
**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



COPYRIGHT PROTECTED DOCUMENT

© ISO 2014

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction.....	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	3
4 Symbols and abbreviated terms	7
5 Conventions	8
5.1 Definition of OSI based services	8
5.2 Requirement structure	8
5.3 Usage of RFC references	8
5.4 Notation used for XML schema diagrams.....	9
6 Document overview.....	9
7 Basic requirements for V2G communication	11
7.1 General information	11
7.2 Service primitive concept of OSI layered architecture	11
7.3 Security concept.....	12
7.4 V2G communication states and data link handling	21
7.5 Data Link Layer.....	26
7.6 Network Layer.....	26
7.7 Transport Layer	28
7.8 V2G Transfer Protocol	32
7.9 Presentation Layer	36
7.10 Application Layer	46
8 Application Layer messages	55
8.1 General information and definitions.....	55
8.2 Protocol handshake definition	56
8.3 V2G Message Definition.....	60
8.4 V2G Communication Session and BodyElement Definitions	62
8.5 Complex data types.....	104
8.6 Identification Modes and Message Set definitions	137
8.7 V2G communication timing	170
8.8 Message sequencing and error handling	184
8.9 Request-Response Message Sequence examples	206
Annex A (informative) Mapping of Part 1 use case elements	214
Annex B (informative) Mapping of ISO 15118 message element names to SAE J2847/2 terms	250
Annex C (normative) Schema definition	254
Annex D (informative) Message examples	278
Annex E (informative) Application of certificates	299
Annex F (normative) Certificate profiles	313
Annex G (informative) Encryption for the Distribution of Secret Keys	321
Annex H (normative) Specification of Identifiers	323
Annex I (informative) Message sequencing for renegotiation.....	326
Annex J (informative) Overview on XML Signatures	330

Annex K (informative) Summary of requirements..... 334

Bibliography..... 341

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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 15118-2 was developed in conjunction with IEC TC 69, *Electric road vehicles and electric industrial trucks*.

ISO 15118 consists of the following parts, under the general title *Road vehicles — Vehicle-to-Grid Communication Interface*:

- *Part 1: General information and use-case definition*
- *Part 2: Network and application protocol requirements*
- *Part 3: Physical and data link layer requirements¹*

¹ To be published.

Introduction

The pending energy crisis and necessity to reduce greenhouse gas emissions has led the vehicle manufacturers to 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 the global energy efficiency and reduce the total CO₂ emissions for road transportation if the electricity is produced from renewable sources. To charge the batteries of such vehicles, specific charging infra-structure is required.

Much of the standardization 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 information transfer between the EV and the EVSE has not been treated sufficiently.

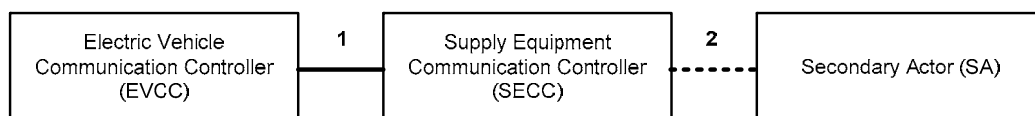
Such communication is necessary for the optimization of energy resources and energy production systems so that vehicles can recharge in the most economical or most energy efficient way. It is also required to develop efficient and convenient billing systems in order to cover the resulting micro-payments. The necessary communication channel may serve in the future to contribute to the stabilization of the electrical grid as well as to support additional information services required to operate electric vehicles efficiently and economically.

Road vehicles — Vehicle-to-Grid Communication Interface — Part 2: Network and application protocol requirements

1 Scope

This part of ISO 15118 specifies the communication between battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV) and the Electric Vehicle Supply Equipment. The application layer message set defined in this part of ISO 15118 is designed to support the energy transfer from an EVSE to an EV. ISO 15118-1 contains additional use case elements (Part 1 Use Case Element IDs: F4 and F5) describing the bidirectional energy transfer. The implementation of these use cases requires enhancements of the application layer message set defined herein. The definitions of these additional requirements will be subject of the next revision of this International Standard.

The purpose of this part of ISO 15118 is to detail the communication between an EV (BEV or a PHEV) and an EVSE. 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/IEC FDIS 15118-2:2013(E)
- 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 of ISO 15118 defines messages, data model, XML/EXI based data representation format, usage of V2GTP, TLS, TCP and IPv6. In addition, it describes how data link layer services can be accessed from a layer 3 perspective. The Data Link Layer and Physical Layer functionality is described in ISO 15118-3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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*

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*

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)

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

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 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 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)