INTERNATIONAL STANDARD

ISO 15118-1

Second edition
2019-04

Road vehicles — Vehicle to grid communication interface —

Part 1: General information and use-case definition

Véhicules routiers — Interface de communication entre véhicule et réseau électrique —
Partie 1: Informations générales et définition de cas d'utilisation

Reference number
ISO 15118-1:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared jointly by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*, and Technical Committee IEC/TC 69, *Electric road vehicles and electric industrial trucks.* The draft was circulated for voting to the national bodies of both ISO and IEC.

This second edition cancels and replaces the first edition (ISO 15118-1:2013) which has been technically revised. The main changes compared to the previous edition are as follows:

— new use cases and requirements for wireless communication, wireless power transfer, automatic connection devices and bidirectional power transfer have been added; and

— as usage of private data and cyber security are becoming an important concern for users, requirements for more traceability and data privacy have also been added.

A list of all parts in the ISO 15118 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The pending energy crisis and the necessity to reduce greenhouse gas emissions have led vehicle manufacturers to make a very significant effort to reduce the energy consumption of their vehicles. They are presently developing vehicles partly or completely propelled by electric energy. Those vehicles will reduce the dependency on oil, improve global energy efficiency and reduce the total CO_2 emissions for road transportation if the electricity is produced from renewable sources. To charge the batteries of such vehicles, specific charging infrastructure is required.

Much of the standardisation work on dimensional and electrical specifications of the charging infrastructure and the vehicle interface is already treated in the relevant ISO or IEC groups. However, the question of the interoperability of information transfer between the vehicle, the local installation and the grid is also of the upmost importance.

Such communication is beneficial for the optimisation of energy resources and energy production systems as vehicles can charge or discharge at the most economic or most energy-efficient instants. It is also required to develop efficient and convenient payment systems in order to cover the resulting micro-payments. The necessary communication channel can serve in the future to contribute to the stabilisation of the electrical grid as well as to support additional information services required to operate electric vehicles efficiently.

The requirements of this document form the basic framework for all use cases descriptions and related documents in the ISO 15118 series. This document is the result of a large consensus among all the actors of the electro mobility and is a guideline for implementers of the ISO 15118 series.

Road vehicles — Vehicle to grid communication interface —

Part 1: General information and use-case definition

1 Scope

This document, as a basis for the other parts of the ISO 15118 series, specifies terms and definitions, general requirements and use cases for conductive and wireless HLC between the EVCC and the SECC.

This document is applicable to HLC involved in conductive and wireless power transfer technologies in the context of manual or automatic connection devices.

This document is also applicable to energy transfer either from EV supply equipment to charge the EV battery or from EV battery to EV supply equipment in order to supply energy to home, to loads or to the grid.

This document provides a general overview and a common understanding of aspects influencing identification, association, charge or discharge control and optimisation, payment, load levelling, cybersecurity and privacy. It offers an interoperable EV-EV supply equipment interface to all e-mobility actors beyond SECC.

The ISO 15118 series does not specify the vehicle internal communication between battery and other internal equipment (beside some dedicated message elements related to the energy transfer).

NOTE 1 Electric road vehicles specifically are vehicles in categories M (used for carriage of passengers) and N (used for carriage of goods) (compare ECE/TR ANS/WP.29/78 ev.2). This does not prevent vehicles in other categories from adopting the ISO 15118 series as well.

NOTE 2 This document is destined to orientate the message set of ISO 15118-2 and ISO 15118-20[1)]. The absence of any particular use case in this document does not imply that it will not be put into practice, with the required messages.

NOTE 3 This document, ISO 15118-2 and ISO 15118-20 are designed to work independent of data transfer medium used. However, the ISO 15118 series is made for fitting the specified data link layers in the corresponding documents in this series.

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.

ISO/TR 8713, *Electrically propelled road vehicles — Vocabulary*

ISO 15118-2, *Road vehicles — Vehicle to grid communication interface — Part 2: Network and application protocol requirements*

ISO 15118-3, *Road vehicles — Vehicle to grid communication interface — Part 3: Physical and data link layer requirements*

1) Under preparation. Stage at the time on publication: ISO/DIS 15118-20:2019.

