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Road vehicles — Vehicle to grid communication interface —

Part 4: Network and application protocol conformance test

Véhicules routiers — Interface de communication entre véhicule et réseau électrique —
Partie 4: Essai de conformité du protocole d'application et du réseau

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Contents

Page

Foreword vii

Introduction viii

1 Scope 1

2 Normative references 2

3 Terms and definitions 2

4 Symbols (and abbreviated terms) 7

5 Conventions 8

5.1 Requirement structure 8
5.2 Test system description 9

6 Test architecture reference model 9
6.1 General information 9
6.2 Platform adapter interface 10
6.3 SUT adapter interfaces 10
6.4 Codecs 11

7 Test suite conventions 11
7.1 General information 11
7.2 Test suite structure (TSS) 11
7.3 Test profiles 13
7.4 Test suite identifiers 62
7.5 Test suite coverage 67
7.6 Test case description 184
7.7 Test case specification 185

8 Test case descriptions for 15118-2 V2GTP 198
8.1 General information 198
8.2 SECC test cases 198
8.3 EVCC test cases 202

9 Test case descriptions for 15118-2 SDP messages 208
9.1 General information 208
9.2 SECC test cases 208
9.3 EVCC test cases 211

10 Test case descriptions for 15118-2 V2G application layer messages 236
10.1 General information 236
10.2 SECC test cases 236
10.3 EVCC test cases 405

Annex A (normative) Configuration specifications 671

A.1 Timer configuration 671

A.2 PICS configuration 671

A.3 PIXIT configuration 673
Annex B (normative) Control part specification 675
B.1 SECC control parts 675
B.1.1 AC specific control parts 675
B.1.2 DC specific control parts 675
B.2 EVCC control parts 688
B.2.1 AC specific control parts 702
B.2.2 DC specific control parts 702
Annex C (normative) Test-case specifications for 15118-2 V2GTP 745
C.1 SECC test cases 745
C.2 EVCC test cases 745
Annex D (normative) Test-case specifications for 15118-2 SDP messages 752
D.1 SECC test cases 752
D.2 EVCC test cases 752
Annex E (normative) Test-case specifications for 15118-2 V2G application layer messages 773
E.1 SECC test cases 773
E.1.1 V2G protocol handshake 773
E.1.1.1 SECC test cases for SupportedAppProtocol 773
E.1.2 V2G messages 773
E.1.2.1 SECC test cases for SessionSetup 775
E.1.2.2 SECC test cases for ServiceDiscovery 775
E.1.2.3 SECC test cases for ServiceDetail 782
E.1.2.4 SECC test cases for PaymentServiceSelection 784
E.1.2.5 SECC test cases for PaymentDetails 788
E.1.2.6 SECC test cases for Authorization 794
E.1.2.7 SECC test cases for ChargeParameterDiscovery 794
E.1.2.8 SECC test cases for PowerDelivery 799
E.1.2.9 SECC test cases for CertificateUpdate 824
E.1.2.10 SECC test cases for CertificateInstallation 839
E.1.2.11 SECC test cases for SessionStop 839
E.1.2.12 SECC test cases for ChargingStatus 842
E.1.2.13 SECC test cases for MeteringReceipt 846
E.1.2.14 SECC test cases for CableCheck 848
E.1.2.15 SECC test cases for PreCharge 852
E.1.2.16 SECC test cases for CurrentDemand 855
E.1.2.17 SECC test cases for WeldingDetection 859
E.2 EVCC test cases 860
Annex F (normative) Function specifications for supporting test execution 1009

