90-8:2016.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power systems management and associated information exchange.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.

Published by BSI Standards Limited 2016

ISBN 978 0 580 91427 0

ICS 33.200

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2016.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------



TECHNICAL REPORT



Communication networks and systems for power utility automation – Part 90-8: Object model for E-mobility

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.200

ISBN 978-2-8322-3256-9

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, definitions and acronyms.....	10
3.1 Terms and definitions.....	10
3.2 Acronyms.....	16
3.3 Abbreviated terms.....	16
4 Document integration and structure.....	17
5 The link between the power grid and electric vehicles.....	18
5.1 General.....	18
5.2 E-Mobility actors and their roles.....	19
5.3 E-Mobility use cases.....	20
5.3.1 General.....	20
5.3.2 Identification (ID) (D2 & D4).....	21
5.3.3 Charging status and control (E2 & E3).....	21
5.3.4 Use Case in System A for DC charging (E2 & E3).....	23
5.3.5 Common information model for electric vehicles.....	24
5.4 Description of information model.....	25
5.4.1 General.....	25
5.4.2 Plug present (PP) (AC and DC).....	25
5.4.3 Outlet charging current rating.....	26
5.4.4 EVSE charging power rating.....	26
5.4.5 Charging cable rating.....	26
5.4.6 Charging infrastructure supply cable characteristics.....	28
5.4.7 Available connection types.....	28
5.4.8 EV connection type.....	28
5.4.9 EV connection state (AC).....	29
5.4.10 EV connection state (DC).....	30
5.4.11 EVSE PWM signaling.....	31
5.4.12 EV identification.....	32
5.4.13 EVSE identification.....	33
5.4.14 EV charge parameters.....	33
5.4.15 State of charge (SOC).....	33
5.4.16 Isolation Test Fault.....	34
5.4.17 Short-circuit Test Fault.....	34
5.4.18 Welding detection.....	34
5.4.19 Loss of digital communication.....	34
5.4.20 Nameplate information.....	35
5.4.21 Data model references.....	35
5.4.22 Charge schedules.....	35
Annex A (informative) Common information model mappings for AC charging.....	39
A.1 General.....	39
A.2 Specific model definitions for basic charging with IEC 61851-1 support – Graphical representation of mapping IEC 61851-1 domain information.....	39

A.3	Specific model definitions for smart charging with ISO 15118 support – Graphical representation of mapping IEC 61851-1 and ISO 15118-2 domain information.....	39
Annex B (informative)	Common information model mappings for DC charging	41
B.1	General.....	41
B.2	Specific model definitions for IEC 61851-23/24 system A – DC charging – Graphical representation of mapping IEC 61851-23/24 system A domain information.....	41
B.3	Specific model definitions for IEC 61851-23/24 system C – DC charging – Graphical representation of mapping IEC 61851-23/24 system C domain information.....	42
Annex C (normative)	61850 Logical Nodes for Electric Mobility	44
C.1	Overview.....	44
C.2	New and existing logical nodes.....	44
C.2.1	LN: E-Mobility supply equipment Name: DESE.....	44
C.2.2	LN: E-Mobility AC charging outlet Name: DEAO.....	46
C.2.3	LN: E-Mobility DC charging outlet Name: DEDO	49
C.2.4	LN: E-Mobility Electric Vehicle Name: DEEV.....	52
C.2.5	LN: Power cable Name: ZCAB.....	54
C.2.6	LN: Schedule Name: FSCH	55
C.2.7	Schedule states (ScheduleStateKind enumeration)	57
C.2.8	Scheduling interval types (ScheduleIntervalKind enumeration).....	57
C.3	Example of an AC charging station model	58
C.3.1	General	58
C.3.2	Exploded view of DESE1 and DESE2	59
C.3.3	Exploded view of DEAO1 and DEAO2.....	59
C.3.4	Exploded view of DEEV1 and DEEV2	60
C.3.5	Exploded view of FSCH1 and FSCH2	61
C.4	Example of a DC charging station model (system A)	62
C.4.1	General	62
C.4.2	Exploded view of DESE1 and DESE2	63
C.4.3	Exploded view of DEDO1 and DEDO2	65
C.4.4	Exploded view of DEEV1 and DEEV2	66
Annex D (informative)	Information exchange between EV, EVSE and CIO for charge scheduling	68
Annex E (informative)	Architectural concepts (implementation guide).....	69
E.1	Overview.....	69
E.2	Architectural concept for mapping ISO 15118 to IEC 61850.....	69
E.3	Architectural concept for mapping IEC 61851-23/24 system A to IEC 61850	71
Annex F (informative)	Relevant standards for E-Mobility object model.....	72
F.1	Overview.....	72
F.2	Basic structure of IEC 62196 – Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles.....	72
F.3	Basic structure of IEC 61851 – Electric vehicle conductive charging system	73
F.4	Basic structure of ISO 15118 – Vehicle to grid communication interface	73
F.5	Basic structure of IEC 61980 – Electric vehicle wireless power transfer systems	75
Annex G (informative)	Typical use of data objects in the charger domains.....	76
Bibliography	79