ISO 15118-8, *Road vehicles — Vehicle to grid communication interface — Part 8: Physical layer and data link layer requirements for wireless communication*

ISO 15118-20[2)], *Road vehicles — Vehicle to grid communication interface — Part 20: 2nd generation network and application protocol requirements*

EN 50549-1, *Requirements for generating plants to be connected in parallel with distribution networks — Part 1: Connection to a LV distribution network — Generating plants up to and including Type B*

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

IEC 61980-2, *Electric vehicle wireless power transfer (WPT) systems — Part 2 specific requirements for communication between electric road vehicle (EV) and infrastructure with respect to wireless power transfer (WPT) systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 8713 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 General terms

3.1.1
actor
entity which characterizes a role played by a user or any other system that interacts with the subject

3.1.2
ancillary services
services necessary for the operation of an electric power system provided by the system operator and/or by power system users

[SOURCE: IEC IEV Electropedia, 617-3-9, modified — The Note has been removed.]

3.1.3
association
procedure to establish the wireless communication between the *SECC* (3.1.68) controlling the charging infrastructure [e.g. coils for *WPT* (3.1.76)] and the *EVCC* (3.1.31)

3.1.4
authentication
procedure between the *EVCC* (3.1.31) and the *SECC* (3.1.68) or between the USER and the *EV* (3.1.30) supply equipment or the SA, to prove that the provided information [see *identification* (3.1.49)] is either correct, valid, or it belongs to the EVCC, the USER or the SECC

3.1.5
authorization
procedure to verify if an *EV* (3.1.30) is allowed to *charge* (3.1.12) or *discharge* (3.1.22)

3.1.6
automatic connection device
ACD
components supporting the automatic connection and disconnection process for conductive energy transfer between an *EV* (3.1.30) and the *EV supply equipment* (3.1.33 and 3.1.34)

2) Under preparation. Stage at the time of publication: ISO/DIS 15118-20:2019.

3.1.7
basic signalling
physical signalling according to the *pilot function* (3.1.55)

Note 1 to entry: This definition is provided by IEC 61851-1:2017, Annex A.

3.1.8
battery management system
BMS
electronic device that controls or manages the electric and thermal functions of the battery system and that provides communication between the battery system and other vehicle controllers

3.1.9
bidirectional power converter
BPC
stabilized power supply device which delivers *BPT* (3.1.10) functions

3.1.10
bidirectional power transfer
BPT
combination of forward or reverse power transfer sequences

3.1.11
certificate
electronic document which uses a digital signature to bind a public key with an identity

Note 1 to entry: The ISO 15118 series describes several certificates covering different purposes, e.g. the contract certificate including the EMAID and *OEM* (3.1.52) provisioning certificates.

3.1.12
charge

store electrical energy in the vehicle battery

Note 1 to entry: In the first edition of this document, the words “charge” or “charging” were used intensively as a generic term. In this edition, in order to be more precise and to cover with one word *forward* (3.4.1) and *Reverse Power Transfer* (3.4.2) the terms “charge” and its declinations have been replaced by “energy transfer” when appropriate. When energy transfer is used in a sentence, this means that both directions of power flow are possible.

Note 2 to entry: The term “charge” (and the associated verb) has in this text a precise definition in relation to the amount of energy stored in the *EV* (3.1.30) battery which can be different than the total energy transferred to the EV.

Note 3 to entry: In some sentences, the word “charging” is still used. For example, the words “charging site” are still used.

3.1.13
charger
power converter that performs the necessary functions for charging a battery

3.1.14
charging station operator
CSO
EV supply equipment operator
secondary actor (3.1.64) responsible for the installation and operation of a charging infrastructure (including charging sites) and the management of electricity to provide the requested energy transfer services

Note 1 to entry: The term CPO (Charge Point Operator) is also used in the ISO 15118 series. This term is not recommended for trademark reasons.

3.1.15
communication session
sequence of time where the *EVCC* (3.1.31) and the *SECC* (3.1.68) interactively exchange digital information in order to manage charging or discharging the *EV* (3.1.30) battery

Note 1 to entry: A communication session can be paused and resumed later several times. The communication session encapsulates zero or more *energy transfer periods* (3.1.37).

3.1.16
contactor
electrically controlled switch used for switching a power circuit

Note 1 to entry: Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current.

