Final draft ETSI EG 202 237 V1.2.1 (2010-06)

ETSI Guide

Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); Generic approach to interoperability testing

Reference

REG/MTS-00129-IOP-TstApproach

Keywords

interoperability, IP, telephony, 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

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the 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
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

Contents

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 (http://webapp.etsi.org/IPR/home.asp).

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 ETSI Guide (EG) has been produced by ETSI Technical Committee Methods for Testing and Specification (MTS), and is now submitted for the ETSI standards Membership Approval Procedure.

1 Scope

The present document, "A generic approach to interoperability testing", gives general guidance on the specification and execution of interoperability tests for communication systems specifically in the context of product certification. It provides a framework within which interoperability test specifications for a wide range of product types can be developed. The guidelines are expressed as recommendations rather than strict rules and leave enough freedom to allow test specifiers to adopt and adapt processes to suit each particular project while still ensuring that test specifications accurately reflect the requirements of the base standards and can be executed consistently across a range of configurations.

Interoperability testing is the structured and formal testing of functions supported remotely by two or more items of equipment communicating by means of standardized protocols. It is not the detailed verification of protocol requirements specified in a conformance test suite, neither is it the less formal development testing often associated with "plug-fest" and "interop" events (frequently referred to as "bake-offs"). A methodology for the latter type of testing is described in EG 202 810 [i.8].

Although some consideration is given within the methodology to the operating and reporting aspects of interoperability testing, the primary focus of the present document is on the specification of interoperability testing architectures, test plans and test suites.

2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://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.

2.1 Normative references

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

Not applicable.

2.2 Informative references

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 ES 201 873-1: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 1: TTCN-3 Core Language".

[i.2] Void.

[i.3] ETSI TS 101 884: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Technology Mapping; Implementation of TIPHON architecture using SIP".

[i.4] ETSI EG 202 107: "Methods for Testing and Specification (MTS); Planning for validation and testing in the standards-making process".

[i.5] ISO/IEC 9646 (parts 1 to 7): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".

[i.6] IETF RFC 3261: "SIP: Session Initiation Protocol".

[i.7] IETF RFC 4306: "Internet Key Exchange (IKEv2) Protocol".

[i.8] ETSI EG 202 810: "Methods for Testing and Specification (MTS); Automated Interoperability Testing; Methodology and Framework".

[i.9] ETSI ES 202 553: "Methods for testing and Specification (MTS); TPLan: A notation for expressing test Purposes".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

conformance: compliance with requirements specified in applicable standards ISO/IEC 9646 [i.5]

conformance testing: testing the extent to which an Implementation Under Test (IUT) satisfies both static and dynamic conformance requirements ISO/IEC 9646 [i.5]

NOTE: The purpose of conformance testing is to determine to what extent a single implementation of a particular standard conforms to the individual requirements of that standard.

device: item of software or hardware which either alone or in combination with other devices implements the requirements of a standardized specification

Equipment Under Test (EUT): grouping of one or more devices which has not been previously shown to interoperate with previously Qualified Equipment (QE)

Implementation Under Test (IUT): an 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.5])

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

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

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 an EUT 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 an EUT.

System Under Test (SUT): one or more QEs and an EUT

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 following abbreviations apply:

API	Application Programming Interface
EP	End Point
EUT	Equipment Under Test
GFT	Graphical presentation Format for TTCN-3
IFS	Interoperable Features Statement
IUT	Implementation Under Test
IWF	InterWorking Function
MMI	Man-Machine Interface
MoC	Means of Communication
MoT	Means of Testing
OSI	Open Systems Interconnection
PICS	Protocol Implementation Conformance Statement
QE	Qualified Equipment
SIP	Session Initiation Protocol
SUT	System Under Test
TP	Test Purpose
TSS	Test Suite Structure

4 Types of testing

Equipment implementing standardized protocols and services can be formally tested in two related but different ways, which each have benefits and limitations:

- conformance testing can show that a product correctly implements a particular standardized protocol:
  - establishes whether or not the implementation in question 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.
- interoperability testing can demonstrate that a product will work with other like products:
  - assesses the ability of the implementation to support the required trans-network functionality between itself and another, similar implementation to which it is connected.

Conformance testing in conjunction with interoperability testing provides both the proof of conformance and the guarantee of interoperation.

4.1 Interoperability testing

The term "interoperability testing" is often used in relation to the semi-formal testing carried out at multi-vendor events as part of the product development process. While such events, often referred to as "plug-fests", "interops" and "bake-offs", are valuable sources of information on the ability of similar products to communicate, they generally do not offer the structured and, therefore, repeatable, testing that is an essential part of a certification scheme. For a certification (or branding or logo) scheme to be meaningful, it is necessary that interoperability testing is carried out in accordance with a comprehensive and structured suite of tests. In the context of the present document, it is exactly this type of testing which is referred to as "interoperability testing". For other types of schemes, such as those arranged between manufacturers for marketing or other purposes this approach is still valid.

