



**SmartM2M;
Smart Appliances Ontology and Communication
Framework Testing;
Part 1: Testing methodology**

PREVIEW
iTech Standards (http://www.itc.it)
https://standards.iteh.ai/catalog/standards/sist/548117e3-
a8b0-46fc-8f88-929287dd/etsi-ts-103-268-1-v1.1.1-
2017-04

Reference

DTS/SmartM2M-103 268-1 SAP_tst

Keywords

data, data sharing, IoT, M2M, Model,
multi service testing, oneM2M, ontology, testing

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:
<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.
The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2017.
All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members.
3GPP™ and **LTE™** are Trade Marks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.
GSM® and the GSM logo are Trade Marks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	5
Foreword.....	5
Modal verbs terminology.....	5
1 Scope	6
2 References	6
2.1 Normative references	6
2.2 Informative references.....	6
3 Definitions and abbreviations.....	7
3.1 Definitions.....	7
3.2 Abbreviations	8
4 Introduction to the SAP testing methodology	8
5 Conformance testing.....	10
5.1 Introduction	10
5.2 Implementation Under Test	11
5.2.1 Introduction.....	11
5.2.2 Service Layer Communication	12
5.2.2.1 oneM2M implementation.....	12
5.2.2.2 SAP implementation	12
5.3 Identification of the Reference points	12
5.4 Development of Conformance Test Specifications	12
5.4.1 Protocol Implementation Conformance Statements (PICS).....	12
5.4.2 Test Suite Structure & Test Purposes (TSS & TP).....	13
5.4.2.1 Introduction	13
5.4.2.2 Test Suite Structure.....	13
5.4.2.3 Test Purpose	13
5.4.2.3.1 Introduction	13
5.4.2.3.2 TP identifier.....	15
5.4.2.3.3 Test objective	15
5.4.2.3.4 Reference.....	15
5.4.2.3.5 PICS selection	16
5.4.2.3.6 TP behaviour	16
5.4.3 Abstract Test Suite (ATS).....	20
5.4.3.1 Abstract protocol tester	20
5.4.3.2 TTCN-3 test architecture.....	21
5.4.3.2.1 Introduction	21
5.4.3.2.2 Generic Conformance architecture	22
5.4.3.2.3 Smart Appliance Conformance architecture	23
5.4.3.3 TTCN-3 test suite.....	24
5.4.3.3.1 TTCN-3 Test architecture.....	24
5.4.3.3.2 Importing XSD definition.....	24
5.4.3.3.3 The TTCN-3 naming conventions	24
5.4.3.3.4 TTCN-3 code documentation	26
5.4.3.3.5 Test cases structure.....	26
5.4.4 Protocol Implementation eXtra Information for Testing (PIXIT).....	27
6 Interoperability testing	27
6.1 Introduction	27
6.2 Basic concepts for interoperability testing	28
6.2.1 Overview	28
6.2.2 System Under Test (SUT).....	28
6.2.2.1 Introduction.....	28
6.2.2.2 Devices Under Test (DUT).....	28
6.2.2.3 Test interfaces	29
6.2.3 Test Environment.....	29

6.2.3.1	Introduction.....	29
6.2.3.2	Test Descriptions.....	29
6.2.3.3	Test drivers.....	29
6.3	Development of Interoperability Test Specifications	30
6.3.1	Overview	30
6.3.2	Generic SUT Architecture	30
6.3.3	Test architecture and Interfaces	30
6.3.4	Interoperable Functions Statement (IFS)	32
6.3.5	Test Descriptions (TD)	32
Annex A (informative): Example of ICS table.....		34
A.1	SAREF Device Class Statement.....	34
History		35

iTeh STANDARD PREVIEW
 (standards.iteh.ai)
 Full standard:
<https://standards.iteh.ai/catalog/standards/sist/548117e3-a8b0-46fc-8888-929287dd971d/etsi-ts-103-268-1-v1.1.1-2017-04>

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Smart Machine-to-Machine communications (SmartM2M).