Note 2 to entry: As far as communication is concerned, the contactor occurs as a *trigger* (3.1.70) for the power supply.

3.1.17
credential
document attesting the permission of the *EV* (3.1.30) to be *charged* (3.1.12) or to *discharge* (3.1.22)

3.1.18
demand and prognosis
function that covers the collection of grid and local installation conditions which applies to the actual energy transfer process

EXAMPLE The *sales tariff table* (3.1.63) containing a price, CO_2 content and percentage of renewable energy information vs. time based on grid, energy production, energy demand and customer contract information, along with an optional contract-based current limitation. The *grid schedule* (3.1.46) containing a current vs. time limitation at the specific *EV* (3.1.30) supply equipment due to local installation and local electricity demand situation.

3.1.19
demand clearing house
DCH
entity for grid negotiation that provides information on the load of the grid

Note 1 to entry: The demand clearing house mediates between two clearing partners: an *SECC* (3.1.68) and the part of the power grid connected to this SECC. Most likely this function will be served by a system operator.

Note 2 to entry: Demand clearing house and *meter operator* (3.1.51) may exchange information with each other as well as with other *actors* (3.1.1).

EXAMPLE A DCH typically fulfils the following tasks:

— Collect all necessary information from all parts of the power grid, e.g. current or forecasted load of local transformers, distribution grid, power substation, transmission grid, transmission substation, power plants (including renewable energies) and predicted *energy transfer schedules* (3.1.39) submitted by *EVCCs* (3.1.31).

— Consolidate the collected grid information to a “grid profile” and offer it to SECCs/EVCCs.

— Provide energy transfer schedule proposal for the connected *EV* (3.1.30) to the requesting SECC based on the collected grid profile.

— Inform the SECC as to the necessity for an updated energy transfer schedule if the grid profile has changed.

— On the contrary, the SECC will inform the demand clearing house if the EV's energy transfer schedule has changed.

3.1.20
distributed energy resources
DER
distributed set of one or more energy service resources, including generators, energy storage and controllable load, that can be used to deliver *ancillary services* (3.1.2)

3.1.21
departure time
point in time when the user intends to unplug the car and/or leave the charging site

3.1.22
discharge
release the electric charge of the vehicle battery

3.1.23
discovery
phase in which an *EV* (3.1.30) obtains a list of available *SECCs* (3.1.68) in its wireless communication range

3.1.24
distribution system operator
DSO
entity responsible for the voltage stability in the distribution grid

Note 1 to entry: Electricity distribution is the final stage in the physical delivery of electricity to the delivery point, e.g. end user, EV supply equipment (3.1.33 and 3.1.34) or parking operator.

Note 2 to entry: A distribution system network carries electricity from the transmission grid and delivers it to consumers. Typically, the network would include medium-voltage power lines, electrical substations and low-voltage distribution wiring networks with associated equipment.

3.1.25
e-mobility needs
mobility needs expressed by the *EV* (3.1.30) user in terms of *departure time* (3.1.21), *minimum* (3.5.1) and *maximum energy request* (3.5.2) and target energy request

3.1.26
e-mobility operator clearing house
EMOCH

entity mediating between two clearing partners to provide validation services for roaming regarding contracts of different *EMSPs* (3.1.27)

Note 1 to entry: EMOCH mediates for the purpose of:

— collecting all necessary contract information like the EMAID, the EMSP, the communication path to the EMSP, roaming fees, begin and end dates of the contract, etc.;

— providing the *SECC* (3.1.68) with confirmation that an EMSP will pay for a given EMAID [*authorization* (3.1.5) of valid contract]; and

— transferring an *SDR* (3.1.66) after each *energy transfer period* (3.1.37) to connect the EMSP and the *EP* (3.1.29) of the identified contract.

Note 2 to entry: The EMOCH, EMSP and *meter operator* (3.1.51) may exchange information with each other as well as other *actors* (3.1.1).

3.1.27
e-mobility service provider
EMSP
entity with which the customer has a contract for all services related to the *EV* (3.1.30) operation

Note 1 to entry: Typically, the EMSP will include some of the other *actors* (3.1.1), like the spot operator or *EP* (3.1.29), and has a close relationship with the *distribution system operator* (3.1.24) and *meter operator* (3.1.51). An *OEM* (3.1.52) or utility could also fulfil such a role.

