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Road vehicles — Vehicle to grid communication interface —

Part 20:
2nd generation network layer and application layer requirements

Véhicules routiers — Interface de communication entre véhicule et réseau électrique —

Partie 20: Exigences des couches réseau et application de 2ème génération

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Contents

Foreword

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This document was prepared jointly by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*, Technical Committee IEC/TC 69, *Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 301, *Electrically propelled road vehicles,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 15118 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

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 electric power and launched them into the market. Those vehicles will reduce the dependency on oil, improve the global energy efficiency and reduce the total CO_2 emissions for road transportation if the electricity is produced from renewable sources. To charge electricity to the batteries of such vehicles, a specific charging infrastructure is 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, and it was assigned to the ISO 15118 series to treat the subject 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 can 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:

- 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, which enable smoothing of the electricity load of the supply network for higher energy efficiency and also provide power back to the grid;
- 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.

INTERNATIONAL STANDARD **ISO 15118-20:2022(E)**

Road vehicles — Vehicle to grid communication interface —

Part 20: Network and application protocol requirements

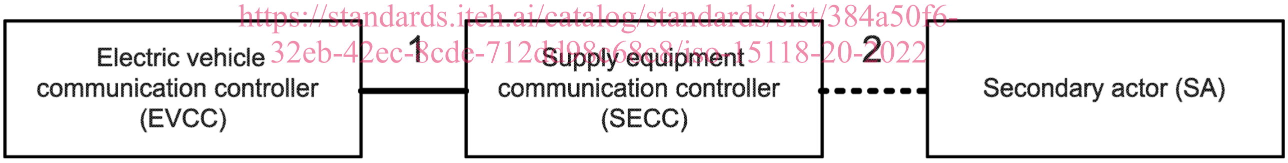
1 Scope

This document specifies the communication between the electric vehicle (EV), including battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV), and the electric vehicle supply equipment (EVSE). The application layer messages defined in this document are designed to support the electricity power transfer between an EV and an EVSE.

This document defines the communication messages and sequence requirements for bidirectional power transfer.

This document furthermore defines requirements of wireless communication for both conductive charging and wireless charging as well as communication requirements for automatic connection device and information services about charging and control status.

The purpose of this document is to detail the communication between an electric vehicle communication controller (EVCC) and a 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 the EVCC and the SECC (see Figure 1).


Electric vehicle communication controller (EVCC)
1
Supply equipment communication controller (SECC)
2
Secondary actor (SA)

Key

1 scope of this document

2 message definition considers use cases defined for communication between SECC to SA

Figure 1 — Communication relationship among the EVCC, SECC and SA

This document defines messages, data model, XML/EXI-based data representation format, usage of V2GTP, TLS, TCP and IPv6. These requirements belong to the 3rd until the 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 an OSI layer 3 perspective.

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 3780, *Road vehicles – World Manufacturer Indentifier (WMI) code*

ISO 4217, *Codes for the representation of currencies*

ISO 15118-2:2014, *Road vehicles — Vehicle to grid communication interface — Part 2: Network and application protocol requirements*

ISO 15118-3:2015, *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*

ISO 19363:2020, *Electrically propelled vehicles—Magnetic field wireless power transfer—Safety and interoperability requirements*

ISO/IEC 11889-1:2015, *Information technology — Trusted platform module library — Part 1: Architecture*

IEC 61851-1:2017, *Electric vehicle conductive charging system — Part 1: General requirements*

IEC 61851-23-1:2014, *Electric vehicle conductive charging system - Part 23-1: DC Charging with an automatic connection system*

IEC 61980-2, *Electric vehicle wireless power transfer (WPT) systems - Part 2: Specific requirements for communication between electric road vehicle (EV) and infrastructure*

IEC 63119-2[1], *Information exchange for Electric Vehicle charging roaming service — Part 2: Use cases*

EN 50696:2021, *Contact interface for automated connection devices (ACD)*

IETF RFC 768, *User Datagram Protocol* (August 1980)

IETF RFC 793, *Transmission Control Protocol - DARPA Internet Program - Protocol Specification (September 1981)*

IETF RFC 2865, *Remote Authentication Dial In User Service (RADIUS)* (June 2000)

IETF RFC 2866, *RADIUS Accounting* (June 2000)

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

IETF RFC 3579, *RADIUS (Remote Authentication Dial In User Service) Support For Extensible Authentication Protocol (EAP)* (September 2003)

IETF RFC 3748, *Extensible Authentication Protocol (EAP)* (June 2004)

IETF RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax* (January 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)

[1] Under preparation. Stage at the time of publication: IEC/CCDV 63119-2:2022.

