DEUTSCHE NORM Februar 2021

DIN EN ISO 15118-8

ICS 43.120

Ersatz für
DIN EN ISO 15118-8:2019-08

Straßenfahrzeuge – Kommunikationsschnittstelle zwischen Fahrzeug und Ladestation – Teil 8: Anforderungen an Bitübertragungs- und Sicherungsschicht für die drahtlose Kommunikation (ISO 15118-8:2020); Englische Fassung EN ISO 15118-8:2020

Road vehicles –
Vehicle to grid communication interface –
Part 8: Physical layer and data link layer requirements for wireless communication (ISO 15118-8:2020);
English version EN ISO 15118-8:2020

Véhicules routiers –
Interface de communication entre véhicule et réseau électrique –
Partie 8: Exigences relatives à la couche physique et à la couche de liaison entre les données pour la communication sans fil (ISO 15118-8:2020);
Version anglaise EN ISO 15118-8:2020

Gesamtumfang 43 Seiten

DIN-Normenausschuss Automobiltechnik (NAAutomobil)

Nationales Vorwort

Der Text von ISO 15118-8:2020 wurde vom Technischen Komitee ISO/TC 22 „Road vehicles“ der Internationalen Organisation für Normung (ISO) erarbeitet und als EN ISO 15118-8:2020 durch das Technische Komitee CEN/TC 301 „Straßenfahrzeuge“ übernommen, dessen Sekretariat von AFNOR (Frankreich) gehalten wird.

Das zuständige deutsche Normungsgremium ist der Arbeitsausschuss NA 052-00-31 AA „Datenkommunikation“ des DIN-Normenausschusses Automobiltechnik (NAAutomobil).

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die Englische Fassung von EN ISO 15118-8:2020.

Das DIN-Präsidium hat mit seinem Beschluss 1/2004 festgelegt, dass von dem in den Regeln der europäischen Normungsarbeit von CEN/CENELEC verankerten Grundsatz, wonach Europäische Normen in den drei offiziellen Sprachen Deutsch, Englisch und Französisch veröffentlicht werden, in begründeten Ausnahmefällen abgewichen und auf die deutsche Sprachfassung verzichtet werden kann.

Die Genehmigung dafür hat die DIN-Geschäftsleitung entsprechend ihren in Anlage 1 zu dem DIN-Rundschreiben A 5/2004 festgelegten Kriterien für die vorliegende Norm auf Antrag des NA 052 NAAutomobil als Ergebnis einer Einzelfallentscheidung erteilt, zumal bereits dieser Norm zugrunde liegende Papiere überwiegend in englischer Sprache auch von den deutschen Marktteilnehmern angewendet werden.

Um den Energieverbrauch von Fahrzeugen zu senken, werden Fahrzeuge mit elektrischem Teil- oder Komplettantrieb entwickelt. Um die Batterien dieser Fahrzeuge aufladen zu können, wird eine spezielle Ladeinfrastruktur benötigt.

Während verschiedene Teilaspekte in der Normung von Elektrofahrzeugen und Infrastruktur bei ISO und IEC bereits behandelt wurden, beschäftigt sich diese Normenreihe mit dem Informationsaustausch zwischen Elektrofahrzeug und Ladeinfrastruktur. Kommunikation ist für das effektive Aufladen von Fahrzeugen sowie die Entwicklung effizienter und komfortabler Abrechnungssysteme unabdingbar.

Dieser Teil der Normenreihe beschreibt Anforderungen an die Bitübertragungs- und Sicherungsschicht für die drahtlose Kommunikation.

Änderungen

Gegenüber DIN EN ISO 15118-8:2019-08 wurden folgende Änderungen vorgenommen:

a) Anpassung der Anforderung V2G8-034;

b) Korrektur von Fehlern und Verbesserungen von Formulierungen im gesamten Dokument.

Frühere Ausgaben

DIN EN ISO 15118-8: 2019-08

Nationaler Anhang NA
(informativ)

Begriffe

Die Benummerung der folgenden Begriffe und Abkürzungen ist identisch mit der Benummerung in der englischen Fassung.

Für die Anwendung dieses Dokuments gelten die Begriffe nach ISO 15118-1, ISO 15118-2 und die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

— IEC Electropedia: verfügbar unter http://www.electropedia.org/

— ISO Online Browsing Platform: verfügbar unter http://www.iso.org/obp

3.1
Zugriffspunkt
AP, *en: access point*
Gerät zur drahtlosen Kommunikation, welches dem Nutzer erlaubt, sich mit anderen drahtlosen oder kabelgebundenen Kommunikationsgeräten zu verbinden

Anmerkung 1 zum Begriff: Siehe IEEE 802.11-2012.

3.2
Ladestation
CS, *en: charging site*
Bereich mit einer oder mehreren Elektrofahrzeug-Ladeeinrichtungen (en: electric vehicle supply equipment, EVSE), die durch eine Kommunikationssteuerung für die Ladeeinrichtung (en: supply equipment communication controller, SECC) gesteuert werden

3.3
Station
STA
(en: station)
logische Entität, welche eine einzeln adressierbare Instanz einer Medium-Zugriffssteuerung und die Schnittstelle der physikalischen Schicht zum drahtlosen Medium ist und nicht als *Zugriffspunkt* (3.1) agiert

3.4
IEEE 80211.n
IEEE 802.11, in dem die Instanzen entweder HT *APs* (3.1) oder HT *STAs* (3.3) sind

Anmerkung 1 zum Begriff: Die Eigenschaften einer HT STA sind in IEEE 802.11-2012, 4.3.10, zusammengefasst. Ein HT AP ist ein Zugriffspunkt, welcher dieselben Eigenschaften wie eine HT STA implementiert.

3.5
Schicht-2-Verbindungsaufbau
(en: layer 2 link establishment)
Verbindungsaufbau, der über einen erfolgreichen Verbindungs-/Anschlussprozess, wie in IEEE 802.11-2012, 10.3.5.2 und 10.3.5.3, beschrieben, angezeigt wird

3.6
Gebiet mit verfügbarem Dienst
(en: service available area)
beschränktes Gebiet um eine Ladestation herum, in dem die SECC einen Verbindungsdienst mit gesicherter Qualität bereitstellt

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 15118-8

September 2020

ICS 43.120

Supersedes EN ISO 15118-8:2019

English Version

Road vehicles - Vehicle to grid communication interface - Part 8: Physical layer and data link layer requirements for wireless communication (ISO 15118-8:2020)

Véhicules routiers - Interface de communication entre véhicule et réseau électrique - Partie 8: Exigences relatives à la couche physique et à la couche de liaison entre les données pour la communication sans fil (ISO 15118-8:2020)

Straßenfahrzeuge - Kommunikationsschnittstelle zwischen Fahrzeug und Ladestation - Teil 8: Anforderungen an Bitübertragungs- und Sicherungsschicht für die drahtlose Kommunikation (ISO 15118-8:2020)

This European Standard was approved by CEN on 20 September 2020.

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, Turkey 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

Ref. No. EN ISO 15118-8:2020 E

European foreword

This document (EN ISO 15118-8:2020) 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 March 2021, and conflicting national standards shall be withdrawn at the latest by March 2021.

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.

This document supersedes EN ISO 15118-8:2019.

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 15118-8:2020 has been approved by CEN as EN ISO 15118-8:2020 without any modification.

Contents

Page

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 of 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 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* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 301, *Road vehicles,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 15118-8:2018) of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— DFS and/or TPC are now used instead of only DFS, see 7.2.3 and 7.3.3;

— correction of requirement V2G8-034;

— editorial corrections.

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

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.

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, a 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 and ISO 15118-2, respectively.

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

IEEE 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:

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

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

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 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 802.11 where the instances are HT *APs* (3.1) or HT *STAs* (3.3)

Note 1 to entry: The features of an HT STA are summarized in IEEE 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 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.