NOTE: It is possible that other organizations within the global standardization community will have interpretations of this term which differ to a greater or lesser extent.

The purpose of interoperability testing is to prove that end-to-end functionality between (at least) two communicating systems is as required by the standard(s) on which those systems are based.

Figure 1: Illustration of interoperability testing

The important factors which characterize interoperability testing are:

- the Equipment Under Test (EUT) and the Qualified Equipment (QE) together define the boundaries for testing (figure 1);
- the EUT and QE come from different suppliers (or, at least, different product lines);
- interoperability tests are performed at interfaces that offer only normal user control and observation (i.e. not at specialized interfaces introduced solely for testing purposes);
- interoperability tests are based on functionality as experienced by a user (i.e. they are not specified at the protocol level). In this context a user may be human or a software application;
- the tests are performed and observed at functional interfaces such as Man-Machine Interfaces (MMIs), protocol service interfaces and Application Programming Interfaces (APIs).

The fact that interoperability tests are performed at the end points and at functional interfaces means that interoperability test cases can only specify functional behaviour. They cannot explicitly cause or test protocol error behaviour.

4.2 Conformance testing

The purpose of conformance testing is to determine to what extent a single implementation of a particular standard conforms to the individual requirements of that standard.

Figure 2: Illustration of conformance testing

The important factors which characterize conformance testing are as follows:

- the System or Implementation Under Test (SUT or IUT) defines the boundaries for testing (figure 2);
- the tests are executed by a dedicated test system that has full control of the SUT and the ability to observe all communications from the SUT;
- the tests are performed at open standardized interfaces that are not (usually) accessible to a normal user. (i.e. they are specified at the protocol level).

Because the conformance tester maintains a high degree of control over the sequence and contents of the protocol messages sent to the IUT it is able to explore a wide range of both expected and unexpected (invalid) behaviour.

It is not within the scope of the present document to define a conformance testing methodology. However, because interoperability testing and conformance testing complement one another, the reader of the present document would be well-advised to study the established ISO conformance testing methodology defined in ISO/IEC 9646 parts 1 to 7 [i.5] as applied in all ETSI conformance test specifications.

4.3 Combining interoperability testing and conformance testing

Conformance and interoperability are both important and useful approaches to the testing of standardized protocol implementations although it is unlikely that one will ever fully replace the other. Conformance testing is able to show that a particular implementation complies with the protocol requirements specified in the associated base standard. However, it is difficult for such testing to be able to prove that the implementation will interoperate with similar implementations in other products. On the other hand, interoperability testing can clearly demonstrate that two implementations will cooperate to provide the specified end-to-end functions but cannot easily prove that either of them conforms to the detailed requirements of the protocol specification.

The purpose of interoperability testing is not only to show that products from different manufacturers can work together but also to show that these products can interoperate using a specific protocol. Without this additional aspect, interoperability testing could be considered to be almost meaningless. Within the context of standardization, it is of little interest to know that two products can interoperate unless there is a guarantee that they are connected together by means of a standardized protocol. It is, therefore, advisable to test the conformance of an implementation before testing for interoperability with other (similarly tested) implementations.

Although there are quite distinct differences between conformance testing and interoperability testing, it is valid to consider using the techniques together to give combined results. Such an approach will almost certainly involve some compromise and it is unlikely that it would provide the breadth and depth of testing that conformance and interoperability can offer when applied individually. However, some limited conformance testing with extensive interoperability testing, for example, may be useful in certain situations. The test configuration shown in figure 3 permits complete interoperability testing to be undertaken while limited protocol conformance monitoring takes place.

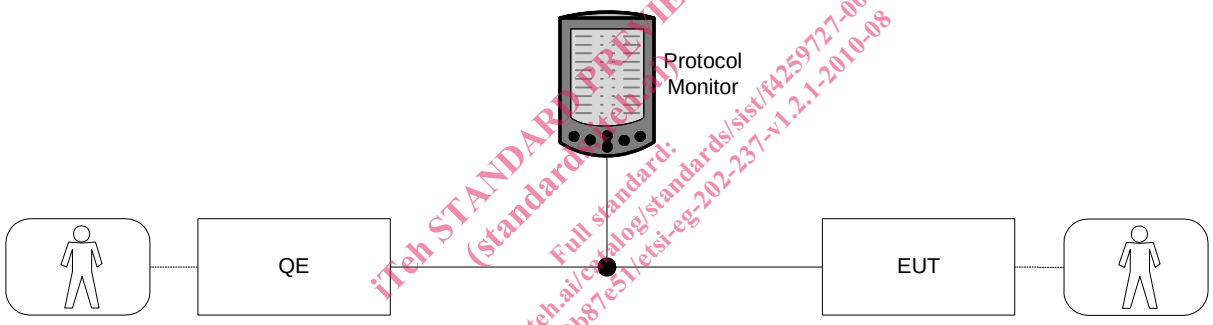

Figure 3: Interoperability testing with conformance monitoring

While this arrangement cannot provide a complete proof of conformance, analysis of the protocol monitor output will be able to show whether protocol signalling between the EUT and QE conformed to the appropriate standard(s) throughout the testing.