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 5116, *An Interface and Algorithms for Authenticated Encryption* (January 2008)

IETF RFC 5216, *The EAP-TLS Authentication Protocol* (March 2008)

IETF RFC 5234, *Augmented BNF for Syntax Specifications: ABNF* (January 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 6724, *Default Address Selection for Internet Protocol version 6 (IPv6)* (September 2012)

IETF RFC 6818, *Updates to the Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile* (January 2013)

IETF RFC 6874, *Representing IPv6 Zone Identifiers in Address Literals and Uniform Resource Identifiers* (February 2013)

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

IETF RFC 7405, *Case-Sensitive String Support in ABNF* (December 2014)

IETF RFC 7748, *Elliptic Curves for Security* (January 2016)

IETF RFC 8032, *Edwards-Curve Digital Signature Algorithm (EdDSA)* (January 2017)

IETF RFC 8200, *Internet Protocol, Version 6 (IPv6) Specification* (July 2017)

IETF RFC 8201, *Path MTU Discovery for IP version 6* (July 2017)

IETF RFC 8398, *Internationalized Email Addresses in X.509 Certificates* (May 2018)

IETF RFC 8399, *Internationalization Updates to RFC 5280* (May 2018)

IETF RFC 8415, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6)* (November 2018)

IETF RFC 8439, *ChaCha20 and Poly1305 for IETF Protocols* (June 2018)

IETF RFC 8446, *The Transport Layer Security (TLS) Protocol Version 1.3* (August 2018)

IETF RFC 8504, *IPv6 Node Requirements* (January 2019)

IETF RFC 8335, *PROBE: A Utility for Probing Interfaces* (February 2018)

ANSI X9.62, *Public Key Cryptography For The Financial Services Industry: The Elliptic Curve Digital Signature Algorithm (ECDSA)* (2005)

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

IANA Service & Port Registry, *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 FIPS PUB 202, *SHA-3 Standard: Permutation-Based Hash and Extendable-Output Functions* (August 2015)

ITU-T X.509, *Information technology — Open Systems Interconnection — The Directory: Public-key and attribute certificate frameworks* (October 2019)

IEEE 802.1X-2020, *IEEE Standard for Local and Metropolitan Area Networks--Port-Based Network Access Control (January, 2020)*

WPA3, *WPA3 Specification Version 3.0* (December 2020)

NIST Special Publication 800-38D, *Recommendation for Block Cipher Modes of Operation: Galois/Counter Mode (GCM) and GMAC* (November 2007)

NIST Special Publication 800-56A, Revision 3, *Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography* (April 2018)

3 Terms and definitions

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

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

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

3.1
access point
AP
wireless communication device that allows the user to connect to other wireless or wired communication devices

3.2
authorization mode
authenticate and authorize the user account

Note 1 to entry: Authorization mode refers to *EIM* (3.17) and *PnC* (3.41).

3.3
automatic connection device pantograph
ACDP
components supporting the automatic connection and disconnection process for conductive energy transfer between an EV and EVSE via pantograph

3.4
basic charging

BC
charging based on PWM

Note 1 to entry: According to ISO/IEC 11889-1:2015, Annex A.

3.5
certificate
electronic document which uses a digital signature to bind a public key with an identity

Note 1 to entry: The ISO 15118 series describe several certificates covering different purposes [e.g. contract certificate including the *EMAID* (3.19) and *OEM* (3.36) provisioning certificates].

3.6
charging limit
set of physical constraints that is negotiated during a *service session* (3.50)

EXAMPLE Voltage, current, energy, power, etc.

3.7
charging session
collection of charging transactions at a charge point related only to the charging of an electric vehicle assigned to a specific customer in a specific timeframe with a unique identifier

Note 1 to entry: The charging session is a subset of the *service session* (3.50).

3.8
charging station operator
CSO
secondary actor 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 CSO for charge point operator is also used in other ISO 15118 documents. This term is not recommended for trademark reasons.

3.9
communication session
sequence of time where *EVCC* (3.21) and *SECC* (3.47) interactively exchange digital information in order to manage charging or discharging the EV 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.

3.10
communication setup timer
timer (3.61) monitoring the time between establishment of TLS connection and reception of SessionSetupRes by *EVCC* (3.21)

3.11
contract certificate
certificate (3.5) issued for the *EVCC* (3.21) by an *eMSP* (3.20) *sub-CA* (3.57), which is used in XML signatures on application layer so that the *SECC* (3.47) or secondary actor can verify the signature created by the EVCC with the contract certificate issued for that EV

Note1 to entry: The secondary actor uses the *EMAID* (3.19), which is part of the contract certificate's subject field, to authorize the EV for charging based on the eMSP's associated e-mobility contract.

3.12
CP state
control pilot state
state according to control pilot function defined in IEC 61851-1

3.13
credential
piece of information attesting an entity's identity

3.14
cross certificate
certificate (3.5) containing the public key of an existing certificate of a CA in one organization (called cross-certified CA) but signed by a root CA of another organization (called cross-certifying CA)

Note 1 to entry: With cross-certification, an end-entity, who only trusts a cross-certifying root CA, can validate a certificate chain issued by the root CA of another organization through a cross certificate appended to the chain.

3.15
distinguished encoding rules
DER
method for encoding a data object, such as an ITU-T X.509 *certificate* (3.5), to be digitally signed or to have its signature verified

3.16
dynamic control mode
control mode for the communication

Note 1 to entry: Further Information can be found in ISO 15118-1.