F.1 Configuration functions 1009
F.2 Pre-condition functions 1009
F.2.1 SECC functions 1011
F.2.2 EVCC functions 1027
F.3 Post-condition functions 1027
F.3.1 SECC functions 1038
F.3.2 EVCC functions 1038
F.4 Common behavior functions 1039
F.4.1 SECC functions 1040
F.4.2 EVCC functions 1042
F.5 Library functions 1044
Annex G (normative) Function specifications for 15118-2 V2GTP 1051
G.1 SECC functions 1051
G.2 EVCC functions 1053
Annex H (normative) Function specifications for 15118-2 SDP messages 1056
H.1 SECC functions 1056
H.2 EVCC functions 1057
Annex I (normative) Function specifications for 15118-2 V2G application layer messages 1061
I.1 SECC functions 1061
I.1.1 V2G protocol handshake 1061
I.1.1.1 SECC functions for SupportedAppProtocol 1061
I.1.2 V2G messages 1063
I.1.2.1 SECC functions for SessionSetup 1063
I.1.2.2 SECC functions for ServiceDiscovery 1064
I.1.2.3 SECC functions for ServiceDetail 1072
I.1.2.4 SECC functions for PaymentServiceSelection 1080
I.1.2.5 SECC functions for PaymentDetails 1087
I.1.2.6 SECC functions for Authorization 1091
I.1.2.7 SECC functions for ChargeParameterDiscovery 1104
I.1.2.8 SECC functions for PowerDelivery 1140
I.1.2.9 SECC functions for CertificateUpdate 1154
I.1.2.10 SECC functions for CertificateInstallation 1167
I.1.2.11 SECC functions for SessionStop 1176
I.1.2.12 SECC functions for ChargingStatus 1176
I.1.2.13 SECC functions for MeteringReceipt 1185
I.1.2.14 SECC functions for CableCheck 1197
I.1.2.15 SECC functions for PreCharge 1203
I.1.2.16 SECC functions for CurrentDemand 1207

I.1.2.17 SECC functions for WeldingDetection 1213
I.2 EVCC functions 1217
Annex J (normative) Template specifications for V2G TCP/TLS Port Control 1373
Annex K (normative) Template specifications for 15118-2 V2GTP 1375
K.1 Common templates 1375
Annex L (normative) Template specifications for 15118-2 SDP messages 1376
L.1 Common templates 1376
Annex M (normative) Template specifications for 15118-2 V2G application layer messages 1377
M.1 Common templates 1377
M.1.1 V2G protocol handshake 1378
M.1.1.1 CMN templates for SupportedAppProtocol 1378
M.1.2 V2G messages 1378
M.1.2.1 CMN templates for SessionSetup 1378
M.1.2.2 CMN templates for ServiceDiscovery 1378
M.1.2.3 CMN templates for Authorization 1381
M.1.2.4 CMN templates for PowerDelivery 1381
M.1.2.5 CMN templates for SessionStop 1383
M.1.2.6 CMN templates for ChargingStatus 1384
M.1.2.7 CMN templates for CableCheck 1384
M.1.2.8 CMN templates for PreCharge 1385
M.1.2.9 CMN templates for CurrentDemand 1385
M.1.2.10 CMN templates for WeldingDetection 1387
M.2 SECC templates 1387
M.3 EVCC templates 1397
Annex N (normative) Template specifications for Security 1430
N.1 Common templates 1430
Annex O (normative) Data type definitions 1434
O.1 Data types for PICS 1434
O.2 Data types for PIXIT 1434
O.3 Data types for V2G TCP/TLS Port Control 1436
O.4 Data types for V2GTP 1437
O.5 Data types for SDP messages 1438
O.6 Data types for V2G messages 1438
O.7 Data types for Security 1457

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Electrical and electronic equipment*, and Technical Committee IEC/TC 69 *Electric road vehicles and electric industrial trucks*. The draft was circulated for voting to the national bodies of both ISO and IEC.

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

Introduction

The first three parts of ISO 15118 describe the use cases and the technical specification of the Vehicle-to-Grid Communication Interface which is intended for the optimized use of energy resources so that electric road vehicles can recharge in the most economic or most energy efficient way. It is furthermore 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.

The complexity resulting from the network and application protocol requirements defined in the second part of the standard requires a considerable amount of testing in order to enable interoperability between independent implementations. This document therefore defines a conformance test suite for the network and application layer protocols in order to derive a common and agreed basis for conformance tests. The resulting test suite is a necessary prerequisite for downstream interoperability tests. Since interoperability furthermore involves the actual application logic of an implementation those tests are beyond the scope of this document. Hence this document focuses on the interface aspects and the corresponding requirements given in part two only.