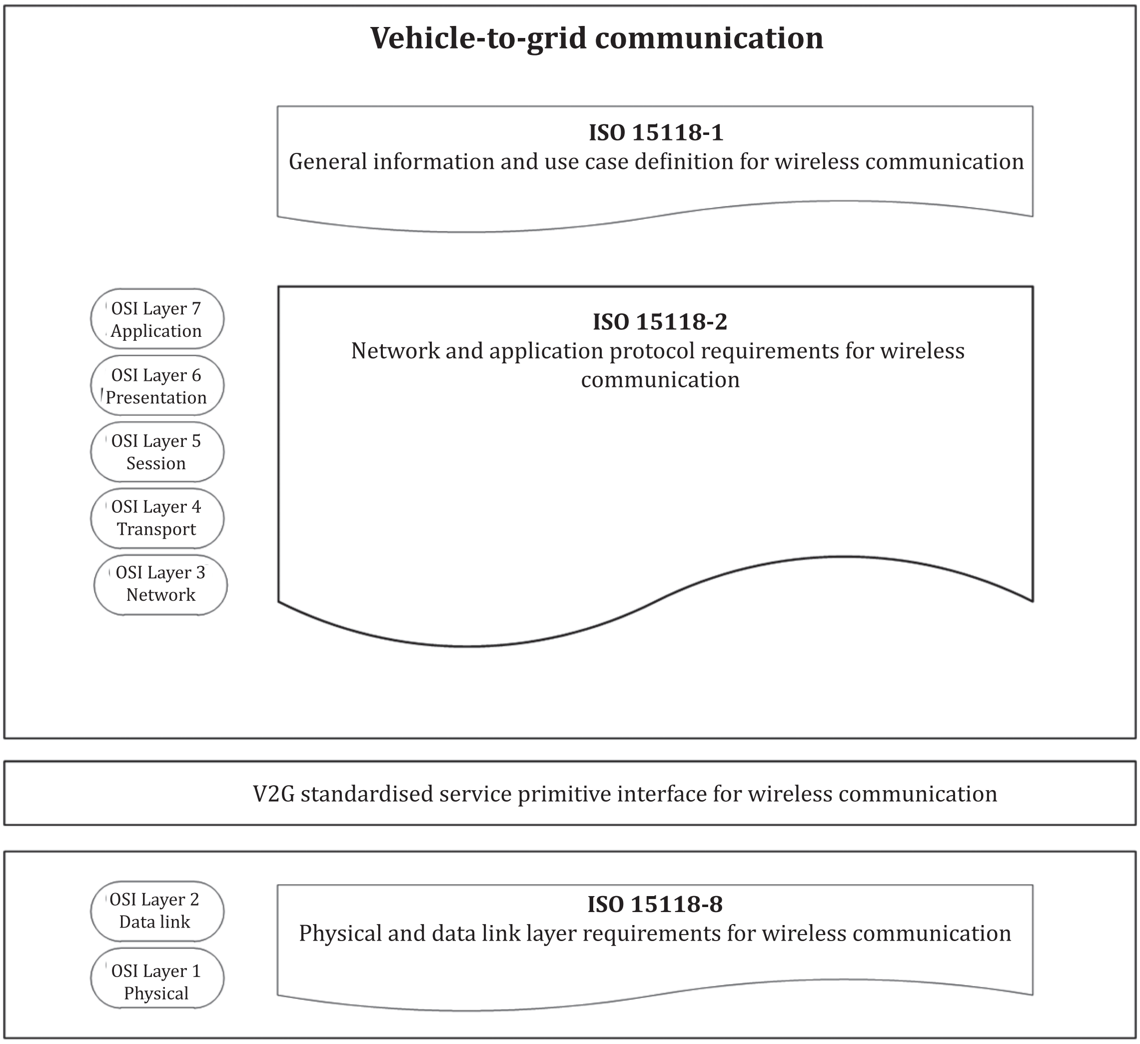


Figure 1 — Overview of ISO 15118-1, ISO 15118-2, and this document in the ISO/IEC OSI reference model

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 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®[1)], ZigBee®[2)], 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 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 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 802.11-2012, 4.3.10).

1) 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.

2) 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 = 1 024 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 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 can 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, Table D.1.

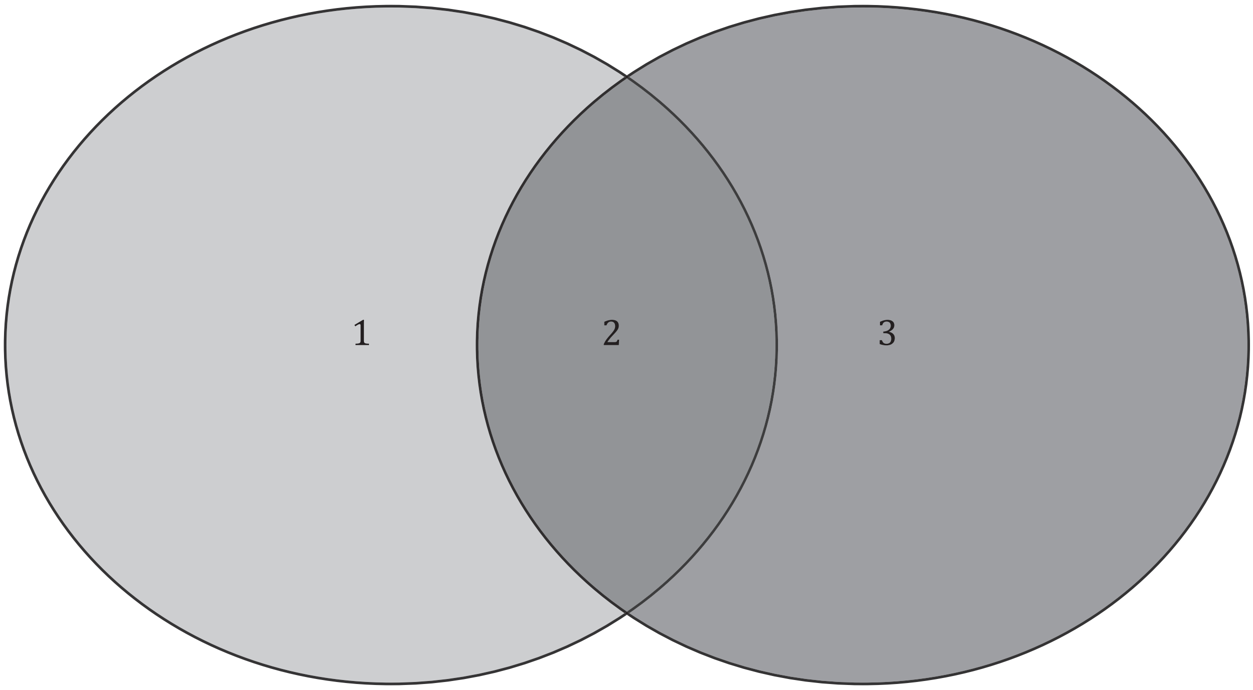
NOTE 3 Depending on local regulations, the implementation of DFS and/or TPC can be required. The DFS mechanism is described in IEEE 802.11-2012, 10.9. The TPC mechanism is described in IEEE 802.11-2012, 10.8.

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



Key

1 15118 channels

2 channels to be used by SECC and EVCC

3 channels allowed by local regulation

Figure 2 — Illustration of a subset of ISO 15118 (all parts) channels and channels allowed by local regulation

7.2.4 SECC channel scanning and selection

Since SECCs operate using unlicensed shared spectrum, the spectrum environment at the operation site of the SECC should be taken into account when selecting the operating channel in order to improve robustness of the communication link between the SECC and EVCC(s). The SECC may perform automatic channel scanning and selection to choose an appropriate channel. The effectiveness of the automatic channel selection is dependent on the channel selection algorithm, which is out of scope of this document. Alternatively, the operator may analyse the operating environment through a spectrum site survey and select the most suitable channel/list of channels for the SECC. These two methods are not mutually exclusive to each other and may be used in combination depending on the needs of the SECC operator. The requirements in this subclause are formulated as the basic requirements to ensure a good level of confidence for smooth operation.

[V2G8-009] Channel selection of the SECC shall be done by an automatic channel scanning and channel switching algorithm.

NOTE 1 Channel scanning refers to an SECC scanning a list of channels which it can operate in.

NOTE 2 Channel switching refers to the change of the current operating channel of the SECC to a different and more preferred channel after channel scanning.

[V2G8-010] If a site spectrum survey for channel selection is done by the operator, automatic channel scanning and channel switching shall be optional.

[V2G8-011] If an automatic channel scanning is implemented, the wireless communication module of the SECC shall scan the spectrum after power-on.

[V2G8-012] If an automatic channel scanning is implemented, the wireless communication module of the SECC shall scan the spectrum after ending the V2G communication session, when there is no other associated EVCC.

[V2G8-013] The spectrum scan shall be started within 5 s after the last V2G communication session is finished.

NOTE 3 The term V2G communication session is defined in ISO 15118-2.

