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Road vehicles — Vehicle to grid communication interface —

Part 8: Physical layer and data link layer requirements for wireless communication

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

Partie 8: Exigences relatives à la couche physique et à la couche liaison de données pour la communication sans fil

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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).

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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 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.

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 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 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 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 economic 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.

In ISO 15118-3, the messages exchanged between the vehicle and the infrastructure are transported by the cable used for power transfer. With the inception of wireless power transfer technologies and the tremendous development of wireless communication in our societies, the need for a wireless communication between vehicle and charging infrastructure becomes imperative. This is the main focus of this document. The relevant information on use-case definitions and network and application protocol requirements can be found in ISO 15118-1[1)] and ISO 15118-2[2)], respectively.

1) Under development. Stage at time of publication: ISO/DIS 15118-1:2018.

2) Under development. Stage at time of publication: ISO/CD 15118-2:2018.

Road vehicles — Vehicle to grid communication interface —

Part 8: Physical layer and data link layer requirements for wireless communication

1 Scope

This document specifies the requirements of the physical and data link layer of a wireless High Level Communication (HLC) between Electric Vehicles (EV) and the Electric Vehicle Supply Equipment (EVSE). The wireless communication technology is used as an alternative to the wired communication technology as defined in ISO 15118-3.

It covers the overall information exchange between all actors involved in the electrical energy exchange. ISO 15118 (all parts) are applicable for conductive charging as well as Wireless Power Transfer (WPT).

For conductive charging, only EVSEs compliant with "IEC 61851-1 modes 3 and 4" and supporting HLC are covered by this document. For WPT, charging sites according to IEC 61980 (all parts) and vehicles according to ISO/PAS 19363 are covered by this document.

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

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/PAS 19363, *Electrically propelled road vehicles — Magnetic field wireless power transfer — Safety and interoperability requirements*

IEEE Std 802.11™-2012, IEEE *Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — specific requirements: Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15118-1, ISO 15118-2 and the following apply.

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

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

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

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

Note 1 to entry: See IEEE Std 802.11™-2012.

3.2
charging site
CS
area with one or more EVSEs controlled by one SECC

3.3
station
STA
logical entity that is a singly addressable instance of a medium access control and physical layer interface to the wireless medium which does not act as an *access point* (3.1)

3.4
IEEE 802.11n
IEEE Std 802.11 where the instances are HT APs or HT STAs

Note 1 to entry: The features of an HT STA are summarized in IEEE Std 802.11-2012, 4.3.10. An HT AP is an access point implementing the same set of features as an HT STA.

3.5
layer 2 link establishment
connection establishment indicated by a successful association/reassociation process as described in IEEE Std 802.11-2012, 10.3.5.2 and 10.3.5.3

3.6
service available area
restricted area around a charging station in which an SECC provides a connecting service with an ensured quality

4 Abbreviated terms

AP	Access Point
AWC	Automotive Wireless Communication
CS	Charging Site
DFS	Dynamic Frequency Selection
EDCA	Enhanced Distributed Channel Access
EID	Element Identifier
EMC	Electromagnetic Compatibility
ETT	Energy Transfer Type
EV	Electric Vehicle
EVCC	Electric Vehicle Communication Controller
EVSE	Electric Vehicle Supply Equipment

HLC	High Level Communication
HLE	Higher Layer Entities
HT	High Throughput
ISM	Industrial, Scientific and Medical
MAC	Medium Access Control
SAP	Service Access Point
SECC	Supply Equipment Communication Controller
SSID	Service Set Identifier
TPC	Transmit Power Control
U-NII	Unlicensed National Information Infrastructure
VSE	Vendor Specific Element
WLAN	Wireless Local Area Network
WPT	Wireless Power Transfer

5 Conventions

5.1 Definition of OSI based services

This document is based on the OSI Service Conventions (see ISO/IEC 10731) for the individual layers specified in this document.