Road vehicles — Vehicle to grid communication interface — Part 4: Network and application protocol conformance test

1 Scope

This document specifies conformance tests in the form of an Abstract Test Suite (ATS) for a System Under Test (SUT) implementing an EVCC or SECC according to ISO 15118-2. These conformance tests specify the testing of capabilities and behaviors of an SUT as well as checking what is observed against the conformance requirements specified in ISO 15118-2 and against what the supplier states the SUT implementation's capabilities are.

The capability tests within the ATS check that the observable capabilities of the SUT are in accordance with the static conformance requirements defined in ISO 15118-2. The behavior tests of the ATS examine an implementation as thoroughly as is practical over the full range of dynamic conformance requirements defined in ISO 15118-2 and within the capabilities of the SUT (see NOTE).

A test architecture is described in correspondence to the ATS. The conformance test cases in this document are described leveraging this test architecture and are specified in TTCN-3 Core Language for ISO/OSI Network Layer (Layer 3) and above. The conformance test cases for the Data Link Layer (Layer 2) and Physical Layer (Layer 1) are described in ISO 15118-5. Test cases with overlapping scopes are explicitly detailed.

This document does not include specific tests of other standards referenced within ISO 15118-2, e.g. IETF RFCs. Furthermore, the conformance tests specified in this document do not include the assessment of performance nor robustness or reliability of an implementation. They cannot provide judgments on the physical realization of abstract service primitives, how a system is implemented, how it provides any requested service, nor the environment of the protocol implementation. Furthermore, the test cases defined in this document only consider the communication protocol defined ISO 15118-2. Power flow between the EVSE and the EV is not considered.

NOTE 1 Practical limitations make it impossible to define an exhaustive test suite, and economic considerations can restrict testing even further. Hence, the purpose of this document is to increase the probability that different implementations are able to interwork. This is achieved by verifying them by means of a protocol test suite, thereby increasing the confidence that each implementation conforms to the protocol specification. However, the specified protocol test suite cannot guarantee conformance to the specification since it detects errors rather than their absence. Thus conformance to a test suite alone cannot guarantee interworking. What it does do is give confidence that an implementation has the required capabilities and that its behavior conforms consistently in representative instances of communication.

NOTE 2 This document has some interdependencies to the conformance tests defined in ISO 15118-5 which result from ISO/OSI cross layer dependencies in the underlying protocol specification (e.g. for sleep mode)

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.

IEC 61851-1:2017, *Electric vehicle conductive charging system — Part 1: General requirements*

ISO 15118-1:2013, *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*

ETSI ES 201 873-5 V4.6.1, *TTCN-3: TTCN-3 Runtime Interface (June 2014)*

ETSI ES 201 873-6 V4.6.1, *TTCN-3: TTCN-3 Control Interface (June 2014)*

NOTE 1 Even though the technical specification ISO 15118-2:2014, which is the baseline for this conformance test document, explicitly references IEC 61851-1:2011, this document references IEC 61851-1:2017 because of applicability on the market.

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 15118-1, ISO 15118-2, ISO 15118-3 and the following apply.

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

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

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

3.1
abstract test case
complete and independent specification of the actions required to achieve a specific test purpose

Note 1 to entry: This specification is defined at the level of abstraction of a particular Abstract Test Method, starting in a stable testing state and ending in a stable testing state and may involve one or more consecutive or concurrent connections.

Note 2 to entry: The specification should be complete in the sense that it is sufficient to enable a test verdict to be assigned unambiguously to each potentially observable test outcome (i.e. sequence of test events).

Note 3 to entry: The specification should be independent in the sense that it should be possible to execute the derived executable test case in isolation from other such test cases (i.e. the specification should always include the possibility of starting and finishing in the "idle" state).

Note 4 to entry: Compare with ITU-T X.290.

3.2
abstract test suite
ATS
test suite composed of abstract test cases

Note 1 to entry: Compare with ITU-T X.290.