5 Interoperability testing process overview

The present document provides users with guidelines on the main steps associated with interoperability testing. The intention is that the guidelines should be simple and pragmatic so that the document can be used as a "cook-book" rather than a rigid prescription of how to perform interoperability testing.

The main components of the guidelines are described in clauses 8 and 9 and are as follows:

- development of interoperability test specifications, including:
  - identification of interoperable functions;
  - identification of abstract architectures;
  - specification of interoperability test suite structure and test purposes;
  - specification of interoperability test cases.

- the testing process, including:
  - test planning;
  - specification of test configurations;
  - execution of the tests;
  - logging results and producing test reports.

As their name implies, guidelines are only for guidance and the actual process followed should use and adapt whichever of these guidelines are most applicable in each particular situation. In some cases this may mean the application of all aspects.

6 Basic concepts

Figure 4 illustrates the main concepts specified in the present document. It shows the two main components of the methodology, namely the Means of Testing (MoT) and the System Under Test (SUT). The MoT includes the roles of test drivers and a test coordinator, the interoperability test cases and mechanisms for logging and reporting. The SUT comprises the Equipment Under Test (EUT) and one or more items of Qualified Equipment (QE). The Means of Communication (MoC) between the QE and the EUT is considered to be neither part of the SUT nor of the MoT.

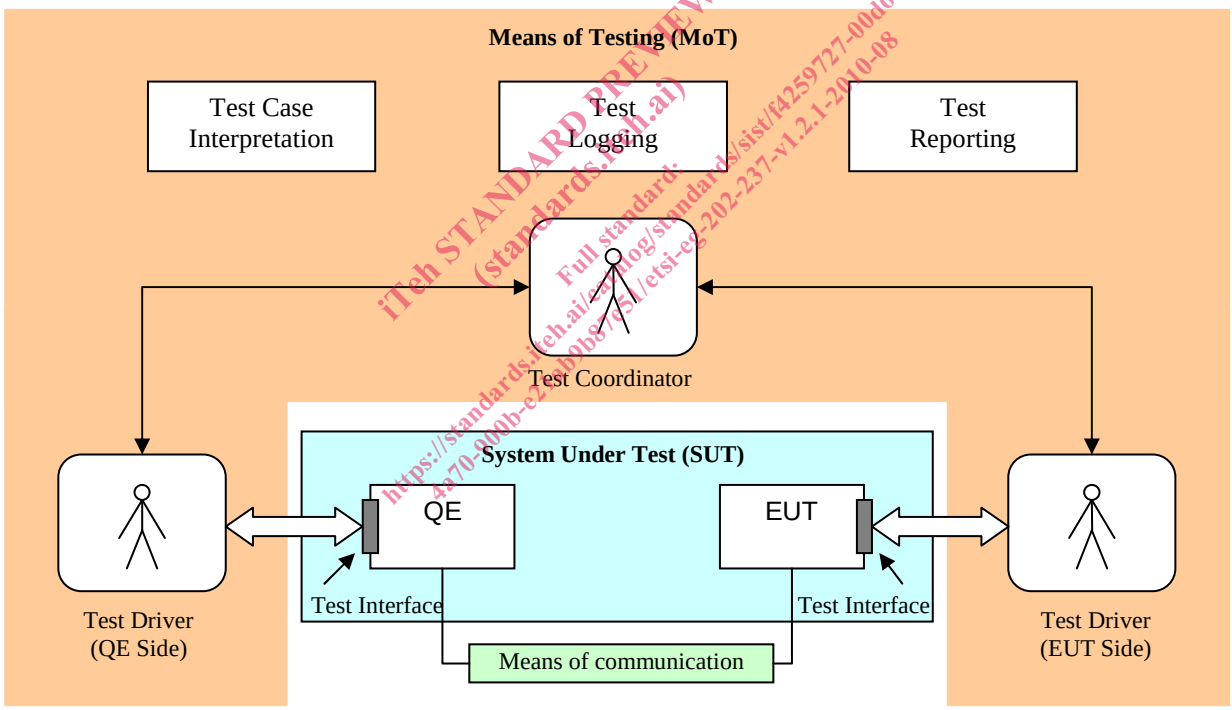

Figure 4: Illustration of main concepts

6.1 Means of Testing

The combination of equipment and procedures that realizes and performs the selection and execution of test cases is known as the Means of Testing (MoT). Test cases may be executed either by a human operator or by an automated program (see clause 6.6). The MoT should also be capable of logging test results and of producing test reports (see clause 9.4). The MoT includes neither the System Under Test nor the means by which devices in the System Under Test communicate.