5.2 Requirement structure

Each individual requirement included in this document has a unique code, as follows:

“**[V2G8-XXX]** Requirement text”

— where “V2G8” represents this document,

— where XXX represents the individual requirement number, and

— where “requirement text” includes the actual text of the requirement.

EXAMPLE **[V2G8-999]** This shall be an example requirement.

6 System architecture

This document is organized along architectural lines, same as in ISO 15118-3 emphasizing the large-scale separation of the system into two parts: the MAC sub layer of the Data Link Layer and the Physical Layer. These layers are intended to correspond closely to the lowest layers of the ISO/IEC Model for Open Systems (see ISO/IEC 7498-1). Figure 1 shows the relationship of this document to the OSI reference model.

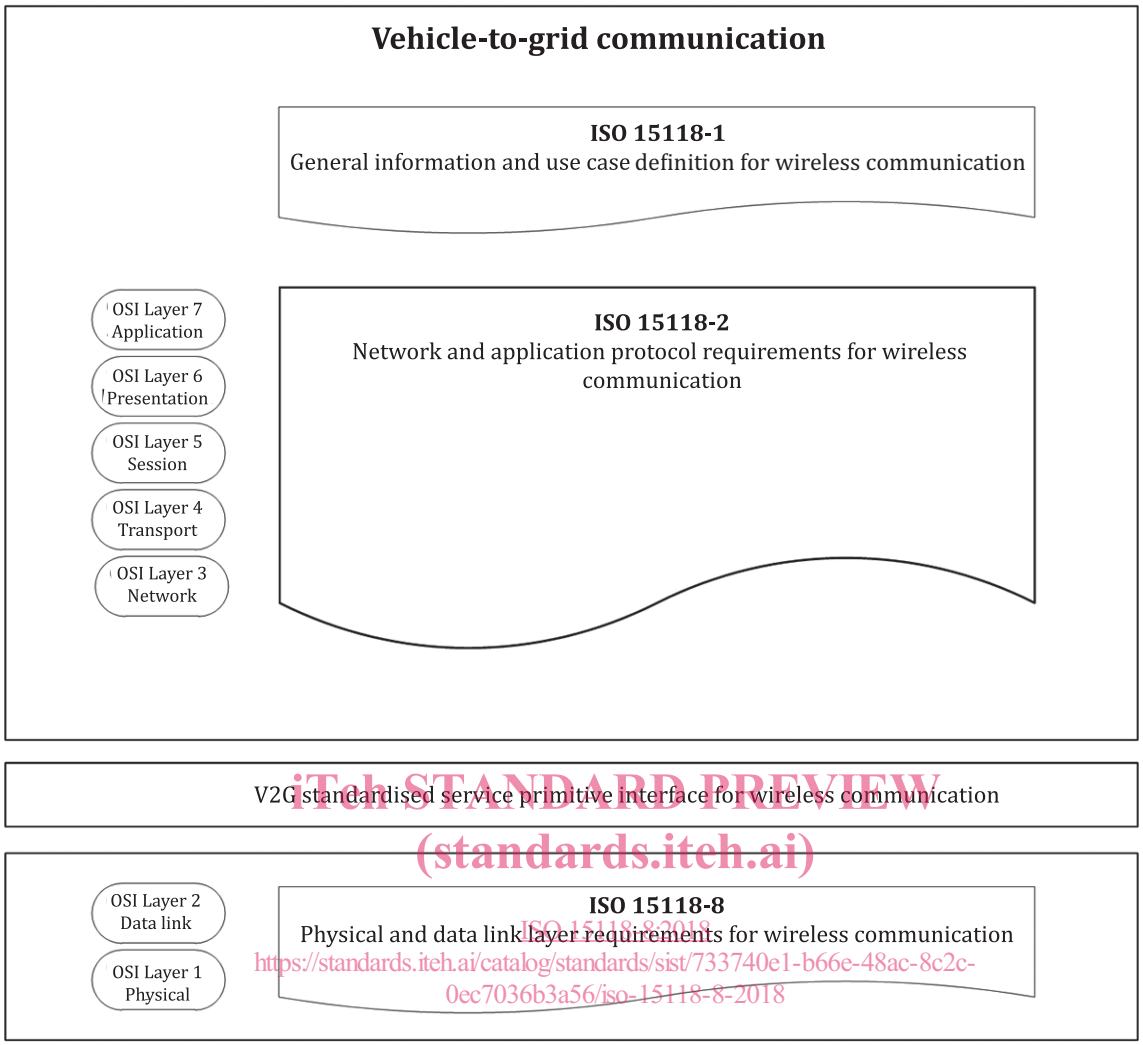

Figure 1 — Overview of ISO 15118-1, ISO 15118-2, and this document in the ISO/IEC OSI reference model

This document defines requirements applicable to layer 1 and 2, including the V2G Standardized Service Primitive Interface for wireless communication, according to the OSI layered architecture. Layers 3 to 7 are specified in ISO 15118-2.

This document covers both conductive charging and WPT use-cases using wireless communication. If not defined differently, requirements apply for both conductive charging and WPT.

7 Wireless communication requirements

7.1 Overview

This clause gives requirements for the wireless communication module on both the EVCC and the SECC side. EVCC and SECC make use of Wireless Local Area Network (WLAN) as specified in IEEE Std 802.11-2012 for wireless communication. More specifically, they implement the feature set of an HT STA or HT AP (which were originally specified in IEEE 802.11n-2009 and are thus commonly referred to as IEEE 802.11n), and operate in the 2,4 GHz and 5 GHz bands.

These frequency bands are ISM and U-NII bands where both other wireless communication technologies (e.g. Bluetooth®[3], ZigBee®[4], baby phone), and non-communication systems (e.g. microwave ovens, radar systems) can cause interference with the WLAN communication channels. Therefore, the requirements in this document are designed in a way where not only system interoperability is ensured, but also the communication robustness is hardened. In addition, manufacturers and operators need to make sure that the system is configured for robustness. For example, particular care has to be given to selecting an appropriate operating channel to avoid the above mentioned interference.