3.3
black box testing
method of testing that examines the behavior of an SUT without considering the internal implementation and structure of the SUT, thus relying on the SUT's open interface for testing

3.4
conformance requirements
conformance of a real system consisting of conformance to each requirement and conformance to the set

Note 1 to entry: Set of interrelated requirements which together define the behavior of the system and its communication. Conformance of a real system will, therefore, be expressed at two levels, conformance to each individual requirement and conformance to the set. Applicable ISO 15118-4 conformance tests include requirements and transfer syntax requirements as far as they can be validated by black box testing.

Note 2 to entry: See also *static conformance requirements* and *dynamic conformance requirements*.

3.5
conforming implementation
IUT which satisfies both static and dynamic conformance requirements, consistent with the capabilities stated in the PICS(s)

Note 1 to entry: Compare with ITU-T X.290.

3.6
dynamic conformance requirements
one of the requirements which specifies what observable behavior is permitted by the relevant specification(s) in instances of communication

Note 1 to entry: The requirements for this conformance specification are defined in ISO 15118-2.

Note 2 to entry: Compare with ITU-T X.290.

3.7
executable test case
realization of an abstract test case

Note 1 to entry: Compare with ITU-T X.290.

3.8
expected behavior
exact response of the SUT according to the underlying protocol specification to the stimulus defined in the test behavior

3.9
implementation conformance statement
ICS
statement made by the supplier of an implementation or system claimed to conform to a given specification, stating which capabilities have been implemented

Note 1 to entry: The given specification for this conformance specification is ISO 15118-2.

Note 2 to entry: Compare with ITU-T X.290.

3.10
implementation extra information for testing
IXIT

statement made by a supplier or implementer of an IUT which contains or references all of the information (in addition to that given in the ICS) related to the IUT and its testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT

Note 1 to entry: Compare with ITU-T X.290.

3.11
implementation under test
IUT
implementation of one or more OSI protocols in an adjacent user/provider relationship, being that part of a real open system which is to be studied by testing

Note 1 to entry: Compare with ITU-T X.290.

3.12
main test component
MTC
single test component in a test component configuration responsible for creating and controlling *parallel test components* and computing and assigning the test verdict

Note 1 to entry: Compare with ITU-T X.290.

3.13
parallel test component
PTC
test component created by the main test component

Note 1 to entry: Compare with ITU-T X.292.

3.14
post-condition
test steps needed to define the path from the end of the *test behavior* up to the finishing stable state for the test case

Note 1 to entry: See also *Test behavior.*

3.15
pre-condition
test steps needed to define the path from the starting stable state of the test case up to the initial state from which the *test bevavior* will start

Note 1 to entry: See also *Test behavior.*

3.16
protocol implementation conformance statements
PICS
ICS for an implementation or system claimed to conform to a given protocol specification

Note 1 to entry: The given protocol specification for this conformance specification is ISO 15118-2.

Note 2 to entry: Compare with ITU-T X.290.

3.17
protocol implementation extra information for testing
PIXIT
IXIT related to testing for conformance to a given protocol specification

Note 1 to entry: The given protocol specification for this conformance specification is ISO 15118-2.

Note 2 to entry: Compare with ITU-T X.290.

3.18
runtime environment
environment that describes the operating system and corresponding platform requirements of a system

EXAMPLE Test system.

3.19
semantically invalid test behavior
SemITB
test steps where the test system sends stimuli to the SUT that are semantically invalid according to the protocol requirements

Note 1 to entry: This type of test behavior is defined in this conformance standard and explicitly includes requirements which define the appropriate error handling of the SUT.

3.20
static conformance requirements
one of the requirements that specify the limitations on the combinations of implemented capabilities permitted in a real open system which is claimed to conform to the relevant specification(s)

Note 1 to entry: Compare with ITU-T X.290.

3.21
system under test
SUT
real open system in which the IUT resides

Note 1 to entry: Compare with ITU-T X.290.

3.22
syntactically invalid test behavior
SynITB
test steps where the test system sends stimuli to the SUT that are syntactically invalid according to the protocol requirements

Note 1 to entry: This type of test behavior is not defined in this conformance standard, see codec requirements.