The present document is part 1 of a multi-part deliverable covering Conformance test specifications for Smart Appliances Ontology and Communication Framework Testing as identified below:

- Part 1: "Testing methodology";**
- Part 2: "Protocol Implementation Conformance Statement (PICS) pro forma";
- Part 3: "Test Suite Structure and Test Purposes (TSS & TP)";
- Part 4: "Abstract Test Suite (ATS) and Protocol Implementation eXtra Information for Testing (PIXIT)".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The scope of the present document is to support Smart Appliance common ontology and communication framework testing needs. It specifies a global methodology for testing for Smart Appliances, based oneM2M specifications. It analyses the overall testing needs and identifies and defines the additional documentation required.

The testing framework proposed in the present document provides methodology for development of conformance and interoperability test strategies, test systems and the resulting test specifications for SAP.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] ETSI TS 103 264: "SmartM2M; Smart Appliances; Reference Ontology and oneM2M Mapping".
- [2] ETSI TS 103 267: "SmartM2M; Smart Appliances; Communication Framework".
- [3] ETSI TS 118 101: "oneM2M; Functional Architecture (oneM2M TS-0001)".
- [4] ETSI TS 118 104: "oneM2M; Service Layer Core Protocol Specification (oneM2M TS-0004)".
- [5] ETSI TS 118 112: "oneM2M; Base Ontology (oneM2M TS-0012)".
- [6] ETSI TS 118 108: "oneM2M; CoAP Protocol Binding (oneM2M TS-0008)".
- [7] ETSI TS 118 109: "oneM2M; HTTP Protocol Binding (oneM2M TS-0009)".
- [8] ETSI TS 118 110: "oneM2M; MQTT Protocol Binding (oneM2M TS-0010)".
- [9] ETSI TS 118 120: "oneM2M; WebSocket Protocol Binding (oneM2M TS-0020)".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EG 202 798: "Intelligent Transport Systems (ITS); Testing; Framework for conformance and interoperability testing".
- [i.2] ISO/IEC 9646 (all parts): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".

- [i.3] ETSI ES 201 873 (all parts): "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3".
- [i.4] ETSI EG 202 237: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); Generic approach to interoperability testing".
- [i.5] ETSI EG 201 058: "Methods for Testing and Specification (MTS); Implementation Conformance Statement (ICS) pro forma style guide".
- [i.6] ETSI ETR 266: "Methods for Testing and Specification (MTS); Test Purpose style guide".
- [i.7] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [i.8] ISO 10746 (all parts): "Information technology - Open Distributed Processing - Reference model".
- [i.9] ETSI TS 103 268-2: "SmartM2M; Smart Appliances Ontology and Communication Framework Testing; Part 2: Protocol Implementation Conformance Statement (PICS) proforma".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ISO 10746 [i.8], ETSI TS 103 264 [1], ETSI TS 103 267 [2], ETSI TS 118 101 [3], ETSI TS 118 104 [4] and the following apply:

conformance testing: process for testing that an implementation is compliant with a protocol standard, which is realized by test systems simulating the protocol with test scripts executed against the implementation under test

interoperability testing: activity of proving that end-to-end functionality between (at least) two devices is as required by the base standard(s) on which those devices are based

testing framework: document providing guidance and examples necessary for the development and implementation of a test specification

conformance: compliance with requirements specified in applicable standards ISO/IEC 9646 [i.2]

Device Under Test (DUT): combination of software and/or hardware items which implement the functionality of standards and interact with other DUTs via one or more reference points

Implementation Under Test (IUT): implementation of one or more Open Systems Interconnection (OSI) protocols in an adjacent user/provider relationship, being the part of a real open system which is to be studied by testing (ISO/IEC 9646-1 [i.2])

interoperability: ability of two systems to interoperate using the same communication protocol

interoperability test suite: collection of test cases designed to prove the ability of two (or more) systems to interoperate

InterWorking Function (IWF): translation of one protocol into another one so that two systems using two different communication protocols are able to interoperate

Qualified Equipment (QE): grouping of one or more devices that has been shown and certified, by rigorous and well-defined testing, to interoperate with other equipment

NOTE 1: Once a DUT has been successfully tested against a QE, it may be considered to be a QE, itself.