[V2G8-014] Channel scanning and channel switching shall be done within 30 s after starting the channel scanning.

[V2G8-015] If an automatic channel scanning is implemented, the wireless communication module of the SECC shall scan the spectrum at least every 60 min when there is no associated EVCC and use the results of the scan as the input to its channel selection algorithm.

NOTE 4 The channel selection algorithm is out of scope of this document. The implementation of the algorithm is up to the provider of the SECC. Refer to Annex B for examples of the parameters and environmental conditions which may be taken into account by such an algorithm.

7.2.5 Quality of service

Enhanced distributed channel access (EDCA) is a mechanism specified in IEEE 802.11 to support applications with quality of service requirements. EDCA delivers traffic based on differentiating IEEE 802.11 access categories. Traffic with higher access categories such as voice (AC_VO) or video (AC_VI) has a higher chance to gain the right to access the medium than traffic with lower access categories such as best effort (AC_BE) or background (AC_BK). IPv6 traffic classes can be mapped to IEEE 802.11 access categories. Therefore, by assigning tags to application traffic with different IPv6 traffic classes, it is possible to prioritize the transmission of certain application data. For example, for V2G application, a higher traffic class can be assigned to the V2G traffic than to the VAS traffic.

The mapping of IPv6 traffic classes to access categories is defined in this subclause. Traffic class assignment for V2G application is defined in ISO 15118-2.

[V2G8-016] The wireless communication module of the SECC shall support the EDCA as defined in IEEE 802.11.

NOTE The EDCA mechanism is described in IEEE 802.11-2012, 9.2.4.2.

[V2G8-017] The wireless communication module of the SECC shall map IPv6 traffic classes to IEEE 802.11 access categories according to Table 3.

Table 3 — Mapping table of IPv6 traffic classes to IEEE 802.11 access categories

IPv6 traffic class	IEEE 802.11 access category
0 – 31	AC_BE
32 – 95	AC_BK
96 – 127	AC_BE
128 – 191	AC_VI
192 – 255	AC_VO

7.2.6 Association support

An SECC is, from the perspective of the EVCC, indistinguishable from any other WLAN AP. A specific SECC can be identified by its SECC ID as described in ISO 15118-1. In the case of WLAN, the SECC ID is the SSID. It is recommended to use a prefix with “AWC” (automotive wireless communication) in the SSID, e.g. “AWC-xyz123”, “AWC-Provider-XYZ”, etc. However, even if the SECC ID is known beforehand, another AP with the same SSID (but which is not the right SECC or not an SECC at all) might be present. To support the association process, it is thus required to transmit some basic information about the CS without the necessity to establish a connection on layer 3 or higher layer. For WLAN, the preferred way to do this is the inclusion of a so called vendor specific element (VSE) into the management frames transmitted by the SECC (see IEEE 802.11-2012, 8.4.2.28 for a description of the general structure of a VSE). This subclause details how this mechanism is to be used in the context of ISO 15118 (all parts).

[V2G8-018] The SECC shall include a VSE as specified in Table 4 in its beacon frames.

NOTE 1 The beacon frame is described in IEEE 802.11-2012, 8.3.3.2.

[V2G8-019] The SECC shall include a VSE as specified in Table 4 in its probe response frames.

NOTE 2 The probe response frame is described in IEEE 802.11-2012, 8.3.3.10.

Table 4 — Vendor specific element fields for SECC

Field	**Octet no.**	**Field size** (octets)	**Value**	**Description**
Element ID	0	1	0xDD	Fixed value as defined in IEEE 802.11–2012, Tables 8 - 54.
Length	1	1	Length of the payload, ranging from 0x11 to 0xFF	The payload consists of all fields of the VSE except the element ID and the length itself.
Organization ID	2 to 6	5	0x70B3D53190	A context-dependent identifier consisting of the public organizationally unique identifier (0x70B3D5319) assigned by the IEEE to ISO/TC 22/SC 31 and a four bit extension identifier (0x0) indicating its usage in the context of ISO 15118 (all parts) (IEEE 802.11–2012, 8.4.1.31).
Element type	7	1	0x01	This field is used to distinguish between multiple types of VSEs using the same organization ID. A value of 0x01 identifies the VSE transmitted by an SECC as defined in this document[a].

[a] The value of the field element type will not be modified in future revisions of this document, unless the format or the meaning of the content of the VSE changes.

[b] An example of such a national authority is the “Energie Codes und Services GmbH” in Germany.

[c] The charging site ID is the unique identifier for the SECC. It may be used for reservation or any other purposes.

Table 4 *(continued)*

Field	**Octet no.**	**Field size** (octets)	**Value**	**Description**
Energy transfer type	8	1	Bitfield indicating the energy transfer types supported by the CS, ranging from 0x01 to 0x0F	Bitfield describing the energy transfer types supported by the CS. The meaning of the single bits is given below in order from the least (bit 0) to the most significant bit (bit 7). All energy transfer types supported by the CS shall be set to 1, otherwise to 0. Bits 4 to 7 are reserved for future use and shall always be set to zero. Bit 0 – AC support Bit 1 – DC support Bit 2 – WPT support Bit 3 – ACD support Bit 4 – *reserved* Bit 5 – *reserved* Bit 6 – *reserved* Bit 7 – *reserved*
Country code	9 to 10	2	Country code of the operator of the CS	Two character country code according to ISO 3166-1.
Operator ID	11 to 13	3	ID of the operator of the CS	Operator ID as defined in ISO 15118-2:2014, Annex H. The ID is typically issued by a national authority[b]. If the operator of the CS has no operator ID, the value shall be set to "–––"(0x2D2D2D).
Charging site ID	14 to 18	5	ID of the CS	Unique identifier of the CS, to be defined by the operator[c]. The charging site ID is a numerical value and in general not a valid UTF-8 string.
Additional information	19 et sqq.	0 to 238	A UTF-8 encoded string	This field is optional; see **[V2G8-020]** and Table 5 for details.

[a] The value of the field element type will not be modified in future revisions of this document, unless the format or the meaning of the content of the VSE changes.

[b] An example of such a national authority is the "Energie Codes und Services GmbH" in Germany.

[c] The charging site ID is the unique identifier for the SECC. It may be used for reservation or any other purposes.

[V2G8-020] If additional information is included into the VSE of the SECC, this shall be done as a UTF-8 encoded string of the form *<ETT>*:*<parameter>*=*<value>*:*<parameter>*=*<value>*,*<value>*|*<ETT>*: etc.

where

<ETT>	signifies the energy transfer type as defined in Table 5,
<parameter>	signifies the parameter as defined in Table 5,
<value>	signifies the value as defined in Table 5,
: (0x3A)	is used to separate the ETT and the parameters,
= (0x3D)	is used to separate the parameter from its values,
, (0x2C)	is used to separate multiple values for one parameter, and
| (0x7C)	is used to separate multiple parameter sets (one per ETT).

Table 5 — Optional information for inclusion into the vendor specific element for both SECC and EVCC

ETT	Parameter	Value	Description
AC	C	1	AC charging connector type 1 (IEC 62196-2)
		2	AC charging connector type 2 (IEC 62196-2)
		3	AC charging connector type 3 (IEC 62196-2)
	M	1	AC single phase charging [IEC 62196 (all parts)]
		3	AC three phase charging [IEC 62196 (all parts)]
	S	C	AC charging service
		B	AC bidirectional power transfer service
		I	AC island operation service
DC	C	1	DC charging connector type 1 [IEC 62196 (all parts)]
		2	DC charging connector type 2 [IEC 62196 (all parts)]
	M	1	DC charging on the core pins [IEC 62196 (all parts)]
		2	DC charging using the extended pins of a configuration EE or configuration FF connector (IEC 62196-3)
		3	DC charging using the core pins of a configuration EE or configuration FF connector (IEC 62196-3)
		4	DC charging using a dedicated DC coupler
	S	C	DC charging service
		H	DC high power charging service
		B	DC bidirectional power transfer service
		I	DC island operation service
WPT	Z	1	Gap class Z1 (IEC 61980-3)
		2	Gap class Z2 (IEC 61980-3)
		3	Gap class Z3 (IEC 61980-3)
	P	1	Power class MF-WPT1 (IEC 61980-3)
		2	Power class MF-WPT2 (IEC 61980-3)
		3	Power class MF-WPT3 (IEC 61980-3)
		4	Power class MF-WPT4 (IEC 61980-3)
	F	M	Manual/proprietary positioning without parameters
		A1	Fine positioning signal from EV to EVSE using low frequency antenna
		A2	Fine positioning signal from EVSE to EV using low frequency antenna
		V1	Fine positioning signal from EV to EVSE using magnetic vectoring
		V2	Fine positioning signal from EVSE to EV using magnetic vectoring
		E	Fine positioning signal from EVSE to EV using low power excitation
	A	E	Alignment check using low power excitation
		P	Alignment check using point-to-point signal from EV to EVSE
	P	E	Pairing using low power excitation from EVSE to EV
		P	Pairing using point-to-point signal from EV to EVSE
		V	Pairing using magnetic vectoring
		A	Pairing using low frequency antenna
	G	C	Geometry of the primary device is circular (IEC 61980-3)
		D	Geometry of the primary device is double D (IEC 61980-3)
		P	Geometry of the primary device is polarized (IEC 61980-3)

Table 5 *(continued)*

ETT	Parameter	Value	Description
ACD	ID		EVID which may be used to support association. The format of EVID is not defined in this document. This field is only applicable for VSEs for EVCCs.