3.23
test behavior
set of test steps (test body) which are essential in order to achieve the test purpose and assign verdicts to the possible outcomes

3.24
test execution
interpretation or execution of an abstract test suite

Note 1 to entry: Conceptually, the TE can be decomposed into three interacting entities: an Executable Test Suite (ETS), a Test Framework (TFW) and an optional internal Encoding/Decoding System (EDS) entity.

Note 2 to entry: See also ETSI ES 201 873-5 V4.6.1.

3.25
test framework
TFW

entity to perform all actions of test cases or functions

Note 1 to entry: The Test Framework interacts with the Test Management (TM), SUT Adaptor (SA) and Platform Adaptor (PA) entities via Test Control Interface (TCI) and Test Runtime Interface (TRI) and additionally manages the Executable Test Suite (ETS) and Encoding/Decoding System (EDS) entities. It initializes adaptors as well as ETS and EDS entities. This entity performs all the actions necessary to properly start the execution of a test case or function with parameters in the ETS entity. It queries the TM entity for module parameter values required by the ETS and sends logging information to it. It also collects and resolves associated verdicts returned by the ETS entity.

Note 2 to entry: See also ETSI ES 201 873-5 V4.6.1.

Note 3 to entry: In this document, the Test Framework TTCN-3 Runtime System (T3RTS) is used to explain a Test Framework functionality.

3.26
test purpose
prose description of a well-defined objective of testing, focusing on a single conformance requirement or a set of related conformance requirements as specified in the appropriate OSI specification

EXAMPLE Verifying the support of a specific value of a specific parameter

Note 1 to entry: Compare with ITU-T X.290.

3.27
test system
real system combining the test framework, abstract test suite, test execution and adapters as well as codecs

Note 1 to entry: Typically also containing a common runtime environment based on an operating system.

3.28
test control interface
TCI
four interfaces that define the interaction of the TTCN-3 Executable with the test management, the coding and decoding, the test component handling and the logging in a test system

Note 1 to entry: Compare with ETSI ES 201 873-6 V4.6.1.

3.29
test runtime interface
TRI
two interfaces that define the interaction of the TTCN-3 Executable between the SUT and the Platform Adapter (PA) and the System Adapter (SA) in a test system

Note 1 to entry: Compare with ETSI ES 201 873-5 V4.6.1.

3.30
test system interface
TSI
test component that provides a mapping of the ports available in the (abstract) TTCN-3 test system to those offered by a real test system

Note 1 to entry: Compare with ETSI ES 201 873-6 V4.6.1.

3.31
valid test behavior
VTB

test steps where the test system sends stimuli to the SUT that are valid (syntactically and semantically) according to the protocol requirements

Note 1 to entry: This type of test behavior is defined in this conformance document.

Note 2 to entry: The protocol requirements for this conformance specification are defined in ISO 15118-2.

3.32
verdict
test verdict
statement of "pass", "fail" or "inconclusive", as specified in an abstract test case, concerning conformance of an IUT with respect to that test case when it is executed

Note 1 to entry: Compare with ITU-T X.290.

4 Symbols and abbreviated terms

For the purpose of this document, the following abbreviations apply.

ALM	Application Layer Message
ATS	Abstract Test Suite
BEV	Battery Electric Vehicle
CA	Certificate Authority
CPL	Control Pilot Line
CRL	Certificate Revocation List
DH	Diffie Hellman
DER	Distinguished Encoding Rules
ECDSA	Elliptic Curve Digital Signature Algorithm
EDS	Encoding/Decoding System
EIM	External Identification Means
EMAID	E-Mobility Account Identifier
ETS	Executable Test Suite
EV	Electric Vehicle
EVCC	Electric Vehicle Communication Controller
EVSE	Electric Vehicle Supply Equipment
EXI	Efficient XML Interchange
HAL	Hardware Abstraction Layer
ICS	Implementation Conformance Statement
ID(s)	Identifier(s)
ITB	Invalid Test Behavior
IUT	Implementation under Test
IXIT	Implementation eXtra Information for Testing
OCSP	Online Certificate Status Protocol
OEM	Original Equipment Manufacturer