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Road vehicles — Vehicle-to-Grid Communication Interface —

Part 2:
Network and application protocol requirements

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

Partie 2: Exigences du protocole d'application et du réseau

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Foreword

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

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

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

— *Part 1: General information and use-case definition*

— *Part 2: Network and application protocol requirements*

— *Part 3: Physical and data link layer requirements*[1]

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[1] To be published.

Introduction

The pending energy crisis and necessity to reduce greenhouse gas emissions has led the vehicle manufacturers to a very significant effort to reduce the energy consumption of their vehicles. They are presently developing vehicles partly or completely propelled by electric energy. Those vehicles will reduce the dependency on oil, improve the global energy efficiency and reduce the total CO_2 emissions for road transportation if the electricity is produced from renewable sources. To charge the batteries of such vehicles, specific charging infra-structure is required.

Much of the standardization work on dimensional and electrical specifications of the charging infrastructure and the vehicle interface is already treated in the relevant ISO or IEC groups. However the question of information transfer between the EV and the EVSE has not been treated sufficiently.

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

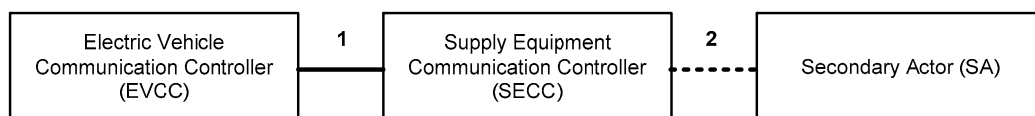iTeh STANDARD PREVIEW
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Road vehicles — Vehicle-to-Grid Communication Interface — Part 2: Network and application protocol requirements

1 Scope

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

The purpose of this part of ISO 15118 is to detail the communication between an EV (BEV or a PHEV) and an EVSE. Aspects are specified to detect a vehicle in a communication network and enable an Internet Protocol (IP) based communication between EVCC and SECC.

Key

1   Scope of ISO/IEC FDIS 15118-2:2013(E)
2   Message definition considers use cases defined for communication between SECC to SA

Figure 1 — Communication relationship among EVCC, SECC and secondary actor

This part of ISO 15118 defines messages, data model, XML/EXI based data representation format, usage of V2GTP, TLS, TCP and IPv6. In addition, it describes how data link layer services can be accessed from a layer 3 perspective. The Data Link Layer and Physical Layer functionality is described in ISO 15118-3.

2 Normative references

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

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

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

IEC 61851-1, *Electric vehicle conductive charging system — Part 1: General requirements (Ed 2.0 2010)*

IEC 61851-22, *Electric vehicle conductive charging system - Part 22: AC electric vehicle charging station*

IEC CDV 61851-23, *Electric vehicle conductive charging system - Part 23: D.C. electric vehicle charging station (Ed 1.0 2012)*

IEC 62196, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles*

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

W3C XML Signature Syntax and Processing Version 1.1, - W3C Recommendation (April 2013)

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

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

IETF RFC 1981, *Path MTU Discovery for IP version 6 (August 1996)*

IETF RFC 2460, *Internet Protocol, Version 6 (IPv6) Specification (December 1998)*

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

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

IETF RFC 3315, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6) (July 2003)*

IETF RFC 3484, *Default Address Selection for Internet Protocol version 6 (IPv6) (February 2003)*

IETF RFC 6582, *The NewReno Modification to TCP's Fast Recovery Algorithm (April 2012)*

IETF RFC 4291, *IP Version 6 Addressing Architecture (February 2006)*

IETF RFC 4429, *Optimistic Duplicate Address Detection (DAD) for IPv6 (April 2006)*

IETF RFC 4443, *Internet Control Message Protocol (ICMP v6) for the Internet Protocol version 6 (IPv6) specification (March 2006)*

