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Information technology — Open Systems Interconnection — Conformance testing methodology and framework —

Part 2:
Abstract Test Suite specification

Technologies de l'information — Interconnexion de systèmes ouverts — Cadre général et méthodologie des tests de conformité OSI —

Partie 2: Spécification des suites de tests abstraites

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 9646-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee 21, *Open Systems Interconnection, data management and open distributed processing*.

This second edition cancels and replaces the first edition (ISO/IEC 9646-2:1991) which has been technically revised.

ISO/IEC 9646 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Conformance testing methodology and framework*:

— *Part 1: General concepts*
— *Part 2: Abstract Test Suite specification*
— *Part 3: The Tree and Tabular Combined Notation*
— *Part 4: Test realization*
— *Part 5: Requirements on test laboratories and clients for the conformance assessment process*
— *Part 6: Protocol profile test specification*
— *Part 7: Implementation conformance statements*

Annexes A, B and C of this part of ISO/IEC 9646 are for information only.

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Introduction

This part of ISO/IEC 9646 provides a common approach to the specification of OSI conformance test suites at a level which is independent of the means of executing those test suites (hereafter called "Abstract Test Suites"). This level of abstraction is suitable for standardization and facilitates the comparison of results produced by different organizations which run the corresponding Executable Test Suites.

Clauses 6 and 7 recall that there are requirements on OSI protocol specifiers which have to be fulfilled before there can be an objective basis for the process of developing an Abstract Test Suite. The need is expressed for consistent conformance clauses and for ICS proformas in relevant base specifications (e.g. International Standards or ITU-T Recommendations which specify OSI protocol standards).

Clauses 8 to 14 describe the process of developing an Abstract Test Suite, including the design criteria to be used and guidance on its structure and coverage. The possible Abstract Test Methods are defined and guidance is given to help the test suite specifier to decide which test method(s) to use in the production of a particular test suite. Requirements and guidance are given on the specification of abstract test cases. These include the subdivision of test cases into test steps and the assignment of test verdicts to test outcomes.

The test suite specifier is also required to provide information to the test realizers (*e.g.* limitations governing test case selection).

Finally, in clause 15, guidance and requirements are given on test suite maintenance.

This part of ISO/IEC 9646 is also to be published by ITU-T as Recommendation X.291.

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Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 2: Abstract Test Suite specification

1 Scope

1.1 This part of ISO/IEC 9646 specifies the requirements and gives guidance for the production of system-independent conformance test suites for one or more OSI specifications. In particular, it is applicable to the production of all OSI conformance testing specifications including all draft versions of such conformance testing specifications.

1.2 This part of ISO/IEC 9646 is applicable to the production of abstract test cases which check the conformance of an implementation to the relevant static and/or dynamic conformance requirements by controlling and observing protocol behaviour. The Abstract Test Methods included in this part of ISO/IEC 9646 are, in fact, capable of being used to specify any test case which can be expressed abstractly in terms of control and observation of Protocol Data Units (PDUs) and Abstract Service Primitives (ASPs). Nevertheless, for some protocols, test cases may be needed which cannot be expressed in these terms. The specification of such test cases is outside the scope of this part of ISO/IEC 9646, although the test cases may themselves need to be included in a conformance testing specification.

NOTE – For example, some static conformance requirements related to an Application service may require testing techniques which are specific to that particular Application.

This part of ISO/IEC 9646 is applicable to the production of test suites for testing implementations of one or more adjacent protocols, whether or not these are embedded under other protocols.

1.3 The following are outside the scope of this part of ISO/IEC 9646:

a) the relationship between Abstract Test Suite (ATS) specification and Formal Description Techniques;

b) testing by means of test methods which are specific to particular applications, protocols or systems, including testing by means other than PDU exchange.

NOTE – This part of ISO/IEC 9646 applies fully to some but not all Physical layer protocols. Nevertheless, many of the concepts apply to all protocols.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9646. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 9646 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7498: 1984, *Information processing systems – Open systems – Basic Reference Model.*
(See also CCITT Recommendation X.200 (1984))

ISO/TR 8509: 1987, *Information processing systems – Open Systems Interconnection – Service conventions.*
(See also CCITT Recommendation X.210 (1988))

ISO/IEC 8825: 1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).*
(See also CCITT Recommendation X.209 (1988))

ISO/IEC 9646-1: 1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts.*
(See also ITU-T Recommendation X.290 -[1])

ISO/IEC 9646-3: 1992, *Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 3: The Tree and Tabular Combined Notation (TTCN).*
(See also ITU-T Recommendation X.292 (1993))

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ISO/IEC 9646-3 Amd 1: -[1], *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 3: The Tree and Tabular Combined Notation - Amendment 1: TTCN extensions*

ISO/IEC 9646- 6:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 6: Protocol profile test specification.*
(See also ITU-T Recommendation X.295 -[1])

ISO/IEC 9646- 7: -[1], *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements.*
(See also ITU-T Recommendation X.296 -[1])

3 Definitions

For the purposes of this part of ISO/IEC 9646, all the definitions given in ISO/IEC 9646-1 apply.