Figure 1 – Overall structure of IEC 61850 parts	17
Figure 2 – Overview on document structure	18
Figure 3 – Conceptual organization of Logical Devices and Logical Nodes of DER systems	19
Figure 4 – Generic role model of relevant actors for smart charging EVs [CEN BT N987] 20	
Figure 5 – Communication architecture of System A	24
Figure 6 – IEC 61850 Logical Nodes overview, based on [IEEE VPPC2012]	25
Figure 7 – State of DC charging state in IEC 61851-23/24 system A	31
Figure 8 – Exemplary exchange of charge schedule information for an EVSE with one outlet, based on [IEEE VPPC2011]	37
Figure A.1 – Mapping of IEC 61851-1 domain information to IEC 61850-7-420 information model for AC charging	39
Figure A.2 – Mapping of ISO 15118-2 and IEC 61851-1 domain information to IEC 61850-7-420 information model for AC charging	40
Figure B.1 – Mapping of IEC 61851-23/24 system A domain information to IEC 61850-7-420 information model for DC charging	42
Figure B.2 – Mapping of IEC 61851-23/24 system C (ISO 15118-2 and IEC 61851-1) domain information to IEC 61850-7-420 information model for DC charging	43
Figure C.1 – Example of an AC charging station	58
Figure C.2 – Example of a DC charging station	63
Figure D.1 – EV, EVSE and CIO information exchange	68
Figure E.1 – Basic concept of mapping ISO 15118 V2G Communication Interface to IEC 61850 DERs with dedicated SECC in the EVSE managing one EV	69
Figure E.2 – Basic concept of mapping ISO 15118 V2G Communication Interface to IEC 61850 DERs with centralized SECC outside of EVSE managing a set of EVs	70
Figure E.3 – Basic concept of mapping IEC 61851-23/24 system A communication interface to IEC 61850 DERs	71
Figure F.1 – Overview of relevant E-Mobility ISO standards for the V2G interface, based on [EVS27 2013]	72
Figure F.2 – ISO 15118 document structure according to ISO/IEC 7498-1 OSI-layers, based on [IEEE VPPC2012]	75
Table 1 – Overview of use cases relevant to secondary actors [ISO 15118-1:2013]	21
Table 2 – Selected use cases E2 and E3 from [ISO 15118-1:2013]	22
Table 3 – Data objects for plug present	26
Table 4 – Data object for charging current rating	26
Table 5 – Data object for charging power rating	26
Table 6 – Resistor coding for vehicle AC connectors and plugs [IEC 61851-1]	27
Table 7 – Data object for AC charging cable rating	27
Table 8 – Data object for DC charging cable rating	27
Table 9 – Data objects allowing overload of a cable	28
Table 10 – Data objects for supported connection types of an outlet	28
Table 11 – Data object showing the selected connection type of an EV	29
Table 12 – Functions of control pilot pin [IEC 61851-1]	29
Table 13 – Data object showing the connection status on an outlet	30
Table 14 – DC connection status in IEC 61851-23/24 system A	30