Note 2 to entry: The EMSP validates EMAIDs from his customers, which were received either from the *EMOCH* (3.1.26), other EMSPs or spot operators the customer is in relation with.

Note 3 to entry: The EMSP issues EMAIDs to his customers.

3.1.28
electric energy meter
EEM
equipment for measuring electrical energy by integrating power with respect to time

Note 1 to entry: The equipment complies with IEC 62052-11 and IEC 62053-21, IEC 62053-52.

Note 2 to entry: Some *use cases* (3.1.71) need the amount of electric energy measured by the electric energy meter and communicated through the *SECC* (3.1.68) to the *EVCC* (3.1.31), while other scenarios do not need a separate electric energy meter. The *EV* (3.1.30) may get this information and use it according to the *OEM's* (3.1.52) intentions.

3.1.29
electricity provider
EP
entity whose activity is the wholesale purchase of electricity and the subsequent direct resale to a client through a contract

Note 1 to entry: The provider may also deliver energy related services.

Note 2 to entry: Provider can generate flexibilities through modulation of electricity prices (Time-of-Use, Critical Peak Prices...), flexibilities which can have value on energy markets and/or for network operations.

3.1.30
electric vehicle
EV
all road vehicles, including plug-in hybrid road vehicles (PHEV), that derive all or part of their energy from on-board rechargeable energy storage systems (RESS)

[SOURCE: IEC 61851-1:2017, 3.1.32]

3.1.31
electric vehicle communication controller
EVCC
embedded system, within the vehicle, that implements the communication between the vehicle and the *SECC* (3.1.68) in order to support specific functions

Note 1 to entry: Such specific functions could be e.g. controlling input and output channels, encryption or data transfer between the vehicle and the SECC.

3.1.32
electric vehicle power system
EV power system
equipment or combination of equipment providing dedicated functions to supply electric power in both directions:

— from an electrical installation or supply network to an *EV* (3.1.30) for the purpose of charging; and

— from a *DER* (3.1.20) in the EV to supply network or the grid for the purpose of discharging

Note 1 to entry: The former function is equal to the *EV supply equipment* (3.1.33 and 3.1.34), provided by IEC 61851-1.

3.1.33
electric vehicle supply equipment
EV supply equipment
<*conductive power transfer*> conductors, including the phase(s), neutral and protective earth conductors, the *EV* (3.1.30) couplers, attached plugs, and all other accessories, devices, *power outlets* (3.1.58) or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the EV and allowing communication between them as necessary

Note 1 to entry: This document will keep the wording "EV supply equipment" for any energy transfer process but the definition will depend on the technology used.

3.1.34
electric vehicle supply equipment
EV supply equipment
<*wireless power transfer*> off-board electronics that supply the electric power through the primary and secondary device to the *EV* (3.1.30) including all housings and covers

[SOURCE: IEC 61980-1:2015, 3.3]

3.1.35
electronic control unit
ECU
unit providing information regarding the vehicle

3.1.36
energy management system
EMS
system that controls the electric power transfer among the *DER* (3.1.20), premises appliances and the grid

Note 1 to entry: The EMS is similar to the HEMS or *PNEMS* (3.1.57).

3.1.37
energy transfer period
sequence of time between the beginning of energy transfer and the end of the energy transfer

EXAMPLE 1 One or many periods of charging or discharging the battery, doing pre-conditioning or post-conditioning.

EXAMPLE 2 Energy transfer can be achieved, for example, through a cable connection or though *WPT* (3.1.76).

EXAMPLE 3 End of energy transfer can be achieved, for example, with the disconnection of the cable or with leaving the parking place.

3.1.38
energy transfer scenario
combination of *use case* (3.1.71) elements to fulfil a specific energy transfer use case

3.1.39
energy transfer schedule
scheme which contains the power limits for charging or discharging the battery during an *energy transfer period* (3.1.37)

Note 1 to entry: The *EV* (3.1.30) should apply the negotiated limits as close as possible, to allow power balancing for the *EMS* (3.1.36) or the *DSO* (3.1.24).