EXAMPLE 1 This is the VSE transmitted by a German CS (Operator ID: XYZ) which supports DC and AC charging.

EID	Length	Organizational ID	Type	ETT	Country code	Operator ID	Charging site ID
0xDD	**0x11**	**0x70B3D53190**	**0x01**	**0x03**	**0x4445**	**0x58595A**	**0x0123456789**

EXAMPLE 2 This is the VSE transmitted by a Japanese CS (Operator ID: ABC) which supports AC and WPT charging and includes additional information (AC:C=1|WPT:Z=2:P=1,2).

EID	Length	Organizational ID	Type	ETT	Country code	Operator ID	Charging site ID
0xDD	**0x25**	**0x70B3D53190**	**0x01**	**0x05**	**0x4A50**	**0x414243**	**0x0123456789**
Additional information							
0x41433A433D317C5750543A5A3D323A503D312C32							

It is up to the EVCC to utilize the information provided via the VSE. An EVCC could, for example, ignore all APs that do not include the VSE into their management frames or (if the VSE is included) that do not offer a compatible energy transfer type.

7.2.7 Layer 2 interfaces

7.2.7.1 Overview

This subclause describes the terminology primitives used within this document. It is for explanation and for definition of a unique terminology only. This terminology is implementation independent. The data link layer provides two interfaces to higher layers: data service access point (SAP) for data unit interfaces and data link control SAP for link status information, error information, and control functionalities.

7.2.7.2 Data SAP

The network layer/logical link control sublayer data service primitives are defined in ISO/IEC 8802-2.

7.2.7.3 Data link control SAP

The primitives for data link control SAP to layer 3 are:

— D-LINK_READY.indication,

— D-LINK_TERMINATE.request,

— D-LINK_ERROR.request, and

— D-LINK_PAUSE.request.

Primitive details are given in ISO 15118-3:2015, 12.3.

[V2G8-021] The wireless communication module of the SECC shall inform HLE through the D-LINK_READY.indication = link established within T_conn_max_D-Link when the layer 2 link to the wireless communication module of the EVCC is established.

Table 6 — Timing and constant values

Parameter	Description	Min	Typical	Max	Unit
T_conn_max_D-Link	Time for D-Link_READY.indication to higher layers after a layer 2 link is established.			1	s
T_conn_max_comm	The duration between when the EVCC has detected an SECC for initiation of the association procedure for the charging application and when the D-Link_READY.indication is sent to HLE.			5	s

7.2.8 Pairing

7.2.8.1 General

Pairing is a process that correlates an EV with a unique EVSE (plug/primary device). The EVSE to which the EV is connected transfers the power either through a cable or through a WPT technology. If pairing is required, different mechanisms are described in 7.2.8.2 and 7.2.8.3, respectively.

For wireless communication, pairing might take place at a different point of time as compared to wired communication (known as matching as described in ISO 15118-3) due to the fact that the capability to transfer power is not necessarily given at the beginning of the communication.

7.2.8.2 Pairing with conductive charging

Pairing for conductive charging is done by toggling the control pilot line according to ISO 15118-3:2015, 9.4.

7.2.8.3 Pairing with WPT

Pairing mechanisms for WPT are given in IEC 61980 (all parts) and ISO 19363. Pairing related messages are given in ISO 15118-20.

7.3 EVCC requirements

7.3.1 General

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

7.3.2 WLAN technology

[V2G8-022] The wireless communication module of the EVCC shall use IEEE 802.11 compliant wireless communication technology.

[V2G8-023] The wireless communication module of the EVCC shall be configured as STA.

[V2G8-024] The wireless communication module of the EVCC shall support the mandatory feature set of an HT STA according to IEEE 802.11-2012 on all the channels that it supports.

NOTE The feature set of an HT STA is described in IEEE 802.11-2012, 4.3.10.

The EVCC should select any available newer variant of IEEE 802.11 which is supported by the SECC. The selection of newer IEEE 802.11 features is assumed to improve spectral efficiency.

The EVCC can apply any additional feature set of IEEE 802.11, compatible to the available feature set of the SECC, to improve the reliability of the communication. Examples of these features are the intelligent choice of antennae, other modulation schemes or modulation rates, and the ability to handle spatial streams for advanced multiplexing.

In the event the link quality deteriorates, the most robust modulation should be used.

The present document does not limit the usage of any other technologies that may be available in future releases of IEEE 802.11, as long as support for IEEE 802.11n is ensured.

[V2G8-025] The wireless communication module of the EVCC shall use active and/or passive scanning.

Active scanning allows the EVCC to send probe request frames to the SECC instead of passively waiting for beacon frames broadcasted by the SECC. Refer to IEEE 802.11-2012, 10.1.4. If the EVCC would like to achieve fast association, active scanning is recommended.

7.3.3 WLAN frequency and channel

Since SECC selects the operating channel, it is necessary for the EVCC to scan and operate on all allowed channels so that the EVCC will be able to associate and communicate with the SECC on the channel the SECC is operating in.

[V2G8-026] The wireless communication module of the EVCC shall support operation at both the 2,4 GHz and 5 GHz frequency bands, but not necessarily in parallel.

[V2G8-027] The wireless communication module of the EVCC shall support all channels in both the 2,4 GHz and 5 GHz bands, which are listed in Table 1 and Table 2.

NOTE 1 A collection of national regulations in usage of the U-NII band channels is listed in Annex D.

NOTE 2 Depending on the location of the EVCC, not all of the channels listed in Table 1 and Table 2 can be allowed to be used (see Figure 2). V2G8-027 and V2G8-028 refers to the common subset of these two groups.

[V2G8-028] The wireless communication module of the EVCC shall scan all channels in both the 2,4 GHz and 5 GHz bands, which are listed in Table 1 and Table 2.

NOTE 3 Active scanning may be prohibited on certain channels.

NOTE 4 Depending on local regulations, the implementation of DFS and/or TPC can be required. The DFS mechanism is described in IEEE 802.11-2012, 10.9. The TPC mechanism is described in IEEE 802.11-2012, 10.8.

7.3.4 Quality of service

[V2G8-029] The wireless communication module of the EVCC shall support EDCA as defined in IEEE 802.11.

NOTE The EDCA mechanism is described in IEEE 802.11-2012, 9.2.4.2.

[V2G8-030] The wireless communication module of the EVCC shall map IPv6 traffic classes to IEEE 802.11 access categories according to Table 3.

7.3.5 Association support

The EVCC is, from the perspective of the SECC, indistinguishable from any other WLAN STA. To support the association process, it is thus required to transmit some basic information about the EV without the necessity to establish a connection on layer 3 or higher layer. The mechanism used is identical to the one described in 7.2.6.

[V2G8-031] The EVCC shall include a VSE as specified in Table 7 in its association request frames.

NOTE 1 The association request frame is described in IEEE 802.11-2012, 8.3.3.5.

[V2G8-032] The EVCC shall include a VSE as specified in Table 7 in its reassociation request frames.

NOTE 2 The reassociation request frame is described in IEEE 802.11-2012, 8.3.3.7.

[V2G8-033] If active scanning is used, the EVCC shall include a VSE as specified in Table 7 in its probe request frames.

NOTE 3 The probe request frame is described in IEEE 802.11-2012, 8.3.3.9.