NOTE 2: Once a QE is modified, it loses its status as QE and becomes again a DUT.

test case: specification of the actions required to achieve a specific test purpose, starting in a stable testing state, ending in a stable testing state and defined in either natural language for manual operation or in a machine-readable language (such as TTCN-3) for automatic execution

test purpose: description of a well-defined objective of testing, focussing on a single interoperability requirement or a set of related interoperability requirements

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ISO 10746 [i.8], ETSI TS 103 268-2 [i.9], ETSI TS 118 101 [3], ETSI TS 118 104 [4] and the following apply:

API	Application Programming Interface
ATS	Abstract Test Suite
DUT	Device Under Test
EUT	Equipment Under Test
IFS	Interoperable Features Statement
IUT	Implementation Under Test
IWF	InterWorking Function
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
QE	Qualified Equipment
RP	Reference Point
SAP	Smart Appliance
SUT	System Under Test
TP	Test Purpose
TSS	Test Suite Structure
TST	Testing

4 Introduction to the SAP testing methodology

The present document provides:

- Identification of the implementations under test (IUT) for conformance testing and the device under test (DUTs) for interoperability, i.e. answering the question "what is to be tested".
- Definition of the applicable test procedures, i.e. answering the question "how is to be tested".
- Definition of the procedure for development of test specifications and deliverables (for instance: TSS & TP, TP pro forma, TTCN-3 test suite and documentation).

Figure 4-1 illustrates the SAP M2M testing framework and the interactions with M2M base standards and SAP M2M test specifications. The SAP M2M testing framework is based on concepts defined in ISO/IEC 9646 [i.2], TTCN-3 [i.3], ETSI EG 202 237 [i.4] and ETSI EG 202 798 [i.1].

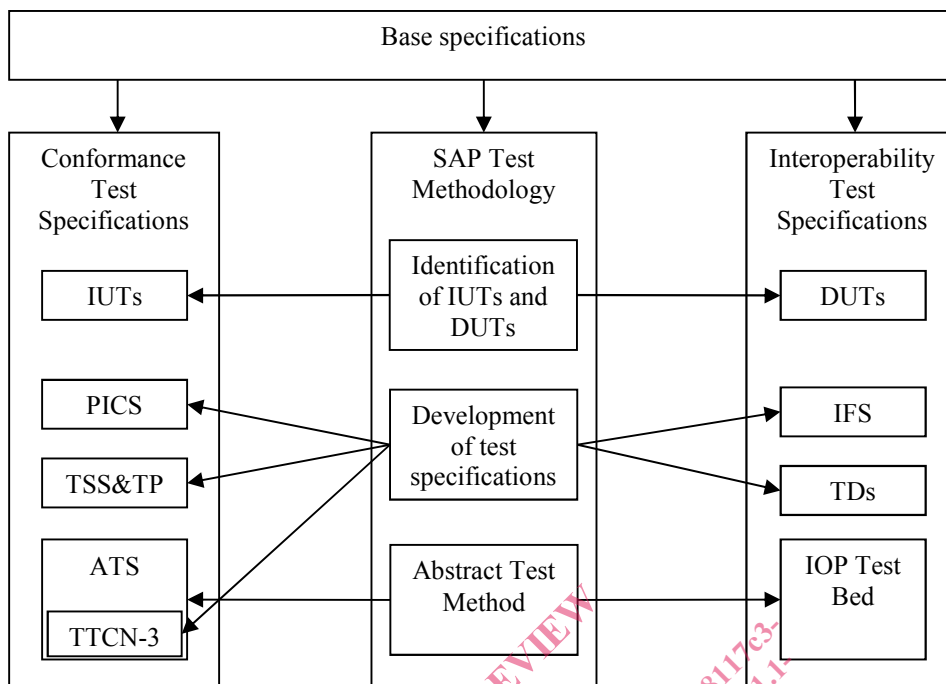


Figure 4-1: SAP M2M testing methodology interactions

ETSI test specifications are usually developed for a single base protocol standard or for a coherent set of standards. As such, it is possible to follow the methodology, specified for conformance test development in ISO/IEC 9646-1 [i.2] without much difficulty. However, M2M and Smart Appliance testing requirements are, in many cases, distributed across a wide range of documents and, thus, an adaptation of the ISO/IEC 9646 [i.2] approach to test development is necessary. Also, for readability, consistency and to ease reusability of TTCN-3 code it is necessary to apply some guidelines on the use of TTCN-3.