This document covers various use-cases in relationship to wireless communication for conductive charging and WPT, considering different range requirements for the communication channel:

— Discovery: The EVCC has entered the communication range of the SECC(s), then associates to an appropriate SECC to start HLC for further steps (typically 5 m to 30 m range);

— Fine Positioning: Alignment of the primary and secondary devices for efficient power transfer in case of WPT and alignment of the connectors of EV and EVSE for power transfer in case of automatic connection for conductive charging (typically 10 cm to 5 m range);

— Charging Control: For example, Power Request from vehicle to EVSE (typically 5 cm to 5 m range).

Use-case details are given in ISO 15118-1.

The distance between EVCC and SECC for Charging Control depends on the installation location of the wireless communication modules and antennae. This is out of scope of this document and vendor specific. As the distance influences the reliability of the communication link, manufacturers are encouraged to pay particular attention to the choice of mounting location. Additional parameters to be considered and some example setups are given in Annex A.

For testing and evaluating an installed system, a concept of service available area has been developed and detailed in Annex C.

7.2 SECC requirements

7.2.1 General

The wireless communication module of the SECC shall fulfil the requirements described in this subclause to ensure interoperability between the SECC and EVCC with adequate communication robustness for V2G applications.

7.2.2 WLAN technology

[V2G8-001] The wireless communication module of the SECC shall use IEEE 802.11 (see IEEE Std 802.11-2012) compliant wireless communication technology.

[V2G8-002] The wireless communication module of the SECC shall be configured as Access Point (AP) according to IEEE 802.11.

[V2G8-003] The wireless communication module of the SECC shall support the mandatory feature set of an HT AP according to IEEE Std 802.11-2012 on all the channels that it supports.