Table 7 — Vendor specific element fields for EVCC

Field Name	**Octet no.**	**Field size** (octets)	**Value**	**Description**
Element ID	0	1	0xDD	Fixed value as defined in IEEE 802.11–2012, Tables 8 - 54.
Length	1	1	Length of the payload, ranging from 0x07 to 0xFF	The payload consists of all fields of the VSE except the element ID and the length itself.
Organization ID	2 to 6	5	0x70B3D53190	A context-dependent identifier consisting of the public organizationally unique identifier (0x70B3D5319) assigned by the IEEE to ISO/TC 22/SC 31 and a four bit extension identifier (0x0) indicating its usage in the context of ISO 15118 (all parts) (see IEEE 802.11–2012, 8.4.1.31).
Element type	7	1	0x02	This field is used to distinguish between multiple types of VSEs using the same organization ID. A value of 0x02 identifies the VSE transmitted by an EVCC as defined in this document[a].
Energy transfer type	8	1	Bitfield indicating the energy transfer types supported by the EV, value ranging from 0x01 to 0x0F	Bitfield describing the energy transfer types supported by the EV. The meaning of the single bits is given below in order from the least (bit 0) to the most significant bit (bit 7). All energy transfer types supported by the EV shall be set to 1, otherwise to 0. Bits 4 to 7 are reserved for future use and shall always be set to zero. Bit 0 – AC supports Bit 1 – DC support Bit 2 – WPT support Bit 3 – ACD support Bit 4 – *reserved* Bit 5 – *reserved* Bit 6 – *reserved* Bit 7 – *reserved*
Additional information	9 et sqq.	0 to 248	A UTF-8 encoded string	This field is optional; see **[V2G8-034]** and Table 5.

[a] The value of the field element type will not be modified in future revisions of this document, unless the format or the meaning of the content of the VSE changes.

[V2G8-034] If additional information is included into the VSE of the EVCC, this shall be done as a UTF-8 encoded string of the form

<ETT>:*<parameter>*=*<value>*:*<parameter>*=*<value>*,*<value>*|*<ETT>*: etc.

where

<ETT>	signifies the energy transfer type as defined in Table 5,
<parameter>	signifies the parameter as defined in Table 5,
<value>	signifies the value as defined in Table 5,
: (0x3A)	is used to separate the ETT and the parameters,
=(0x3D)	is used to separate a parameter from its values,
, (0x2C)	is used to separate multiple values for one parameter, and
|(0x7C)	is used to separate multiple parameter sets (one per ETT).

EXAMPLE This is the VSE transmitted by an EV which supports AC and WPT charging.

EID	Length	Organizational ID	Type	ETT
0xDD	**0x07**	**0x70B3D53190**	**0x02**	**0x05**

It is up to the SECC to utilize the information provided via the VSE. An SECC could, for example, ignore connection requests from STAs that do not include the VSE into their management frames or, if the VSE is included, do not support a compatible energy transfer type.

It is recommended for an SECC installed at charging areas where it potentially receives a lot of association requests from non EVCC STAs, e.g. at public places, to utilize the information provided via the VSE and to accept only connection requests from STAs with a valid VSE.

7.3.6 Layer 2 interfaces

7.3.6.1 Overview

This subclause describes the terminology primitives used within this document. It is for explanation and for definition of a unique terminology only. This terminology is implementation independent. The data link layer provides two interfaces to higher layers: data service access point (SAP) for data unit interfaces and data link control SAP for link status information, error information, and control functionalities.

7.3.6.2 Data SAP

The network layer/logical link control sublayer data service primitives are defined in ISO/IEC 8802-2.

7.3.6.3 Data Control SAP

The primitives for data link control SAP to layer 3 are:

— D-LINK_READY.indication,

— D-LINK_TERMINATE.request,

— D-LINK_ERROR.request, and

— D-LINK_PAUSE.request.

Primitive details are given in ISO 15118-3:2015, 12.3.

To ensure a fast HLC establishment, the wireless communication module shall fulfil the following timing requirements where the timing values are defined in Table 6.

[V2G8-035] The wireless communication module of the EVCC shall inform HLE through the D-LINK_READY.indication = link established within T_conn_max_D-Link when the layer 2 Link to the wireless communication module of the SECC is established.

[V2G8-036] The HLE shall receive the D-LINK_READY.indication = link established within T_conn_max_comm after the EVCC has detected an SECC with which the EVCC would initiate association procedure for the charging application and start the layer 2 association process.

7.4 Security

Security measures at layer 3 and above are defined in ISO 15118-2 for wireless vehicle to grid communication. No additional layer 2 security measures are necessary for both SECC and EVCC.

Annex A
(informative)

Mounting location of wireless communication module and antenna

A.1 Overview

Charging of electric vehicles requires a stable and reliable communication link. This is especially critical in the case of wireless communication. Any reduction of the quality of service, be it a decreased throughput, an increased latency or even an interruption or loss of connection could affect the charging process and thus lead to a negative user experience.

There are several options to improve the robustness of wireless LAN: transmission power, modulation scheme, bandwidth, dedicated quality of service management (e.g. EDCA), and many more. But the ones which are probably the most important are the type and mounting location of the antenna. Manufacturers of EVs as well as EVSEs should pay particular attention to these aspects.

The various types of WLAN antennae differ mainly in their directivity. An omnidirectional antenna allows covering an area around its position in all directions. A directional antenna, in contrast, can only cover a limited zone but will typically allow achieving a higher range.

The antenna does not necessarily need to be integrated into the wireless communication module itself. A spatial separation can be achieved with the help of suitable cabling. This leads to a certain flexibility when choosing the mounting location, which is especially important if the requirements for the positioning of the communication module are contradictory to the ones for the antenna (e.g. operating temperature vs. integration into the ground pad).

The propagation characteristics of electromagnetic radiation in the ultra high (UHF) and super high frequency (SHF) band implicate that transmission works best, when there is a direct line of sight between transmitter and receiver.

The charging infrastructure side needs to be optimised for a certain area to provide its services. This area may be as small as a couple of square meters for a single inductive ground pad for use at home or up to a hectare for a public charging park. Therefore, very different implementations are possible, from integration of the antenna into the ground pad to the installation of multiple external WLAN devices.

The vehicle, on the other hand, should be able to handle the home garage use case as well as the large public charging installations (although it is up to the manufacturer to optimize it for a specific use case). Therefore, an antenna configuration which covers all directions would be desirable. This may even require the use of multiple antennae to satisfy all possible scenarios.

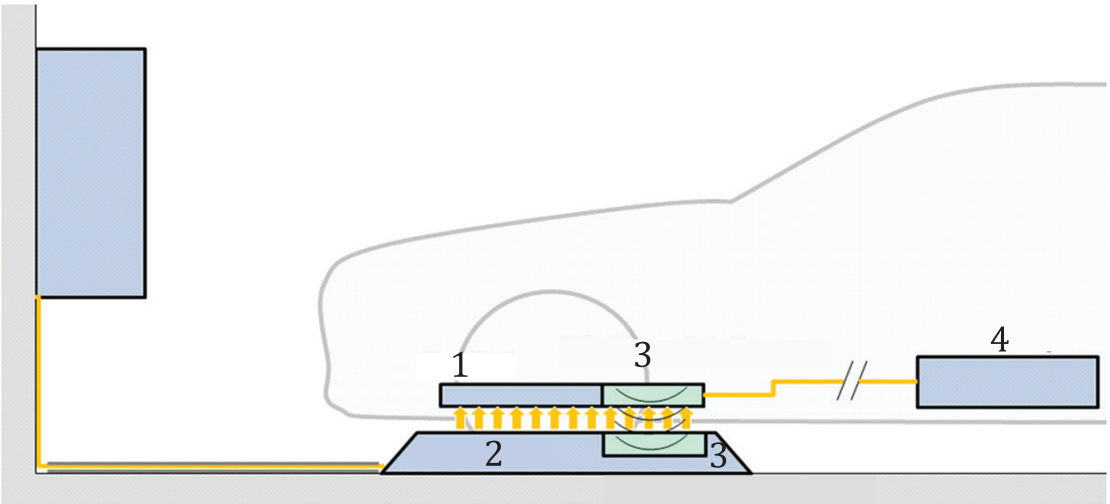
A.2 Examples

A.2.1 General

This subclause gives an overview of possible mounting locations of the wireless communication module and antenna in the vehicle and at the charging site (which is unrelated to the location of the communication controllers). These are examples that impose no requirements on the EV and CS setup.

