

Road vehicles - Vehicle to grid communication interface - Part 20: 2nd generation network layer and application layer requirements (ISO 15118-20:2022)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 15118-20:2022 sisaldab Euroopa standardi EN ISO 15118-20:2022 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 15118-20:2022 consists of the English text of the European standard EN ISO 15118-20:2022.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 18.05.2022.	Date of Availability of the European standard is 18.05.2022.
Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 43.120

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis-ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis-ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Road vehicles - Vehicle to grid communication interface -
Part 20: 2nd generation network layer and application
layer requirements (ISO 15118-20:2022)

Véhicules routiers - Interface de communication entre
véhicule et réseau électrique - Partie 20: Exigences des
couches réseau et application de 2ème génération (ISO
15118-20:2022)

Straßenfahrzeuge - Kommunikationsschnittstelle
zwischen Fahrzeug und Ladestation - Teil 20: 2.
Generation Anforderungen an das Netzwerk- und
Anwendungsprotokoll (ISO 15118-20:2022)

This European Standard was approved by CEN on 12 April 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO 15118-20:2022) has been prepared by Technical Committee ISO/TC 22 "Road vehicles" in collaboration with Technical Committee CEN/TC 301 "Road vehicles" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2022, and conflicting national standards shall be withdrawn at the latest by November 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 15118-20:2022 has been approved by CEN as EN ISO 15118-20:2022 without any modification.

Contents

Page

Foreword.....	v
Introduction.....	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	4
4 Abbreviated terms	12
5 Conventions.....	15
5.1 Definition of OSI based services	15
5.2 Requirement structure.....	15
5.3 Usage of references.....	16
5.4 Notation used for XML schema diagrams.....	16
6 Document overview	16
7 Basic requirements for V2G communication.....	17
7.1 General information	17
7.2 Service primitive concept of OSI layered architecture	18
7.2.1 Overview	18
7.2.2 Syntax of service primitives.....	18
7.3 Security concept.....	19
7.3.1 General	19
7.3.2 Certificate and key management	21
7.3.3 Number of root certificates and root validity.....	35
7.3.4 Support and application of TLS	37
7.3.5 Firewall	38
7.3.6 Protection of the cryptographic keys.....	38
7.3.7 Random number generation	40
7.4 V2G communication states and data link handling.....	42
7.5 Data link layer.....	46
7.5.1 Data link layer security for WLAN	46
7.6 Network link layer	51
7.6.1 General	51
7.6.2 Applicable RFCs, limitations and protocol parameter settings	51
7.6.3 IP addressing.....	53
7.7 Transport layer	54
7.7.1 Transmission control protocol (TCP)	54
7.7.2 User datagram protocol (UDP)	55
7.7.3 Transport layer security (TLS)	56
7.8 V2G transfer protocol.....	82
7.8.1 General information	82
7.8.2 Supported ports	83
7.8.3 Protocol data unit.....	84
7.9 Presentation layer.....	87
7.9.1 XML and efficient XML interchange (EXI)	87
7.9.2 Message security.....	90
7.10 Application layer.....	115
7.10.1 SECC discovery protocol.....	115
8 Application layer messages	128
8.1 General information and definitions.....	128
8.2 Protocol handshake definition	129

8.2.1	Handshake sequence	129
8.2.2	Message definition supportedAppProtocolReq and supportedAppProtocolRes	131
8.2.3	Semantics description supportedAppProtocol messages	132
8.2.4	Message examples	133
8.3	V2G message definition	134
8.3.1	Overview	134
8.3.2	General	135
8.3.3	Header definition	135
8.3.4	Request and response definitions	138
8.3.5	Complex data types	240
8.4	Service selection	361
8.4.1	General	361
8.4.2	General description of configuration parameters	362
8.4.3	Selection of service and service parameters	363
8.5	V2G communication timing	373
8.5.1	Overview	373
8.5.2	Common	373
8.5.3	DC service	374
8.5.4	Message sequence and communication session	374
8.5.5	Session setup and ready to charge	381
8.5.6	V2G message synchronization for AC and DC with IEC 61851-1 signalling	387
8.5.7	V2G message synchronization with IEC 61980-2 signalling for WPT	394
8.6	Message sequencing and error handling	394
8.6.1	Overview	394
8.6.2	Basic definitions for error handling	395
8.6.3	ResponseCode handling	395
8.6.4	Request-response message sequence requirements	406
8.6.5	Multiplexed communication	434
8.6.6	Message sequence diagrams	437
Annex A (normative)	Schema definition	442
Annex B (normative)	Certificate profiles	444
Annex C (normative)	Specification of identifiers	498
Annex D (informative)	ACDP	504
Annex E (informative)	Basic PPD for interoperability	506
Annex F (informative)	Message sequencing for renegotiation	509
Annex G (informative)	Association of VAS client to V2G session	511
Annex H (informative)	Application of certificates	512
Annex I (informative)	Precision of measurements and tolerances	547
Annex J (informative)	Absolute pricing examples	549

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 CO₂ 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.

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).

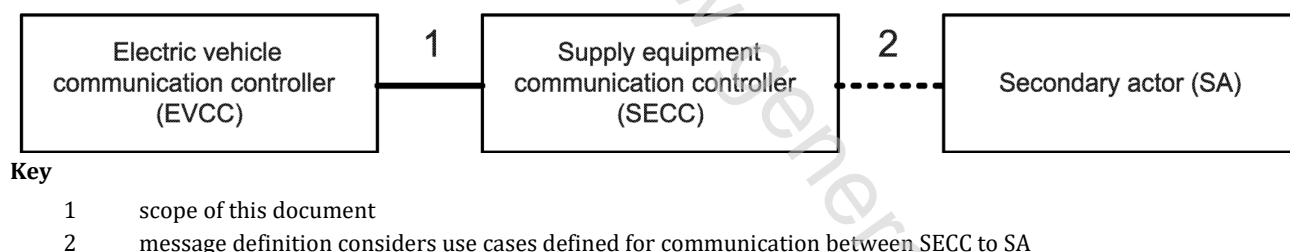


Figure 1 — Communication relationship among the EVCC, SECC and SA

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 Identifier (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 63119-2¹, *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

Note 1 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.