It is this approach that is referred to as the "Smart Appliance testing framework".

As its name implies, the framework is oriented towards the production of Test specifications. The Smart Appliance testing Framework comprises:

- A documentation structure:
 - Catalogue of requirements (PICS or IFS).
 - Test Suite Structure (TSS).
 - Test Purposes:
 - Conformance.
 - Interoperability.
- A methodology linking the individual elements of a test specification together:
 - Style guidelines and examples.
 - Naming conventions.
 - A structured notation for TP.
 - Guidelines on the development of TTCN-3 Test Cases (TCs).
 - Guidelines on the use of tabulated English Test Descriptions (TDs).

5 Conformance testing

5.1 Introduction

The following clauses show how to apply the ETSI conformance testing methodology to SAP M2M in order to properly produce SAP M2M conformance test specifications.

The Conformance testing can show that a product correctly implements a particular standardized protocol, that is, it establishes whether or not the implementation under test meets the requirements specified for the protocol itself.

For example, it will test protocol message contents and format as well as the permitted sequences of messages. In that context, tests are performed at open standardized interfaces that are not (usually) accessible to an end user, and executed by a dedicated test system that has full control of the system under test and the ability to observe all incoming and outgoing communications; the high degree of control of the test system over the sequence and contents of the protocol messages allows to test both valid and invalid behaviour.

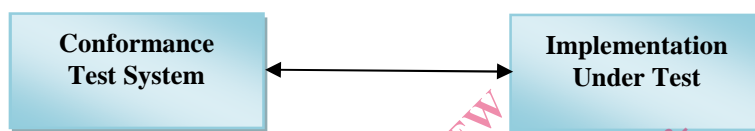


Figure 5.1-1: Conformance testing

Conformance test specifications should be produced following the methodology described in ISO/IEC 9646-1 [i.2]. In summary, this methodology begins with the collation and categorization of the requirements to be tested into a tabular form which is normally referred to as the "Protocol Implementation Conformance Statement" (PICS). Each PICS relates to a specific protocol standard. In those cases where the requirements are distributed across a large number of documents there may be very little benefit in producing an individual PICS for each document. Consequently, the requirements should be collected together and categorized in a single document, referred as the Requirements Catalogue. The present document could be structured as an overall PICS covering the requirements of all the relevant specifications.

For each requirement in the catalogue, one or more tests should be identified and classified into a number of groups which will provide a structure to the overall test suite (TSS). A brief Test Purpose (TP) should then be written for each identified test and this should make it clear what is to be tested but not how this should be done. Although not described or mandated in ISO/IEC 9646-1 [i.2], in many situations (particularly where the TPs are complex) it may be desirable to develop a Test Description (TD) for each TP. The TD describes in plain language (often tabulated) the actions required to reach a verdict on whether an implementation passes or fails the test. Finally, a detailed Test Case (TC) is written for each TP. In the interests of test automation, TCs are usually combined into an Abstract Test Suite (ATS) using a specific testing language such as TTCN-3.

In summary, the SAP M2M Conformance Testing methodology consists of:

- Selection of Implementations Under Test (IUT).
- Identification of reference points.
- Development of test specifications, which includes:
 - Development of "Implementation Conformance Statements" (ICS), if not already provided as part of the base standard.
 - Development of "Test Suite Structure and Test Purposes" (TSS & TP).
 - Development of "Abstract Test Suite" (ATS) including:
 - Definition of the Abstract Protocol Tester (APT).
 - Definition of TTCN-3 test architecture.
 - Development of TTCN-3 test suite, e.g. naming conventions, code documentation, test case structure.