A.2.2 Shortest possible distance for WPT

Figure A.1 shows the shortest possible distance between the wireless communication modules and antennae (WLAN module/Antenna) in vehicle and at the charging spot. This type of installation is typically envisioned for WPT only. In this case, the WLAN module/antenna is located below the vehicle (e.g. part of car pad). The WLAN module/antenna of the charging spot is located in the ground pad. Minimum distance is defined by air gap class in ISO 19363 and IEC 61980 (all parts).



Key

1 car pad

2 ground pad

3 WLAN module/antenna

4 HV-battery

WLAN

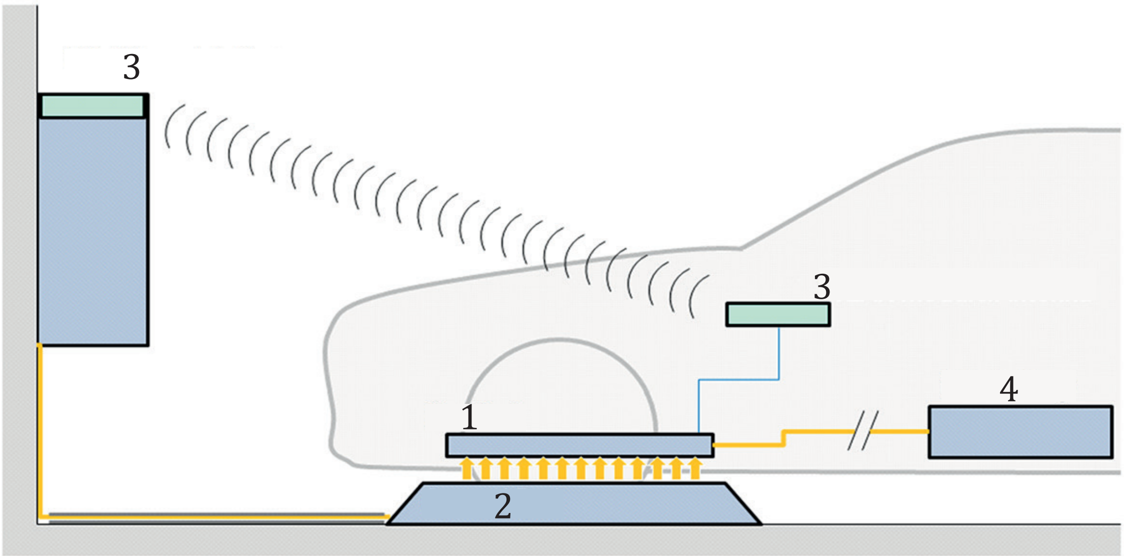
power flow

Figure A.1 — Shortest possible distance between wireless communication module/antennae in case of WPT

Motivation for choosing this configuration could be that the ground pad does not have an external, wall-mounted control unit, but is only connected to the power supply. Special care needs to be taken on the vehicle side to satisfy this use case. One possible solution would be to integrate the WLAN antenna into the car pad of the vehicle.

A.2.3 Typical distance for WPT

Figure A.2 provides an example of the typical distance between the WLAN module/antenna in vehicle and at the charging spot. In this case, the WLAN module/antenna is located inside the vehicle (e.g. part of infotainment system). The WLAN module/antenna of the charging spot is located in the wall box (e.g. payment terminal).



Key

1 car pad

2 ground pad

3 WLAN module/antenna

4 HV-battery

WLAN

power flow

Figure A.2 — Typical distance between wireless communication modules/antennae in case of WPT

This configuration has the advantage that the charging infrastructure covers a wider area with its WLAN AP. On vehicle side, the use of an internal WLAN device is not optimal to establish external connections, but may be justified as it allows using the same WLAN device for multiple applications, which are not necessarily related to charging communication.

A.2.4 Typical distance for AC/DC charging

In the case where wireless communication is used to replace powerline communication for AC/DC charging, Figure A.3 shows a typical case for installation setup in a public charging spot. A wireless SECC may be used to control and communicate to multiple EVCCs. It is also worth noting that wireless communication can substitute to PLC communication with no change in the ISO 15118-2 upper layer messages.

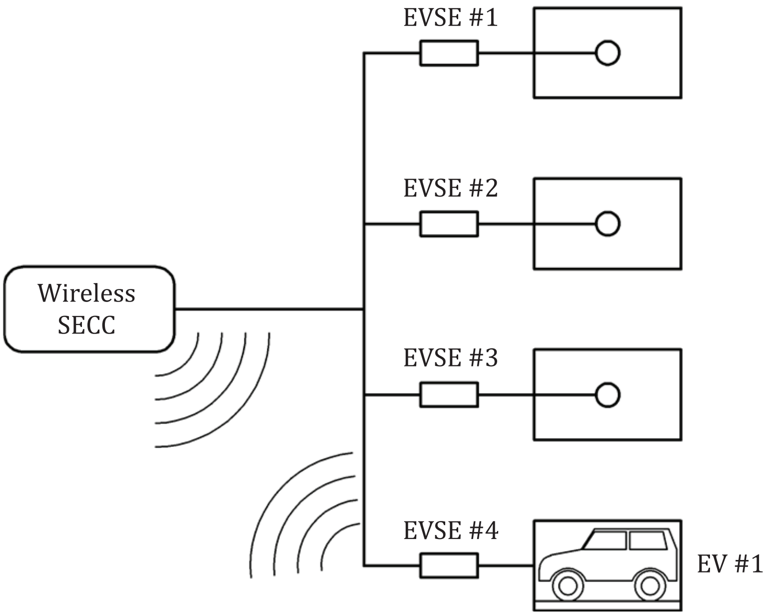
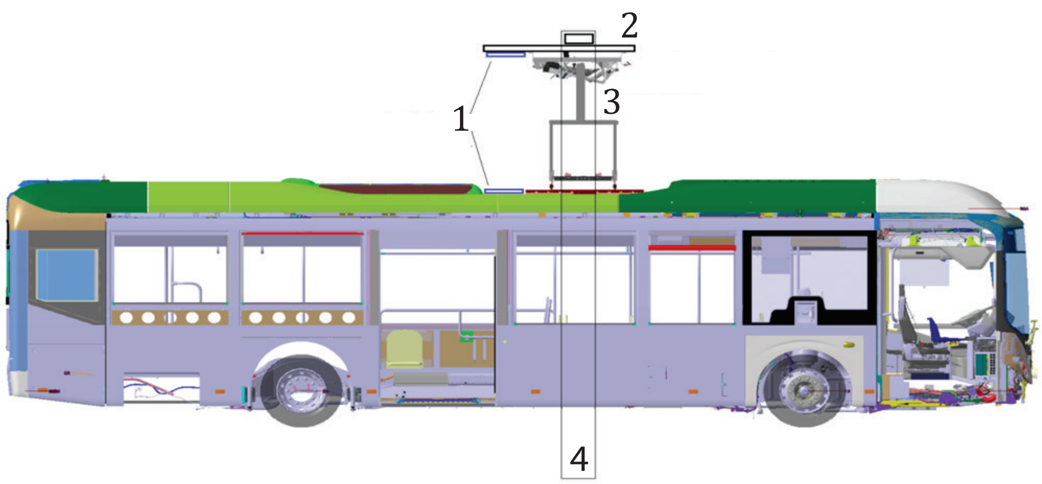


Figure A.3 — Typical distance between wireless communication modules/antennae in case of AC/DC charging in public charging spot

A.2.5 Typical distance for automatic connection device bus charging

Automatic connection device may be used for conductive charging in the case of on-route electric bus charging using inverted pantograph.

Figure A.4 shows the possible location of the patch antenna for both the SECC and the EVCC. Wireless communication is used for automatic connection cases since communication is necessary to be active to control the automatic connection process.



Key

1 patch antenna
2 pantograph mounting adapter
3 inverse pantograph
4 post

Figure A.4 — Typical distance between wireless communication modules/antennae in case of electric bus charging using automatic connection device and patch antennae

Annex B
(informative)

Interference scan and auto channel selection example

B.1 Overview

Wireless communication according to IEEE 802.11 is heavily used by mobile phones, computers and tablets today. Especially the unlicensed 2,4 GHz band is extremely crowded with its overlapping WLAN channels. Additional interferers like microwave ovens, baby phones or Bluetooth devices also reduce the performance of WLAN networks in the 2,4 GHz band.

The IEEE 802.11ax high efficiency WLAN study group is working on improvements for high density WLAN networks in the 2,4 GHz and 5 GHz bands. It is expected to be published in 2020. For details, see http://www.ieee802.org/11/Reports/tgax_update.htm.