Table 15 – Maximum current to be drawn by vehicle [IEC 61851-1].....	32
Table 16 – Data objects for handling PWM related features on an outlet	32
Table 17 – Data object for EV nameplate information.....	32
Table 18 – Data object for EVSE nameplate information	33
Table 19 – Data objects for target setting and limit	33
Table 20 – Data object for showing SOC from the EV	34
Table 21 – Data object for status of an isolation test.....	34
Table 22 – Data object for status of a short-circuit test	34
Table 23 – Data object for status of welding test.....	34
Table 24 – Data object for loss of digital communication	35
Table 25 – Data objects for nameplate information	35
Table 26 – Data objects for logical node references.....	35
Table 27 – Data objects for a Local Limit Profile power schedule	38
Table 28 – Data objects for a Local Reservation Profile power schedule	38
Table C.1 – E-Mobility supply equipment logical node.....	45
Table C.2 – E-Mobility AC charging outlet logical node	47
Table C.3 – Literals of EVACConnectionStateKind.....	48
Table C.4 – Literals of EVACPlugStateKind	48
Table C.5 – Literals of EVACCableCapabilityKind	49
Table C.6 – E-Mobility DC charging outlet logical node	50
Table C.7 – Literals of EVDCConnectionStateAKind	51
Table C.8 – Literals of EVDCConnectionStateCKind	51
Table C.9 – Literals of EVDCCableCapabilityKind.....	52
Table C.10 – Literals of EVDCPlugStateKind	52
Table C.11 – E-Mobility electric vehicle logical node.....	53
Table C.12 – Literals of EVConnectionChargingKind.....	54
Table C.13 – Additions to power cable logical node	54
Table C.14 – Schedule logical node	56
Table C.15 – Literals of ScheduleStateKind	57
Table C.16 – Literals of ScheduleIntervalKind	58
Table C.17 – Example logical node instances	59
Table C.18 – Exploded view of DESE1 and DESE2	59
Table C.19 – Exploded view of DEAO1 and DEAO2.....	60
Table C.20 – Exploded view of DEEV1 and DEEV2	61
Table C.21 – Exploded view of FSCH1 and FSCH2	62
Table C.22 – Example logical node instances	63
Table C.23 – Exploded view of DESE1 and DESE2	64
Table C.24 – Exploded view of DEDO1 and DEDO2	65
Table C.25 – Exploded view of DEEV1 and DEEV2	67
Table G.1 – Use of data objects in charging systems	77

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMUNICATION NETWORKS AND SYSTEMS
FOR POWER UTILITY AUTOMATION –****Part 90-8: Object model for E-mobility****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 TR 61850-90-8, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

Enquiry draft	Report on voting
57/1603/DTR	57/1651/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 website under "<http://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.

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

This part of IEC 61850-90, which is a technical report, describes how current standardization for Electric Road Vehicles (EV) and the Vehicle-to-Grid Communication Interface can be linked to IEC 61850-7-420, which deals with Distributed Energy Resources (DER). This technical report provides necessary background information and proposes an object model for E-Mobility in order to establish an EV plugged into the power grid as DER according to the principles of IEC 61850-7-420. The basic information modeling in IEC 61850 and IEC 61850-7-420 already covers a lot of needs for the E-Mobility domain. Missing parts can be modeled as new logical nodes and data objects, which this technical report defines.

NOTE Editorial Notes on this technical report are summarized in Annex G.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 90-8: Object model for E-mobility

1 Scope

This part of IEC 61850-90, which is a technical report, shows how IEC 61850-7-420 can be used to model the essential parts of the E-Mobility standards related to Electric Vehicles and Electric Vehicle Supply Equipments (IEC 62196, IEC 61851, IEC 15118) and the Power system (IEC 61850-7-420), in order to secure a high level of safety and interoperability.

The namespace of this document is:

- “(TR) IEC 61850-90-8:2015”

The name space "IEC 61850-90-8" is considered as "Transitional" since the model is expected to be included in the next edition of IEC 61850-7-420¹. Potential extensions/modifications may happen if/when the model is given International Standard status. The most optimal backward compatibility with the original content will be strived for during this move.

In accordance with the status of the ISO 15118 series and systems determined in IEC 61851-23 and -24, this technical report focuses on EV charging processes only. Discharging processes in order to support grid services are out of scope, but will be adopted when available in future versions of ISO 15118-2 and IEC 61851-1, -23 and -24.

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 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 61850-7-420:2009, *Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources logical nodes*

IEC 61851-1:2010, *Electric vehicle conductive charging system – Part 1: General requirements*

IEC 61851-21-1:–, *Electric vehicle conductive charging system – Part 21-1: Electric vehicle onboard charger EMC requirements for conductive connection to a.c./d.c. supply*¹

IEC 61851-21-2:–, *Electric vehicle conductive charging system – Part 21-2: EMC requirements for OFF board electric vehicle charging systems*¹

¹ To be published.