4 Abbreviations

For the purposes of this part of ISO/IEC 9646, the abbreviations given in ISO/IEC 9646-1 apply. The following abbreviations also apply to this part of ISO/IEC 9646.

ACSE: association control service element

ASE: application-service-element

ASN.1: abstract syntax notation one

ASP abstract service primitive

ATM abstract test method

ATS: abstract test suite

FDT formal description techniques

ICS: implementation conformance statement

IUT: implementation under test

IXIT: implementation extra information for testing

LT: lower tester

LTCF: lower tester control function

MPyT: multi-party testing

OSI: open systems interconnection

PCO: point of control and observation

PCTR: protocol conformance test report

PDU: protocol data unit

RTS: remote transfer service

SAP: service-access-point

SPyT: single-party testing

SUT: system under test

TCP: test coordination procedures

TM-PDU: test management PDU

TMP: test management protocol

TSS&TP: test suite structure and test purposes

TTCN: tree and tabular combined notation

UT: upper tester

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5 Compliance

5.1 A base specification which complies with this part of ISO/IEC 9646 shall satisfy all the requirements stated in clauses 6 and 7.

NOTE – Such compliance is a precondition for the base specification to be an effective basis for conformance testing of implementations.

5.2 An Abstract Test Suite (ATS) specification which complies with this part of ISO/IEC 9646

a) shall be a conformance test suite;

b) shall be specified in a test notation standardized by ISO/IEC or ITU-T;

c) shall satisfy all the requirements stated in clauses 9 to 15 inclusive;

d) shall be within an ISO/IEC or ITU-T published specification or, in the absence of such a specification, shall be within a publicly available specification which is in the process of being standardized within ISO/IEC or ITU-T, which has the highest standardization status available, and which has the status of at least a Committee Draft or equivalent.

NOTE - ATSs outside the standardization process need to be submitted for international standardization before they can fully comply with this part of ISO/IEC 9646, in order to ensure that they are subject to public scrutiny, correction and acceptance, internationally.

5.3 It is recommended that the test notation used be the Tree and Tabular Combined Notation (TTCN). If TTCN is used, the ATS shall comply with ISO/IEC 9646-3.

NOTE - X.290 (1988) is considered to be obsolete for this purpose.

6 Conformance requirements in OSI base specifications

6.1 Introduction

The meaning of conformance in OSI is discussed in ISO/IEC 9646-1. It is necessary that there be an unambiguous and objective understanding of the conformance requirements of an OSI base specification, as a prerequisite to the production of an ATS for that specification. Clauses 6 and 7 state the requirements on the relevant specifiers to ensure that there is such an understanding of the conformance requirements.

Additional guidance is given in annex B.

6.2 General requirements

6.2.1 A clear distinction shall be made between static and dynamic conformance requirements. To avoid ambiguity, they should be stated separately from one another.

6.2.2 It shall be clear what conformance to the specification means, in the sense of what is required to be done (*i.e.* mandatory), what is permitted but not mandatory (*i.e.* optional), and what is required not be done (*i.e.* prohibited), in order to conform to it.

6.2.3 It shall always be decidable whether an instance of communication conforms dynamically or not.

For example, it should be possible to look at a record of Protocol Data Unit (PDU) activity and decide whether or not it is valid with respect to the relevant specification.

6.3 Conformance clauses

6.3.1 Each base specification, which specifies an OSI protocol, abstract syntax, encoding rules, or information object, shall include a conformance clause, which shall be expressed clearly and unambiguously.

6.3.2 Conformance clauses shall distinguish between the following categories of information:

a) references to clauses which state dynamic conformance requirements;

b) static conformance requirements concerning the implementation of the base specification itself;

c) static conformance requirements concerning multi-specification dependencies (see 6.4).

6.3.3 The requirement to produce an Implementation Conformance Statement (ICS), in compliance with the ICS proforma, shall be stated separately from the requirements on the implementation of the specification itself.