EXAMPLE The schedule is calculated based on the *target setting* (3.1.69), *sales tariff table* (3.1.63) and *grid schedule* (3.1.46) information, respecting the corresponding current limitations, i.e. using the lowest current value.

3.1.40
energy transfer method
element which allows the *EV* (3.1.30) to select its desired energy transfer methods in case both the *EV supply equipment* (3.1.33 and 3.1.34) and the EV support multiple energy transfer methods and different plugs and sockets

Note 1 to entry: See IEC 62196.

3.1.41
EV supply equipment ID
EVSEID
unique *identification* (3.1.49) of the *EV supply equipment* (3.1.33 and 3.1.34)

3.1.42
external identification means
EIM
external means that authorized the coupled *EV* (3.1.30) to be served by services from the *EV supply equipment* (3.1.33 and 3.1.34)

EXAMPLE NFC, RFID, SMS credit/debit card, smartphone or web application, phone call.

Note 1 to entry: EIM also support "charging for free" (fair mode) to be given a positive *authorization* (3.1.5) every time.

3.1.43
fast responding services
services adapted to energy *secondary actors'* (3.1.64) real-time constraints leading to data exchanges limited to energy level boundaries

Note 1 to entry: Energy secondary actors' real-time constraints are in the order of a few seconds.

3.1.44
fleet operator
FO
person or legal entity operating several *EVs* (3.1.30) and who can have the contracts with the *EMSP* (3.1.27)

3.1.45
flexibility operator
party which aggregates flexibilities for its customers

3.1.46
grid schedule
function which sets the power level at a specific time based on the local grid situation

Note 1 to entry: Parameters to calculate the grid schedule are e.g. local grid demand and supply situation, actual and forecast.

3.1.47
high level communication
HLC
bidirectional digital communication using protocol and messages and physical and data link layers

Note 1 to entry: As specified in the ISO 15118 series.

Note 2 to entry: HLC in the ISO 15118 series is compliant with the term digital communication in SAE J1772, SAE 2836, SAE 2847 and SAE 2931.

3.1.48
human machine interface
HMI
interface allowing the *vehicle user* (3.1.75) to receive information relative to the energy transfer process and provide input to the energy transfer system

Note 1 to entry: All information from a user (input) or displayed to a user (output) will be performed through an HMI.

Note 2 to entry: The HMI could be implemented as a function of the *EV* (3.1.30), *EV supply equipment* (3.1.33 and 3.1.34), mobile phone, etc.

3.1.49
identification
procedure for the *EVCC* (3.1.31) or USER to provide its identifying information for the purpose of *authorization* (3.1.5), mostly to provide its capability for payments

EXAMPLE Contract *certificate* (3.1.11), credit card number, etc. and/or procedure for the *SECC* (3.1.68) to provide the *EV supply equipment ID* (3.1.41) to the EVCC.

Note 1 to entry: For simplicity reasons, within the ISO 15118 series, the term "identification" includes also the *authentication* (3.1.4) of the provided identifying information, i.e. this information is correct, or it belongs to the EVCC, the USER or the SECC.

3.1.50
level selector
function to select the lowest value among the data issued from the *demand and prognosis* (3.1.18) function, and then to feed the result to scheduling function

Note 1 to entry: This function may be implemented in the *EV* (3.1.30) or the *EV supply equipment* (3.1.33 and 3.1.34).

3.1.51
meter operator
MO
body having the legal responsibility for the installation and maintenance of the *EEM* (3.1.28)

3.1.52
original equipment manufacturer
OEM
producer who manufactures products or components that are purchased by a company and retailed under that purchasing company's brand name

Note 1 to entry: The OEM refers to the company that originally manufactured the product.

Note 2 to entry: When referring to automotive parts, the OEM designates a replacement part made by the manufacturer of the original part.

3.1.53
pairing
process by which a vehicle is correlated with the unique *EV supply equipment* (3.1.33 and 3.1.34) at which it is located and from which the power will be transferred either through a cable or through a wireless technology

Note 1 to entry: The pairing process is sometimes called the "*association* (3.1.3) problem".

3.1.54
paying unit
PU
device on the *EV supply equipment* (3.1.33 and 3.1.34) side that offers payment methods

EXAMPLE Payment methods: *EIM* (3.1.42), cash, credit cards, etc.