NOTE 1 An HT AP is an access point implementing the same set of features as an HT STA (see IEEE Std 802.11-2012, 4.3.10).

3) Bluetooth® is the trademark of a product supplied by Bluetooth Special Interest Group. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

4) ZigBee® is the trademark of a product supplied by Zigbee alliance. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

The SECC may support other variants of IEEE 802.11 technology, as long as EVCCs can always establish connections via IEEE 802.11n. An example of such a technology is the Very High Throughput PHY (see IEEE 802.11ac-2013).

[V2G8-004] The beacon period of the SECC shall not exceed T_beacon = 105 ms.

NOTE 2 The beacon period is the time between two successive transmissions of the beacon frame. It is measured in Time Units (1 TU = 1024 µs). A typical value would be T_beacon = 100 TU.

NOTE 3 T_beacon is the value of the Beacon Interval field as described in IEEE Std 802.11-2012, 8.4.1.3.

7.2.3 WLAN frequency and channel

There are two frequency bands with up to 35 channels which the SECC and EVCC can use to communicate. The SECC is responsible for choosing the channel for operation. SECCs supporting simultaneous dual band operation are able to offer two operating channels for EVCCs to connect, while SECCs supporting selectable dual band operation are only able to offer a single operating channel. The SECC for wireless communication may be responsible for one or more power outlets as described in ISO 15118-1, which is different from the SECC using powerline communication which controls only a single power outlet as described in ISO 15118-3. Due to the possible drastic difference in the spectral environmental conditions among the EVCCs in the case of SECCs controlling multiple power outlets, offering two operating channels would let the EVCCs choose the channel which is less affected by its local interferences (e.g. from in-car infotainment system) and thus increase the communication robustness. For SECCs installed in an uncontrolled environment where the spectrum will not be monitored professionally, e.g. typically envisioned for WPT systems, it is also advisable to offer simultaneous dual band support.

[V2G8-005] If the SECC supports WPT, the wireless communication module of the SECC shall support operation at both the 2,4 GHz and 5 GHz frequency bands in parallel.

[V2G8-006] If the SECC controls two or more power outlets at a time, the wireless communication module of the SECC shall support operation at both the 2,4 GHz and 5 GHz frequency bands in parallel.

[V2G8-007] If the SECC controls only one power outlet at a time, the wireless communication module of the SECC shall support operation at both the 2,4 GHz and 5 GHz frequency bands, but not necessarily in parallel, unless **[V2G8-005]** applies.

[V2G8-008] The wireless communication module of the SECC shall support a minimum of three channels per frequency band at the operating site among the channels listed in Table 1 and Table 2.

NOTE 1 Depending on the location of the SECC, not all the channels listed in Table 1 and Table 2 may be allowed to be used (see Figure 2). V2G8-027 and V2G8-008 refers to the common subset of these two groups.

NOTE 2 A collection of national regulations in usage of the U-NII band channels is listed in Annex D.

NOTE 3 Depending on local regulations, the implementation of DFS and/or TPC might be required. The DFS mechanism is described in IEEE Std 802.11-2012, 10.9. The TPC mechanism is described in IEEE Std 802.11-2012, 10.8.

Table 1 — Channels allowed to be used for ISO 15118 (all parts) in the 2,4 GHz band

Channel ID	Centre frequency (MHz)
1	2 412
2	2 417
3	2 422
4	2 427
5	2 432
6	2 437
7	2 442
8	2 447
9	2 452
10	2 457
11	2 462

Table 2 — Channels allowed to be used for ISO 15118 (all parts) in the 5 GHz band

Channel ID	Centre frequency (MHz)
36	5 180
40	5 200
44	5 220
48	5 240
52	5 260
56	5 280
60	5 300
64	5 320
100	5 500
104	5 520
108	5 530
112	5 560
116	5 580
120	5 600
124	5 620
128	5 640
132	5 660
136	5 680
140	5 700
149	5 745
153	5 765
157	5 785
161	5 805
165	5 825