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Road vehicles — Vehicle to grid communication interface —

Part 2: Network and application protocol requirements

*Véhicules routiers — Interface de communication entre véhicule et réseau électrique —
Partie 2: Exigences du protocole d'application et du réseau*

ICS: 43.120

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicle*, Subcommittee SC 31, *Data communication*.

This second edition cancels and replaces the first edition (ISO 15118-2:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Includes corrections of errors and inconsistencies;
- Missing parts added;
- Applied changes to achieve a Unified XML Scheme supporting all charging modes and needs;
- Communication requirements on reserve power transfer added;
- Includes requirements in regard to wireless power transfer (included from ISO 15118-7).

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

Introduction

The pending energy crisis and necessity to reduce greenhouse gas emissions started in the former century has led the vehicle manufacturers to a very significant effort to reduce the energy consumption of their vehicles up to the present. As countermeasures to this continuous problem, they developed vehicles partly or completely propelled by electricity power and launched them into the market. Those vehicles will reduce the dependency on oil, improve the global energy efficiency and reduce the total CO₂ emissions for road transportation if the electricity is produced from renewable sources. To charge electricity to the batteries of such vehicles, specific charging infrastructure was required.

Much of the standardization work on dimensional and electrical specifications of the charging infrastructure for electric vehicles and the vehicle interface were treated in the relevant ISO or IEC groups. However, the standardization work about direct information transfer between the electric vehicle and the charging infrastructure was not enough, but it was assigned to ISO 15118 series came to be treated sufficiently.

Such communication is necessary for the optimization of energy resources and energy production systems. With it electric vehicles can be connected to the supply network and communicate the most economic or most energy efficient way for charging/discharging. It is also required to develop efficient and convenient billing systems in order to cover the resulting payments. The necessary communication channel may serve in the future to contribute to the stabilization of the supply network as well as to support additional information services required to operate electric vehicles efficiently and economically.

After the standardization work of the first basic smart charging was completed, more standardization work for further evolved functions and high energy efficiency was continuously requested again.

It includes:

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- * Improved charge methods that reduces efforts and agonies of the charging operation,
 - * Extended functions for the electric vehicles to be utilized as distributed energy resources (enables smoothing of the electricity load of the supply network for higher energy efficiency, and also provide power back to the grid (e.g. for grid services or acting as a standalone power supply as an emergency lifeline),
 - * Information services for the user with higher added value and new convenience.

As for the communication system, the next evolution will be expected to realize these new applications.

Road vehicles — Vehicle to grid communication interface — Part 2: Network and application protocol requirements

1 Scope

This international standard specifies the communication between the electric vehicle (EV), including battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV), and the EV supply equipment. The application layer message sets defined in this revision of ISO 15118-2 are designed to support the electricity power transfer between an EV and an EV supply equipment.

The bidirectional electricity power transfer, use case of that was already included in edition 1.0 of part 1 but not included in part 2, was officially added to the scope of this standard. Herein edition 2.0 of part 2 defines the communication messages and sequence requirements for bidirectional power transfer.

Also the scope is widely extended in this revision, requirements of wireless communication for both conductive charging and wireless charging are defined. Additionally, requirements of communication for automatic connection device and information services about charging and control status are defined in this revision.

The purpose of this part 2 of ISO 15118 is to detail the communication between an electric vehicle communication controller (EVCC) and supply equipment communication controller (SECC). Aspects are specified to detect a vehicle in a communication network and enable an Internet Protocol (IP) based communication between EVCC and SECC.



Key

- 1 Scope of ISO 15118-2
- 2 Message definition considers use cases defined for communication between SECC to SA

Figure 1 — Communication relationship among EVCC, SECC and secondary actor

This part 2 defines messages, data model, XML/EXI based data representation format, usage of V2GTP, TLS, TCP and IPv6. These requirements belong to the area of from 3rd to 7th OSI layer model. In addition the document describes main service sequences of conductive charging, wireless power transfer and bidirectional power transfer, and how data link layer services can be accessed from a layer 3 perspective. The data link layer and physical layer functionality for wired communication is described in part 3 of this standard, and those of wireless communication are described in part 8 of this standard.