6.3.4 The conformance clause of a protocol specification should also include

a) the requirement to be able to accept all correct sequences of PDUs received from peers, and respond with correct PDU sequences;

b) the requirement to be able to respond correctly to all incorrect sequences of PDUs received;

c) in connection oriented protocols, the option to support either the initiation of a connection or the acceptance of a connection, or both;

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d) in connectionless protocols, the option to support the transmission of a PDU, the receipt of a PDU, or both.

6.3.5 A checklist for what should be included or referenced in each conformance clause is given in annex B, B.5.

6.4 Multi-specification dependencies

Multi-specification dependencies may be specified by each base specification requiring the provision of non-mandatory features in one or more underlying base specifications. If multi-specification dependencies are to be included in an ICS proforma, the ICS proforma shall merely reflect the multi-specification dependencies specified in the conformance clause of the corresponding base specification.

Multi-specification dependencies should usually be specified in terms of what elements of a given underlying service are required in order to support the given protocol or information object. In addition, each underlying protocol specification should specify which units of the protocol are required if a given element of service can be said to be supported. This refers to the functionality implied by the element of service, and does not in any way imply the existence of a service interface.

NOTE - This is not conformance to service, but rather is an expression of the conditional requirements that result from the compliance of a protocol to its service definition.

In cases where it is not possible to express dependencies through the underlying service, they can be specified in terms of the units of the underlying protocol or other specification required to support the higher protocol (the referencing specification).

Multi-specification dependencies should only be specified in a protocol specification if they are needed to preserve the integrity of that protocol. They should be avoided where they are really defining a profile.

Multi-specification dependencies may also be specified in a similar way in information object specifications.

7 Requirements on ICS proformas

7.1 The specific requirements to be met by suppliers in respect of each ICS they are to provide, shall be stated in the relevant base specification. The specification of these requirements shall include an ICS proforma. The ICS proforma shall be in the form of a questionnaire to be completed by the supplier or implementor of an implementation of the relevant base specification.

7.2 The ICS proforma shall cover all major mandatory capabilities, all optional and conditional functions, elements of procedure, parameters, options, PDUs, timers, multi-specification dependencies and other capabilities identified in the base specification.

7.3 There shall be a well-defined mapping (by references) from the ICS proforma to the static conformance requirements. The expression of the static conformance requirements in the ICS proforma shall be consistent with the conformance clause of the base specification.

7.4 ISO/IEC 9646-7 provides requirements and guidance on the production of ICS proformas.

8 Abstract Test Suite production process leading to conformance testing specifications

8.1 In order to present the requirements and general guidance for specification of Abstract Test Suites (ATSs), it is useful to assume a normal form of the process of ATS production leading to a conformance testing specification. This clause describes the process in just such a normal form. Test suite specifiers are not required to follow this normal form exactly, however they are recommended to use a similar process involving the same steps, possibly in a different order.

8.2 For the purposes of this part of ISO/IEC 9646, the ATS production process is assumed to be as follows:

a) study the relevant specifications and ICS proformas to determine what the conformance requirements (including options) are which need to be tested (see clause 9);

b) decide which test groups will be needed to achieve the appropriate coverage of the conformance requirements (see 10.2);

c) optionally develop test group objectives: the common testing objectives of the elements of each test group (see 10.3);

d) develop test purposes which reflect the test group objectives (if any) of the test groups in which they are contained, and which provide adequate coverage of the conformance requirements to be tested (see 10.3 and 10.4);

e) choose the abstract testing context and the Abstract Test Method(s) for which the complete abstract test cases need to be specified, and decide what restrictions need to be placed on the capabilities of the Lower Tester(s) and, if appropriate to the chosen Abstract Test Methods(s), the Upper Tester(s) and Test Coordination Procedures (see clause 11);

f) apply a standardized test notation to specify the set of abstract test cases, including the test step structure to be used (see clause 12);

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g) specify the interrelationships

1) among the test cases,

2) between the test cases and the ICS(s), and

3) as far as possible, between the test cases and the Implementation eXtra Information for Testing (IXIT) statement(s),

in order to determine the restrictions on the selection and parametcrization of test cases for execution, and the restrictions, if any, on the orders in which they can be executed (see clause 14);

h) consider the procedures for maintaining the ATS (see clause 15).

8.3 It is also assumed that during the ATS production process an overall structure for the conformance testing specification(s) will be developed, with appropriate parts for

a) the Test Suite Structure and Test Purposes (TSS&TP) (see clause 10);

b) one or more ATSs for one or more Abstract Test Methods (see clause 11);

c) the specification of a Test Management Protocol (TMP), if applicable (see clause 13).