Note 2 to entry: The *SECC* (3.47) controls the power flow and gives the *EVCC* (3.21) set points it should follow.

3.17
external identification means
EIM
authorization means that are handled outside of this document

3.18
elliptic curve cryptography
ECC
mechanism for implementing public-key cryptography based on the discrete logarithms by algebraic structure of elliptic curves

3.19
eMobility account identifier
EMAID
contract identification for the contract that is issued by the *eMSP* (3.20) and used by the *SECC* (3.47) or secondary actor to enable energy transfer and related services (including billing)

Note 1 to entry: The term contract ID is not used anymore in this document. It has been replaced by the term EMAID. The definition is still present for compatibility with ISO 15118-1.

3.20
eMobility service provider
eMSP
entity with which the customer has a contract for all services related to the EV energy transfer

Note 1 to entry: Typically, the eMSP will include some of the other actors, like spot operator or EP, and has a close relationship with the distribution system operator and *meter* (3.33) operator. An *OEM* (3.36) or utility could also fulfil such a role.

Note 2 to entry: eMSPs validate *EMAIDs* (3.19) from their customers, which were received either from the EMOCH, other eMSPs or spot operators the customer is in relation with.

Note 3 to entry: eMSPs issue EMAIDs to their customers.

3.21
electric vehicle communication controller
EVCC
embedded system, within the vehicle, that implements the communication between the vehicle and the *SECC* (3.47) 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 vehicle and SECC.

3.22
EVPowerProfile
scheme which contains the power limits for charging or discharging the battery during an energy transfer period

Note 1 to entry: Refer to definition of "energy transfer schedule" in ISO 15118-1.

Note 2 to entry: In *dynamic control mode* (3.16) it describes a simulation from the EVs perspective on the fastest charging profile in order to reach the EVMaximumEnergyRequest under the constraint of the minimum of the EVSEMaximumChargePower and EVMaximumChargePower.

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

3.23
electric vehicle supply equipment ID
EVSEID
unique identification of the EVSE

3.24
electric vehicle supply equipment
EVSE
<conductive power transfer> conductors, including the phase(s), neutral and protective earth conductors, the EV couplers, attached plugs, and all other accessories, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the EV and allowing communication between them as necessary

3.25
electric vehicle supply equipment
EVSE
<wireless power transfer> off-board equipment comprising the *SECC* (3.47) and one or multiple supply devices working under the control of the same SECC

3.26
global address
IP address (3.28) with unlimited scope

3.27
high level communication charging
HLC-C
energy transfer phase during a *service session* (3.50)

3.28
IP address
address
IP-layer identifier for an interface or a set of interfaces

3.29
link-local address
IP address (3.28) with link-only scope that can be used to reach neighboring interfaces attached to the same link

3.30
maximum transfer unit
MTU
maximum size (in bytes) of the largest protocol data unit that the data link layer can pass onwards

3.31
message set
set of *V2G messages* (3.66) and parameters for the *EVCC* (3.21) or *SECC* (3.47) covering one or multiple use case elements

3.32
message timer
timer (3.61) monitoring the exchange of a request-response-pair

3.33
meter
analogic device able to measure the amount of energy used and to monitor it

3.34
multiplexed communication
MC
exchange of multiple messages with different payload types over the *V2GTP* (3.68) connection between the *EVCC* (3.21) and *SECC* (3.47)

3.35
node
device that implements IPv6

3.36
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: OEM refers to the company that originally manufactured the product.

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

3.37

OEM provisioning certificate

certificate (3.5) issued to the *EVCC* (3.21) by the *OEM* (3.36) to enable the provisioning of a *contract certificate* (3.11)

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

3.38

PE certificate

leaf *certificate* (3.5) issued in *PE* (3.42) to a *private SECC* (3.43) by a PE private root CA or optionally by a PE sub CA, which is used in TLS so that the *EVCC* (3.21) can verify the authenticity of the private SECC

3.39

PE EVSE

EVSE that is operating in a *private environment* (3.42) and is containing or being controlled by a *private SECC* (3.43)

3.40

performance time

non-functional timing requirement defining the time a *V2G entity* (3.65) should not exceed when executing or processing certain functionality

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

3.41

park and charge

PnC

authorization mechanism using *certificates* (3.5) stored in the EV which does not require any user interaction

3.42

private environment

PE

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

3.43

private SECC

SECC (3.47) operating in a *private environment* (3.42) that uses a *PE certificate* (3.38)

Note 1 to entry: *PE* (3.42) usually implies lower security. In most cases SECC requirements will also apply to a private SECC. In some specific cases, the SECC and private SECC requirements can be distinct. Those cases and requirements will be called out as such.

3.44

public SECC

SECC (3.47) operating in a public environment that uses a *PE certificate* (3.38)

3.45

request-response message pair

request message and the corresponding response message

3.46

request-response message sequence

predefined sequence of *request-response message pairs* (3.45)

3.47