2 Normative references

The following referenced documents are required for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 15118-1, *Road vehicles — Vehicle to grid communication interface — Part 1: General information and use-case definition*

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

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

IEC 61851-1, Electric vehicle conductive charging system — Part 1: General requirements(Ed 2.0 2010)

IEC 61851-22, Electric vehicle conductive charging system - Part 22: AC electric vehicle charging station

IEC CDV 61851-23, Electric vehicle conductive charging system - Part 23: D.C. electric vehicle charging station (Ed 1.0 2012)

IEC 62196, Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles

IEC 61980-1, Electric vehicle wireless power transfer (WPT) systems - 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

IEC61980-3, Electric vehicle wireless power transfer (WPT) systems – Part 3: Specific requirements for the magnetic field wireless power transfer systems
ISO 19363, Electrically propelled vehicles—Magnetic field wireless power transfer—Safety and interoperability requirements

SAE J2847-2 V4, Communication Between Plug-In Vehicles and Off-Board DC Chargers

W3C EXI 1.0, Efficient XML Interchange (EXI) Format 1.0 W3C Recommendation (March 2011)

W3C XML Signature Syntax and Processing Version 1.1, W3C Recommendation (April 2013)

ISO 4130 Road vehicles -- Three-dimensional reference system and fiducial marks -- Definitions

IETF RFC 768, User Datagram Protocol (August 1980)
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IETF RFC 793, Transmission Control Protocol - DARPA Internet Program - Protocol Specification (September 1981)

IETF RFC 1981, Path MTU Discovery for IP version 6 (August 1996)

IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification (December 1998)

IETF RFC 6960, X.509 Internet Public Key Infrastructure Online Certificate Status Protocol - OCSP (June 2013)

IETF RFC 3122, Extensions to IPv6 Neighbor Discovery for Inverse Discovery Specification (June 2001)

IETF RFC 3315, Dynamic Host Configuration Protocol for IPv6 (DHCPv6) (July 2003)

IETF RFC 3484, Default Address Selection for Internet Protocol version 6 (IPv6) (February 2003)

IETF RFC 6582, The NewReno Modification to TCP's Fast Recovery Algorithm (April 2012)

IETF RFC 4050, Using the Elliptic Curve Signature Algorithm (ECDSA) for XML Digital Signatures (April 2005)

IETF RFC 4291, IP Version 6 Addressing Architecture (February 2006)

- IETF RFC 4429, *Optimistic Duplicate Address Detection (DAD) for IPv6* (April 2006)
- IETF RFC 4443, *Internet Control Message Protocol (ICMP v6) for the Internet Protocol version 6 (IPv6) specification* (March 2006)
- IETF RFC 4514, *Lightweight Directory Access Protocol (LDAP): String Representation of Distinguished Names* (June 2006)
- IETF RFC 4861, *Neighbor Discovery for IP version 6 (IPv6)* (September 2007)
- IETF RFC 4862, *IPv6 Stateless Address Autoconfiguration* (September 2007)
- IETF RFC 5095, *Deprecation of Type 0 Routing Headers in IPv6* (December 2007)
- IETF RFC 5116, *An Interface and Algorithms for Authenticated Encryption* (January 2008)
- IETF RFC 5234, *Augmented BNF for Syntax Specifications: ABNF* (January 2008)
- IETF RFC 5246, *The Transport Layer Security (TLS) Protocol Version 1.2* (August 2008)
- IETF RFC 5280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile* (May 2008)
- IETF RFC 5289, *TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM)* (August 2008)
- IETF RFC 5480, *Elliptic Curve Cryptography Subject Public Key Information* (March 2009)
- IETF RFC 5722, *Handling of Overlapping IPv6 Fragments* (December 2009)
- IETF RFC 6066, *Transport Layer Security (TLS) Extensions: Extension Definitions* (January 2011)
- IETF RFC 6106, *IPv6 Router Advertisement Options for DNS Configuration* (November 2010)
- IETF RFC 6961, *The Transport Layer Security (TLS) Multiple Certificate Status Request Extension* (June 2013)
- IANA Service&PortRegistry, *Service Name and Transport Protocol Port Number Registry* [viewed 2011-01-16], Available from: <http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml>
- NIST FIPS PUB 180-4: *Secure Hash Standard (SHS)* (March 2012)
- NIST Special Publication 800-56A: *Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography (Revised)* (March 2007)
- NIST Special Publication 800-38A: *Recommendation for Block Cipher Modes of Operation - Methods and Techniques* (2001)

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3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

automatic connection device

ACD

components supporting the automatic connection and disconnection process for conductive energy transfer between an EV and EV supply equipment

3.2

basic charging

BC

charging phase during a charging session controlled by IEC 61851-1 Annex A only

3.3

BCB Toogle

a switching sequence of the PWM Signal from State B to C and back to State B

3.4

charging limits

a set of physical constraints (e.g. voltage, current, energy, power) that is negotiated during a service session

3.5

charging session

a kind of service session applied to charging services

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3.6

communication setup timer

a timer monitoring the time D-LINK_READY.indication(DLINKSTATUS=LinkEstablished) until the Session Setup message

3.7

contract certificate

certificate issued for EVCC by a MO Sub-CA, which is used in XML signatures in application layer so that SECC or secondary actor can verify the contract issued to the EVCC and signatures issued by the EVCC

3.8

control pilot state

CP state

control pilot state according to control pilot function defined in IEC 61851-1 Annex A

3.9

credentials

piece of information attesting an entity's identity

EXAMPLE The combination of an account number and a password is a widely used example of credentials.