8.4 Clauses 9 to 15 provide requirements and guidance which relate to each step in the above process.

8.5 Testing for conformance to a profile is based on the use of appropriate test cases from base specification ATSs for the base specification(s) referenced in the profile. These base specification ATSs may be either single-protocol or multi-protocol ATSs. In some cases, it may be appropriate to standardize a base specification ATS for that subset of the base specification used by one or more specific profile(s), in which case subsequent amendments to the ATS should be made to extend the coverage to meet the needs of other profiles or the complete base specifications as and when necessary.

Additional profile specific test cases may be needed to address conformance requirements that are relevant to the profile but are outside the scope of the TSS&TP for any base specifications. These additional profile specific test cases are standardized in the Profile Specific Test Specification. The requirements and guidance on the production of Profile Test Specifications for protocol profiles are given in ISO/IEC 9646-6.

9 Conformance requirements and ICS proforma

9.1 Before an ATS can be specified, the test suite specifier shall first determine what the conformance requirements are for the relevant base specification(s) and what is stated in the ICS proforma(s) concerning the implementation of those specification(s).

9.2 Clauses 6 and 7 specify the requirements to be met by specifiers of the base specifications as a prerequisite to the production of an ATS for a particular base specification or combination of base specifications.

9.3 If the static conformance requirements are not properly specified, the test suite specifier should contribute to the production of an amendment to or revision of the relevant specification to clarify the conformance requirements.

10 Test Suite Structure and Test Purposes (TSS&TP)

10.1 Basic requirements

10.1.1 The test suite structure and set of test purposes applicable to all ATSs to be specified for the same base specification or combination of base specifications shall be specified in the relevant conformance testing specification, preferably in a separate part.

10.1.2 Each ATS shall comprise a number of test cases, each of which is designed to achieve one of the specified test purposes. The test cases may be grouped into test groups, if necessary nested. The structure shall be hierarchical; thus, an item at a lower level shall be completely contained within a higher level item. Similar test groups may occur in more than one higher level test group.

10.1.3 The test suite specifier shall ensure that a subset of the test purposes of each ATS is concerned with capability testing, and another subset is concerned with behaviour testing. This need not lead to distinct test cases for behaviour and capability testing because it may be possible to use a combined behaviour and capability test purposes. The test suite specifier shall provide an explanation of how the test purposes are derived from or relate to the base specification. The test suite specifier shall also provide a summary of the coverage achieved by the ATS.

10.2 Specification of the test suite structure

10.2.1 In order to ensure that the resulting ATS provides adequate coverage of the relevant conformance requirements, the test suite specifier is advised to design the test suite structure in terms of nested test groups in a top down manner. There are many

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ways of structuring the same test suite into test groups; no one way is necessarily right and the best approach for one test suite may not be appropriate for another test suite. Nevertheless, the test suite specifier shall ensure that the test suite includes test cases for whichever of the following categories are relevant:

a) capability tests (for static conformance requirements);

b) behaviour tests of valid behaviour;

c) behaviour tests that investigate the reaction of the Implementation Under Test (IUT) to invalid test events; these may be subdivided into those concerned with syntactically invalid test events, semantically invalid test events, and inopportune test events, as relevant to the protocol concerned;

d) tests focusing on the different roles of the IUT;

e) tests focusing on PDUs sent to the IUT;

f) tests focusing on PDUs received from the IUT;

g) tests focusing on interactions between PDUs sent and PDUs received;

h) tests related to each mandatory capability;

i) tests related to each optional capability;

j) tests related to each protocol phase;

k) variations in the test event occurring in a particular state;

l) timing and timer variations;

m) PDU encoding variations;

n) variations in values of individual parameters;

o) variations in combinations of parameter values;

p) combinations of related requirements from more than one base specification;

q) tests specific for multi-party behaviour.

This list is not exhaustive; additional categories might be needed to ensure adequate coverage of the relevant conformance requirements for a specific test suite. Furthermore, these categories overlap one another and it is the task of the test suite specifier to arrange them into an appropriate hierarchical structure.

10.2.2 The following structure is an example of a single-layer protocol test group for a particular role in the Single Party Testing context, provided for guidance:

A. Capability tests

A.1 Mandatory capabilities

A.2 Optional capabilities

B. Behaviour tests: response to valid behaviour by peer implementation

B.1 Connection establishment phase (if relevant)

B.1.1 Focus on what is sent to the IUT

B.1.1.1 Test event variation in each state

B.1.1.2 Timing/timer variation

B.1.1.3 Encoding variation

B.1.1.4 Individual parameter value variation

B.1.1.5 Combination of parameter values

B.1.2 Focus on what the IUT is requested to send

– substructured as B.1.1

B.1.3 Focus on interactions

– substructured as B.1.1

B.2 Data transfer phase

– substructured as B.1

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