IETF RFC 4861, *Neighbor Discovery for IP version 6 (IPv6) (September 2007)*

IETF RFC 4862, *IPv6 Stateless Address Autoconfiguration (September 2007)*

IETF RFC 5095, *Deprecation of Type 0 Routing Headers in IPv6 (December 2007)*

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

IETF RFC 5234, *Augmented BNF for Syntax Specifications: ABNF (January 2008)*

IETF RFC 5246, *The Transport Layer Security (TLS) Protocol Version 1.2 (August 2008)*

IETF RFC 5280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile (May 2008)*

IETF RFC 5289, *TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM) (August 2008)*

IETF RFC 5480, *Elliptic Curve Cryptography Subject Public Key Information (March 2009)*

IETF RFC 5722, *Handling of Overlapping IPv6 Fragments (December 2009)*

IETF RFC 6066, *Transport Layer Security (TLS) Extensions: Extension Definitions (January 2011)*

IETF RFC 6106, *IPv6 Router Advertisement Options for DNS Configuration (November 2010)*

IETF RFC 6961, *The Transport Layer Security (TLS) Multiple Certificate Status Request Extension (June 2013)*

IANA Service&PortRegistry, Service Name and Transport Protocol Port Number Registry [viewed 2011-01-16], Available from: http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml

NIST FIPS PUB 180-4: Secure Hash Standard (SHS) (March 2012)

NIST Special Publication 800-56A: Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography (Revised) (March 2007)

NIST Special Publication 800-38A: Recommendation for Block Cipher Modes of Operation - Methods and Techniques (2001)

3 Terms and definitions

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

3.1
Basic Charging
BC
charging phase during a charging session controlled by IEC 61851-1 only

3.2
charging limits
set of physical constraints (e.g. voltage, current, energy, power) that is negotiated during a V2G Communication Session for a charging session

3.3
Communication Setup Timer
Timer monitoring the time from plug-in until the Session Setup message

3.4
Contract Certificate
certificate issued to EVCC either by V2G Root CA or by Sub-CA, which is used in XML Signatures in application layer so that SECC or secondary actor can verify the Contract issued to the EVCC and signatures issued by the EVCC

3.5
CP State
Control Pilot (Vehicle) State according to IEC 61851-1 signalled on Control Pilot Line

3.6
credentials
anything that provides the basis for confidence, belief, credit, etc.

EXAMPLE   Examples include certificates, passwords, user names etc.

3.7
Data Link Setup
setup phase for establishing the data link

Note 1 to entry: Entry Condition: Any valid control pilot signal according to IEC 61851-1; Exit Condition: D-LINK_READY.indication(DLINKSTATUS=LinkEstablished).

3.8
Distinguished Encoding Rules = ASN-1 encoding rule
DER
method for encoding a data object, such as an X.509 certificate, to be digitally signed or to have its signature verified

3.9
global address
IP address with unlimited scope

3.10
High Level Communication Charging
HLC-C
charging phase during a charging session controlled by ISO 15118

3.11
link-local address
IP address with link-only scope that can be used to reach neighbouring interfaces attached to the same link

3.12
Identification Mode
mandatory and optional messages and parameters with respect to charging scenarios using External Identification Means (EIM) and charging scenarios using Plug and Charge (PnC) for identification

Note 1 to entry: An Identification Mode covers a set of similar charging scenarios for a specific identification means.

3.13
(IP) address
IP-layer identifier for an interface or a set of interfaces

3.14
Maximum Transfer Unit
MTU
maximum size (in bytes) of the largest protocol data unit that the Data Link Layer that can be pass onwards

3.15
Message Set
set of mandatory V2G messages and parameters for the EVCC or SECC covering one or multiple use case elements

3.16
Message Timer
Timer monitoring the exchange of a Request-Response-Pair

3.17
network segment
collection of devices that can exchange data on Data Link Layer level directly via Data Link Addresses

EXAMPLE   Ethernet: all devices which can see each other via MAC addresses.