3.10
distinguished encoding rules
DER

method for encoding a data object, such as an X.509 certificate, to be digitally signed or to have its signature verified

3.11
dynamic control mode

Control Mode for the Communication further Information can be found in ISO 15118-1 ED2NOTE The SECC controls the power flow and gives the EVCC Set Points it has to follow

3.12
elliptic curve cryptography
ECC

mechanism for implementing public-key cryptography based on the discrete logarithms by algebraic structure of elliptic curves

3.13
flexible schedule mode

Control Mode for the Communication further Information can be found in ISO 15118-1 ED2

Note 1 to entry: EVCC and SECC negotiate a power profile for Charging or Discharging purposes

3.14
global address

IP address with unlimited scope

3.15
high level communication charging
HLC-C

charging phase during a service session controlled by ISO 15118

3.16
link-local address

IP address with link-only scope that can be used to reach neighboring interfaces attached to the same link

3.17
identification mode

authenticate and authorize the user account

Note 1 to entry: An identification mode is used for identification selection. Multiple identification modes cover same service sequence.

Note 2 to entry: Identification mode refers to EIM and PnC

3.18
IP address
address

IP-layer identifier for an interface or a set of interfaces

3.19
maximum transfer unit
MTU

maximum size (in bytes) of the largest protocol data unit that the data link layer that can be pass onwards

3.20
message set

set of V2G messages and parameters for the EVCC or SECC covering one or multiple use case elements

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3.21

message timer

timer monitoring the exchange of a request-response-pair

3.22 Multiplexed Communication [MC]

exchange of multiple messages with different payload types over the V2GTP connection between EV and EVSE

3.23

node

device that implements IPv6

3.24

OEM provisioning certificate

certificate issued to the EVCC to enable the provisioning of a contract certificate

Note 1 to entry: It is securely requested and received from a secondary actor to uniquely identify the EVCC.

3.25

performance time

non-functional timing requirement defining the time a V2G Entity doesn't exceed when executing or processing certain functionality

Note 1 to entry: This is a fixed time value.

3.26

private environment

area of private responsibility with physical access limited to a small number of vehicles

3.27

renegotiation

messaging for updating the agreement on the charging schedule between EV and EV supply equipment during a V2G communication session by retransmitting the parameters SASchedule and ChargingProfile

3.28

request-response message pair

request message and the corresponding response message

3.29

request-response message sequence

a predefined sequence of request-response message pairs

3.30

SDP client

V2G entity that uses the SDP server to get configuration information about the SECC to be able to access the SECC

3.31

SDP server

a V2G entity providing configuration information for accessing the SECC

3.32

SECC certificate

certificate issued to SECC by a CPO Sub-CA (or PE Root CA in a private environment), which is used in TLS so that the EVCC can verify the authenticity of the SECC

3.33

sequence timer

timer monitoring a request-response message sequence

3.34

service session

set of sequential and cooperative activity for various types of power transfer and other optional services by EVCC and SECC consists of message sets with unique ID

Note 1 to entry: Charging session and WPT session are some kinds of service sessions.

3.35

Sub-CA

subordinate certificate authority who issues e.g. SECC certificates and/or contract certificates on behalf of a root CA such as V2G root CA or mobility operator root CA (only for E-Mobility Accountcertificates)

Note 1 to entry: The ability of issuing the certificates are delegated from V2G root CA, and V2G root CA can revoke the Sub-CA at any time.

3.36

Sub-CA certificate

certificate issued to Sub-CA

3.37

TCP_DATA

socket/interface for data transfer based on TCP connection

3.38

timeout

timing requirement defining the time a V2G entity monitors the communication system for a certain event to occur

Note 1 to entry: If the specified time is exceeded the respective V2G entity initiates the related error handling. This is a fixed time value.

3.39

timer

device or piece of software used in an implementation for measuring time

Note 1 to entry: Depending on the specific use case a timer is used to trigger certain system events as well.

3.40

private environment

closed power transfer service for user group defined by the same service provider

3.41

V2G charging loop

V2G messaging phase for controlling the charging process by ISO 15118

3.42

V2G communication session

association of two specific V2G entities for exchanging V2G messages

3.43

V2G entity

primary actor participating in the V2G communication using a transmission protocol defined by this part of ISO 15118

Note 1 to entry: Primary actors can be EVCC or SECC.

ITd STANDARD PREVIEW
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ISO/DIS 15118-2

<https://standards.iteh.ai/catalog/standards/sist/4c371159-3bf2-443b-bd76-9941109460b5/iso-dis-15118-2>