5.2 Implementation Under Test

5.2.1 Introduction

The "Implementation Under Test" (IUT) is a protocol implementation considered as an object for testing. This means that the test process will focus on verifying the compliance of this protocol implementation (IUT) with requirements set up in the related base standard. An IUT normally is implemented in a "System Under Test" (SUT). For testing, an SUT is connected to a test system over at least a single interface. Such an interface is identified as "Reference Point" (RP) in the present document. Further details on RPs are presented in clause 5.2.

NOTE: Other interfaces between the test system and the IUT may be used to control the behaviour of the IUT during the test process.

IUTs normally are entities of a protocol architecture for a specific communication protocol located in an OSI layer. Figure 5.2.1-1 shows a complete view of communication layer for M2M domain. Further details are presented in the clause 5.2.2.

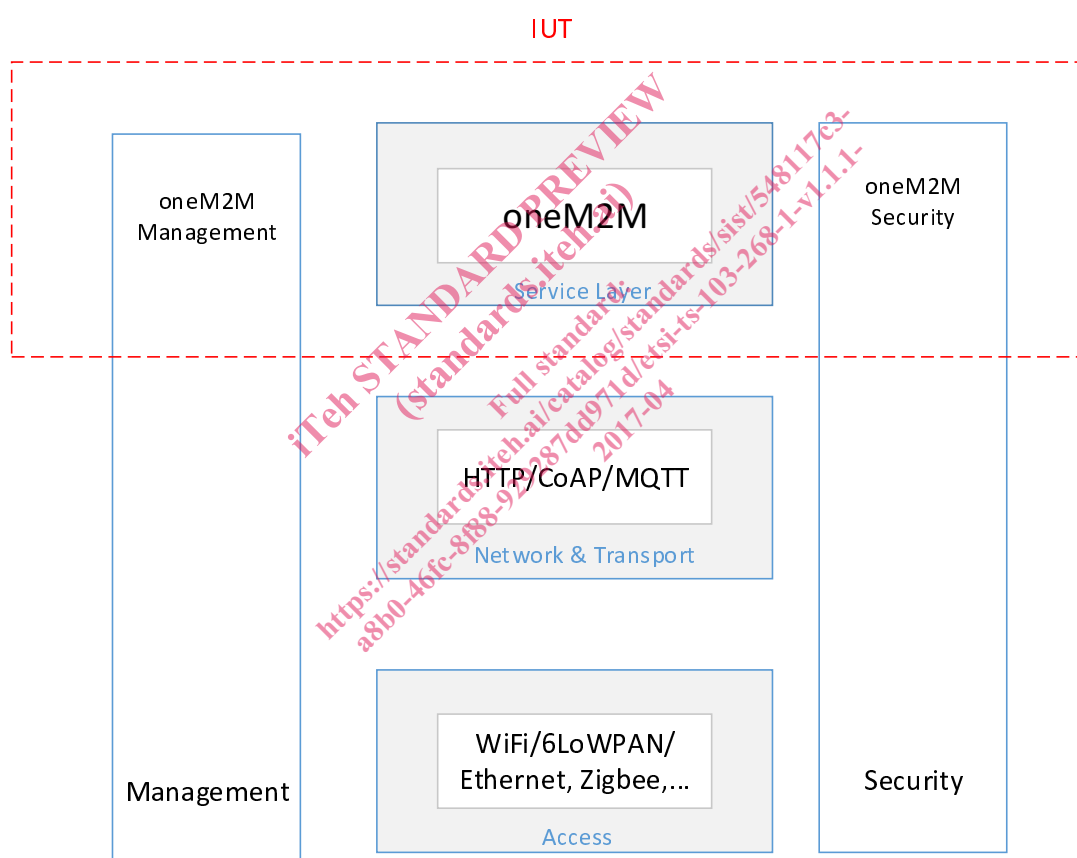


Figure 5.2.1-1: Example of IUT in the oneM2M reference architecture