3.18
node
device that implements IPv6

3.19
OEM Provisioning Certificate
certificate issued to the EVCC, so that a Contract Certificate can be securely requested and received from a secondary actor

3.20
Performance Time
non-functional timing requirement defining the time a V2G Entity shall not exceed when executing or processing certain functionality

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

3.21
private environment
area with (physical) access limited to a small number of vehicles (EVs), which may be a private parking garage or a garage / parking lot of a company with its own EV fleet, where one or several private wall-box(es) are used instead of public charging stations as EVSE, and where in order to keep the private wall-box simple and cheap in production and operation it is allowed to stay offline permanently, which allows a private wall-box to use leaf certificates with a longer maximum validity than allowed for public charging stations and using a private root certificate which is different to the V2G root certificates and which has to be installed into each EV that is allowed to charge within this specific private environment, resulting in a limited number of EVs belonging to one private environment, the difference to a "trusted environment" being that in a (pure; i.e. not additionally "trusted") private environment TLS and the corresponding data encryption at connection level is always used, and solely certificate handling is simplified for the private wall-box (EVSE) since it may stay offline permanently, resulting in unrestricted certificate validity periods, shorter certificate chain length, omitting OCSP, and an additional "pairing mode"

3.22
Identification Mode
group of mandatory and optional Message Sets covering a set of similar charging scenarios for a specific identification means

3.23
renegotiation
messaging for updating the agreement on the charging schedule between EV and EVSE during a V2G Communication Session by retransmitting the parameters SASchedule and ChargingProfile

3.24
Request-Response Message Pair
request message and the corresponding response message

3.25
Request-Response Message Sequence
predefined sequence of Request-Response Message Pairs

3.26
SDP Client
V2G Entity that uses the SDP server to get configuration information about the SECC to be able to access the SECC

3.27
SDP Server
V2G Entity providing configuration information for accessing the SECC

3.28
SECC Certificate
certificate issued to SECC either by V2G Root CA or by Sub-CA, which is used in TLS so that the EVCC can verify the authenticity of the SECC

3.29
Sequence Timer
Timer monitoring a Request-Response Message Sequence

3.30
Sub-CA
subordinate certificate authority who issues SECC Certificates and/or Contract Certificates on behalf of the V2G Root CA

Note 1 to entry: The ability of issuing the certificates are delegated from V2G Root CA, and V2G Root CA can revoke the Sub-CA at any time.

3.31
Sub-CA Certificate
certificate issued to Sub-CA

3.32
TCP_DATA
socket/interface for data transfer based on TCP connection

3.33
Timeout
timing requirement defining the time a V2G Entity monitors the communication system for a certain event to occur

Note 1 to entry: If the specified time is exceeded the respective V2G Entity initiates the related error handling. This is a fixed time value.

3.34
Timer
device or piece of software used in an implementation for measuring time.

Note 1 to entry: Depending on the specific use case a timer is used to trigger certain system events as well.

3.35
Trusted Environment
closed user group (e. g. members of car sharing system) with some pre-distributed token for access to the SECC charging service (e.g. key to home garage, RFID token for car sharing), which is something where a person or instance is responsible for, for example (not limited to) a person with its home garage, a car sharing operator or a taxi operator

3.36
V2G Charging Loop
V2G messaging phase for controlling the charging process by ISO 15118

3.37
V2G Communication Session
association of two specific V2G Entities for exchanging V2G messages

3.38
V2G Entity
primary actor participating in the V2G communication using a mandatory or optional transmission protocol defined by ISO 15118-2

3.39
V2G Message
message exchanged on application layer

Note 1 to entry: Refer to Clause 8 Application Layer messages.

3.40
V2G Setup
setup phase for V2G messaging

Note 1 to entry: Entry Condition: D-LINK_READY.indication(DLINKSTATUS=LinkEstablished); Exit Condition: PowerDeliveryReq with ChargeProgress equals Start or Stop.