However, this is not available today but proprietary auto channel selection mechanisms are available in various WLAN Access points on the market.

Interference can cause degradation in throughput, link quality, range, jitter, and latency/roundtrip time up to loss of communication.

How auto channel selection is implemented is out of scope of this document.

This annex will give an example of an auto channel selection algorithm to choose a channel which is the least influenced by WLAN interference. There are many different approaches to measure interference. Some are given below:

— interference detection based on energy detection. Energy detection identifies all interferers including non-WLAN devices such as baby phones;

— interference detection based on WLAN preamble;

— interference detection based on WLAN preamble and time on air (physical and virtual carrier sense).

Figure B.1 shows WLAN channels 1 to 14 in 2,4 GHz band. Channel usage is limited by national limitations (e.g. in US channel 1 to 11 is allowed, in most EU countries channels 1 to 13 can be used, in JP channels 1 to 14 can be used). Additional national limitations like maximum transmission power or outdoor usage should be considered. It also shows overlapping of each channel with other channels. Only three non-overlapping channels are available (e.g. 1, 6 and 11). A simple channel selection mechanism can be implemented by detecting WLAN beacons and choosing a free one.

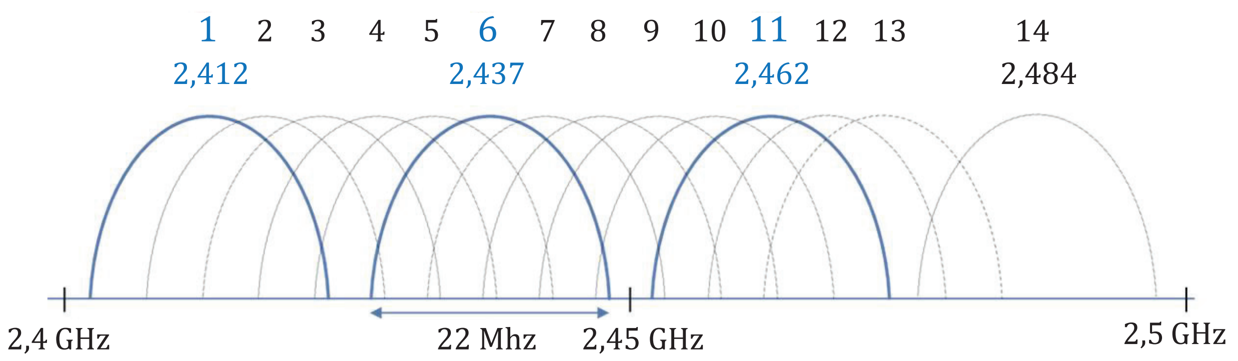


Figure B.1 — 2,4 GHz WLAN channels/frequencies

B.2 Example with one WLAN interferer

Figure B.2 shows a WLAN environment where channel 3 is already used. The WLAN Access point setting up a new network should choose a channel in the range 8 to 14 for WLAN interference free communication.

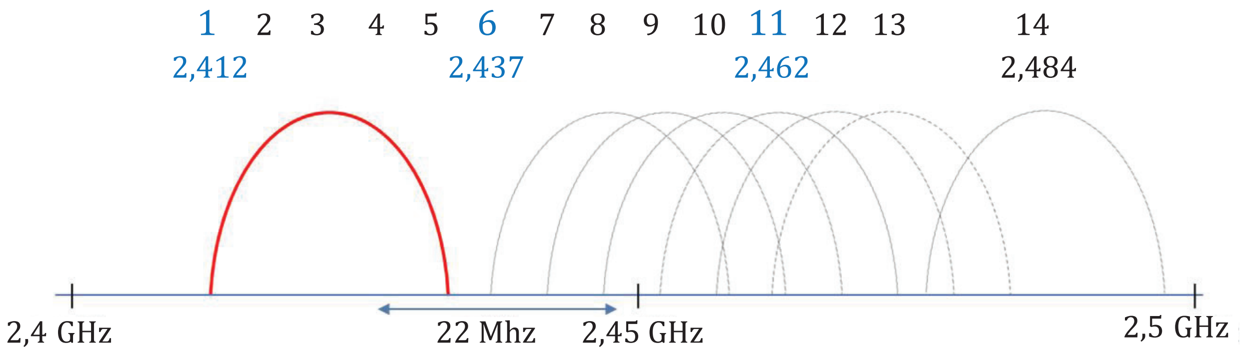


Figure B.2 — One WLAN Interferer is on channel 3 while channels 8 to 14 are interference free

B.3 Example with three WLAN interferers

Figure B.3 shows a WLAN environment with channels 1, 4 and 6 already used by existing WLAN networks. The WLAN Access point setting up a new network should choose one channel in the range 11 to 14 for WLAN interference free communication.

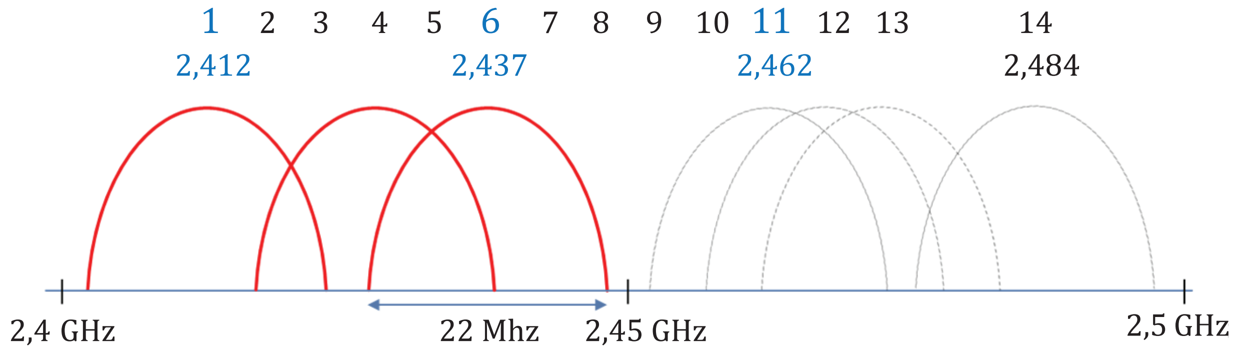


Figure B.3 — WLAN Interferers exist on channel 1, 4 and 6 while channels 11 to 14 are interference free

B.4 Summary

Previous subclauses show examples of low density 2,4 GHz WLAN networks where interference free channels are available. In high density WLAN areas there might be no interference free channels. Selection of least overlapping channels is one possibility to increase performance of the WLAN network. However, using the same channel as an interferer might also increase the performance because medium access can include request-to-send/clear-to-send information instead of energy detection only.

Table B.1 gives an example of a simple weighting algorithm based on channel overlap. Note that channels 12 to 14 are not to be used for implementation of this document. These are included in this annex to give the reader a complete overview of the channels in the 2,4 GHz band.

For example, in first row: if there is already an existing WLAN network on channel 1, the highest priority for a new network would be channels 6 to 14. If these are also used priority 2 would be channel 5 because this is least overlapping with channel 1. Next priority would be channel 4, then channel 3 and 2. Channel 2 would have lowest priority since it is most overlapping with channel 1.

Table B.1 — 2,4 GHz channel selection priority

	Priority 1	**Priority 2**	**Priority 3**	**Priority 4**	**Priority 5**
Channel 1	6 to 14	5	4	3	2
Channel 2	7 to 14	6	5	4	3, 1
Channel 3	8 to 14	7	6	5, 1	4, 2
Channel 4	9 to 14	8	7,1	6, 2	5, 3
Channel 5	10 to 14	9,1	8,2	7, 3	6, 4
Channel 6	1, 11 to 14	10, 2	9, 3	8, 4	7, 5
Channel 7	1, 2, 12 to 14	11, 3	10, 4	9, 5	8, 6
Channel 8	1, 2, 3, 13 to 14	12, 4	11, 5	10, 6	9, 7
Channel 9	1 to 4, 14	13, 5	12, 6	11, 7	10, 8
Channel 10	1 to 5	14, 6	13, 7	12, 8	11, 9
Channel 11	1 to 6	7, 14	8	13, 9	12, 10
Channel 12	1 to 7	8	9, 14	10	11, 13
Channel 13	1 to 8	9	10	11, 14	12
Channel 14	1 to 9	10	11	12	13

More sophisticated algorithms of auto channel selection are described in various IEEE papers.