3.41
V2G Transfer Protocol
communication protocol to transfer V2G messages between two V2GTP entities

3.42
V2GTP Entity
V2G Entity supporting the V2G Transfer Protocol

3.43
V2G Root CA
certificate Authority (CA) who issues Contract Certificates and/or SECC Certificates, or who delegates ability to issue such Certificates to Sub-CA

3.44
V2G Root Certificate
certificate issued to V2G Root CA

4 Symbols and abbreviated terms

For the purposes of this document, the following abbreviated terms apply:

BEV	Battery Electric Vehicle
CA	Certificate Authority
CRL	Certificate Revocation List
DH	Diffie Hellman
DER	Distinguished Encoding Rules
ECDSA	Elliptic Curve Digital Signature Algorithm
EMAID	E-Mobility Account Identifier
EMOCH	E-Mobility Operator Clearing House (see also 15118-1, [12])
EV	Electric Vehicle
EVCC	Electric Vehicle Communication Controller
EVSE	Electric Vehicle Supply Equipment
EXI	Efficient XML Interchange
OCSP	Online Certificate Status Protocol
OEM	Original Equipment Manufacturer
NACK	Negative Acknowledgement
PDU	Protocol Data Unit
PHEV	Plug-in Hybrid Electric Vehicle
PKI	Public Key Infrastructure
PLC	Power Line Communication
PnC	Plug and Charge
SA	secondary actor

SDP	SECC Discovery Protocol
SDU	Service Data Unit
SECC	Supply Equipment Communication Controller
TCP	Transmission Control Protocol
V2G	Vehicle to Grid Communication
V2G CI	Vehicle-to-Grid Communication Interface
V2GTP	V2G Transfer Protocol
UDP	User Datagram Protocol
XML	Extensible Markup Language

5 Conventions

5.1 Definition of OSI based services

ISO 15118-2 is based on the conventions discussed in the OSI Service Conventions (refer to ISO 10731) as they apply for the individual layers specified in this document.

This part of ISO 15118-2 describes requirements applicable to layer 3-7 according to the OSI layered architecture.

5.2 Requirement structure

This document uses a requirement structure i.e. a unique number identifies each individual requirement included in this document. This requirement structure allows for easier requirement tracking and test case specification. The following format is used:

"[V2G"Y"-"XXX"]" requirement text Where:

— **"V2G"** represents the ISO 15118 set of standards,

— Y represents the document part of the ISO 15118 document set

— XXX represents the individual requirement number and

— "requirement text" includes the actual text of the requirement.

EXAMPLE   **[V2G2-000]** This shall be an example requirement.

5.3 Usage of RFC references

When RFCs are referenced all "shall/ shall not" requirements are mandatory.

[V2G2-001]   In this document, if a referenced RFC has been updated by one or several RFC, the update is fully applicable.

[V2G2-002]   If an update or part of an update applicable to an RFC referenced herein is not compatible with the original RFC or the implementation described by this standard the update shall not apply.

[V2G2-003]   All published Errata, for the ISO 15118 referenced RFCs, are fully applicable in this standard.

5.4 Notation used for XML schema diagrams

This standard makes use of XML as a description format for V2G messages. For details with regards to the XML schema diagram notation used in this document refer to Altova XMLSpy Manual.

Allowing for an easy way to distinguish the types used for the XML schema definitions in this standard following naming conventions apply:

⸺ complex type use capitalized first letters

⸺ simple types use non capitalized first letters

6   Document overview

Figure 2 describes the organization of the different ISO 15118 documents and the usage of the subclauses , according to the OSI layered architecture.

As indicated by the bold framed shapes this Part of ISO 15118 defines requirements applicable to layers 3-7 according to the OSI layered architecture. Layer 1 and 2 requirements including the V2G Standardized Service Primitive Interface are specified in Part 3 of this standard.