Annex C
(informative)

Introduction of service available area

C.1 Overview

A charging station providing a wireless communication service for conductive charging or WPT has a restricted area in which the EVCC can use its service. It is defined as the service available area of an SECC.

This annex gives an outline of a possible introduction of the service available area concept. It is recommended to introduce into the communication system concept in order to minimize the level of interferences.

C.2 Dimensions of the service available area

An SECC will provide the connecting service for EVCC within the defined area around the charging station. Dimensions of this area will be defined by a charging service provider according to the providing connection service. The dimensions of the service available area are defined according to service contents.

EXAMPLE 1 5 m (L) × 2 m (W) for conductive charging service.

EXAMPLE 2 15 m (L) × 15 m (W) for park assistance service.

C.3 Quality of service within service available area

The SECC will ensure a service quality of providing a wireless connection service within the service available area. In other words, SECC will ensure enough traffic rate of communication with the EVCC. If it does not, the service will be interrupted or stopped.

An SECC providing a wireless connecting service should keep the designed communication traffic rate high enough to ensure the designed performance of service sequences.

Enough traffic rate will be designed by a charging service provider according to sequences of a providing service.

EXAMPLE 1 For the conductive charging service, round trip time will be kept less than 250 ms.

EXAMPLE 2 For the fine positioning service, round trip time will be kept less than 100 ms.

In order to maintain the service quality within the service available area, the service provider should check the traffic rate regularly and if an interferer to the traffic rate is found, necessary counter measures will be taken by the service provider.

The service quality of an SECC is checked and kept by a regular maintenance by the service provider.

Service provider will check the communication traffic rate within all points of service available area with testing tool.

NOTE 1 The communication traffic rate measured by a testing tool will never ensure the traffic rate of a connected vehicle around a measured point.

NOTE 2 Service provider will take counter measures such as remove interferers or install shields to maintain the quality of connection services.

C.4 Typical cases of the service available area

As stated above, the service available area is provided by a continuous measurement of the traffic rate and managements of electric wave situations in the defined area. Some distance between the charging station and the boundaries of the area is necessary in order to decrease the effect of electro-magnetic interferences and install shields or barriers to them or radio relay points.

Typical use cases where such kind of management can be applicable are:

— a home garage with a WPT pad surrounded by a private garden,

— a commercial WPT pad installed within a gas station area, and

— a public WPT pad installed within a site of public buildings.

If there are a site of a constant area and the manager of it, it will be added as a candidate.

Annex D
(informative)

National regulations in usage of U-NII bands

Table D.1 — National/regional regulations on U-NII band channel usage (dated: 13 Feb 2017)

Channel ID	Center frequency (MHz)	Europe	US	Japan	Korea	China
36	5 180	Indoor (200 mW EIRP)	Indoor or Outdoor. Outdoor AP (1 W/125 mW 30° above horizon). Indoor AP: (1 W EIRP) STA (250 mW EIRP with ≤6 dBi antenna). Further restrictions if >6 dBi antenna.	Indoor	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)
38	5 190	No	No	No	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)
40	5 200	Indoor (200 mW EIRP)	Indoor or Outdoor. Outdoor AP (1 W/125 mW 30° above horizon). Indoor AP: (1 W EIRP) STA (250 mW EIRP with ≤6 dBi antenna). Further restrictions if >6 dBi antenna.	Indoor	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)
42	5 210	No	No	No	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)
44	5 220	Indoor (200 mW EIRP)	Indoor or Outdoor. Outdoor AP (1 W/125 mW 30° above horizon). Indoor AP: (1 W EIRP) STA (250 mW EIRP with ≤6 dBi antenna). Further restrictions if >6 dBi antenna.	Indoor	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)
46	5 230	No	No	No	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)

Table D.1 *(continued)*

Channel ID	Center frequency (MHz)	Europe	US	Japan	Korea	China
48	5 240	Indoor (200 mW EIRP)	Indoor or Outdoor. Outdoor AP (1 W/125 mW 30° above horizon). Indoor AP: (1 W EIRP) STA (250 mW EIRP with ≤6 dBi antenna). Further restrictions if >6 dBi antenna.	Indoor	Indoor (200 mW EIRP)	Indoor (200 mW EIRP)
50	5 250	No	No	No	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
52	5 260	Indoor/DFS/TPC (200 mW EIRP)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	Indoor/DFS/TPC	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
54	5 270	No	No	No	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
56	5 280	Indoor/DFS/TPC (200 mW EIRP)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	Indoor/DFS/TPC	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
58	5 290	No	No	No	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
60	5 300	Indoor/DFS/TPC (200 mW EIRP)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	Indoor/DFS/TPC	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
62	5 310	No	No	No	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
64	5 320	Indoor/DFS/TPC (200 mW EIRP)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	Indoor/DFS/TPC	DFS/TPC (1 000 mW EIRP)	Indoor/DFS/TPC (200 mW)
100	5 500	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
102	5 510	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)

Table D.1 *(continued)*

Channel ID	Center frequency (MHz)	Europe	US	Japan	Korea	China
104	5 520	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
106	5 530	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
108	5 530	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
110	5 550	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
112	5 560	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
114	5 570	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
116	5 580	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
118	5 590	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
120	5 600	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
122	5 610	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
124	5 620	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
126	5 630	No	No	No	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)

Table D.1 *(continued)*

Channel ID	Center frequency (MHz)	Europe	US	Japan	Korea	China
128	5 640	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	DFS/TPC (1 000 mW EIRP)	TCP/DFS (1 000 mW EIRP)
130		No	No	No	No	No
132	5 660	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	No	TCP/DFS (1 000 mW EIRP)
134	5 670	No	No	No	No	TCP/DFS (1 000 mW EIRP)
136	5 680	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	No	TCP/DFS (1 000 mW EIRP)
138	5 690	No	No	No	No	TCP/DFS (1 000 mW EIRP)
140	5 700	DFS/TPC Indoor/Outdoor (200/1 000 mW EIRP, respectively)	Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. DFS	DFS/TPC	No	TCP/DFS (1 000 mW EIRP)
142	5 710	No	Indoor or Outdoor. Limit on output power based on portion of bandwidth contained in U-NII-2 or −3 band: Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. (U-NII-3) Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi. DFS	No	No	TCP/DFS (1 000 mW EIRP)

Table D.1 *(continued)*

Channel ID	Center frequency (MHz)	Europe	US	Japan	Korea	China
144	5 720	No	Indoor or Outdoor. Limit on output power based on portion of bandwidth contained in U-NII-2 or −3 band: Indoor or Outdoor. (250 mW EIRP) Further restrictions if >6 dBi antenna. (U-NII-3) Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi. DFS	No	No	TCP/DFS (1 000 mW EIRP)
149	5 745	No restriction (25 mW EIRP)	Typical Outdoor. Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi.	No	1 000 mW EIRP	No restriction (25 mW EIRP)
151	5 755	No	No	No	1 000 mW EIRP	No restriction (25 mW EIRP)
153	5 765	No restriction (25 mW EIRP)	Typical Outdoor. Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi.	No	1 000 mW EIRP	No restriction (25 mW EIRP)
155	5 775	No	No	No	1 000 mW EIRP	No restriction (25 mW EIRP)
157	5 785	No restriction (25 mW EIRP)	Typical Outdoor. Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi.	No	1 000 mW EIRP	No restriction (25 mW EIRP)
159	5 795	No	No	No	1 000 mW EIRP	No restriction (25 mW EIRP)
161	5 805	No restriction (25 mW EIRP)	Typical Outdoor. Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi.	No	1 000 mW EIRP	No restriction (25 mW EIRP)
165	5 825	No restriction (25 mW EIRP)	(802.11n 20 MHz and Legacy 802.11a) Typical Outdoor. Max output 1 W with ≤6 dBi antenna. Further restrictions if >6 dBi.	No	No	No restriction (25 mW EIRP)

Bibliography

[1] ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

[2] ISO/IEC 8802-2, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 2: Logical link control*

[3] ISO/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

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

[5] IEC 61980-1, *Electric vehicle wireless power transfer (WPT) systems — Part 1: General requirements*

[6] 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*

[7] IEC 61980-3, *Electric vehicle wireless power transfer (WPT) systems — Part 3: Specific requirements for the magnetic field wireless power transfer systems*

[8] IEC 62196 (all parts), *Plugs, socket-outlets, vehicle couplers and vehicle inlets — Conductive charging of electric vehicles*