INTERNATIONAL STANDARD

ISO/IEC 9646-4

Second edition
1994-12-15

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

Part 4:
Test realization

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

Partie 4: Réalisation des tests

Reference number
ISO/IEC 9646-4:1994(E)

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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 9646-4 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 tje first edition (ISO/IEC 9646-4:1991) 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*

Annex A of this part of ISO/IEC 9646 is for information only.

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Introduction

ISO/IEC 9646-1 and ISO/IEC 9646-2 define a general methodology for testing the conformance of implementations to OSI protocol specifications and/or transfer syntaxes issued as International Standards or ITU-T Recommendations; these parts also put requirements on the production of OSI conformance testing specifications and Abstract Test Suites (ATS) specifications.

ISO/IEC 9646-3 defines a standardized test notation, the Tree and Tabular Combined Notation (TTCN), for the specification of an ATS.

Once OSI conformance testing specifications and ATSs in compliance with ISO/IEC 9646-2 are available, the test results obtained by different test laboratories should be comparable, if they base their test operations on the same reference ATS specification.

ISO/IEC 9646-5 puts requirements on the conformance assessment process, so that test results can be compared with those of other test laboratories, and can have a wide acceptance.

This part of ISO/IEC 9646 concentrates on the intermediate stage, namely, test realization. Before the test preparation can begin, a Means of Testing (MOT) the Implementation Under Test (IUT) has to be made available.

Test realizers are those organizations which take responsibility for providing such an MOT.

ISO/IEC 9646-6 defines a general methodology for specifying the requirements for the production of Profile Test Specification (PTS) for conformance testing against profiles.

ISO/IEC 9646-7 defines how to express and document the conformance of systems to base specifications and profiles, using Implementation Conformance Statements (ICS) based on standardized ICS proformas and profile Requirements Lists (RLs).

This part of ISO/IEC 9646 places requirements on test realization, to ensure that the execution of test cases reflects the behaviour specified in the reference ATS specification. In this way, the purpose of the ATS is achieved.

This part of ISO/IEC 9646 is also to be published by ITU as ITU-T Recommendation X.293.

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Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 4: Test realisation

1 Scope

This part of ISO/IEC 9646 specifies requirements and gives guidance concerning the realization of a Means of Testing (MOT), in conformance with a reference Abstract Test Suite (ATS) specification, specified in compliance with ISO/IEC 9646-2. This part of ISO/IEC 9646 is applicable to producing MOTs for testing a single protocol, multiple protocols or a profile.

NOTE - This implies the use of ATSs as defined in ISO/IEC 9646-1. However, within this part, the term ATS also applies to the additional Abstract Test Cases designed for testing a specific profile, and included in the Profile Specific Test Specification (PSTS).

These requirements are limited to those aspects of an MOT which can be mapped on to the abstract testing functions defined in ISO/IEC 9646-1, or which are essential to a proper use of the ATS. Such aspects might include a facility to produce conformance log, or the progression of the Implementation Extra Information for Testing (IXIT) proformas. Further implementation details of test systems and Upper Testers are outside the scope of this part of ISO/IEC 9646.

Acceptance, validation and installation of MOT are outside the scope of this part of ISO/IEC 9646.

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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7498: 1984, *Information technology - Open Systems Interconnection - Basic reference model.*
(See also ITU-T Recommendation X.200).

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 9646-2: 1994, *Information technology - Open systems interconnection - Conformance testing methodology and framework - Part 2: Abstract test suite specification.*
(See also ITU-T Recommendation X.291 - [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).

ISO/IEC 9646-3 Amd: - [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 9646-5: 1994, *Information technology - Open systems interconnection - Conformance testing methodology and framework - Part 5: Requirements on test laboratories and clients for the conformance assessment process*
(See also ITU-T Recommendation X.294 -[1]).

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

1. To be published

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ISO/IEC 9646-7: - [1], *Information technology - Open systems interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statements.*3Definitions
(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. In addition, the definition of 'TTCN coordination point' is given in ISO/IEC 9646-3.

4 Abbreviations

For the purpose of this part of ISO/IEC 9646, the following abbreviations given in ISO/IEC 9646-1 apply:

ASP: abstract service primitive.
ATM: abstract test method.
ATS: abstract test suite.
BIT: basic interconnection tests.
ETS: executable test suite.
ICS: implementation conformance statement.
IUT: implementation under test.
IXIT: implementation extra information for testing.
LT: lower tester.
LTCF: lower tester control function.
MOT: means of testing IUTs.
MPyT: multi-party testing.
OSI: open systems interconnection.
PATS: parameterized abstract test suite.
PCO: point of control and observation.
PDU: protocol data unit.
PETS: parameterized executable test suite.
PSTS: profile specific test specification.
PTS: profile test specification.
SATS: selected abstract test suite.
SETS: selected executable test suite.
SPyT: single-party testing.
SUT: system under test.
TCP: test coordination procedures.
TM-PDU: test management PDU.
TMP: test management protocol.
TTCN: tree and tabular combined notation.
UT: upper tester.

5 Test realization overview

5.1 Introduction

Test realization is the process of producing a Means of Testing (MOT) for testing the conformance of IUTs to OSI protocol specification, based on a conformance testing specification and its Abstract Test Suite (ATS).

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5.2 Means of Testing composition

An MOT is a combination of equipment and procedures that can perform

a) the derivation of test cases,

b) the selection of test cases,

c) the parameterization of test cases,

d) the execution of test cases and

e) the production of a conformance log.

With respect to a conformance assessment for a base protocol specification, the MOT provides a realization of an ATS for that protocol, in conformance with a reference ATS specification.

With respect to a conformance assessment for a profile, the MOT provides a realization of each ATS, including the additional abstract test cases, if any, in conformance with the Profile Test Specification Summary (PTS-Summary).

5.3 Means of Testing (MOT) functionality

In the derivation process, the abstract test cases of the ATS are converted into executable test cases forming an Executable Test Suite (ETS).

The selection process for a base specification begins with the complete ATS. The inappropriate test cases for the IUT are deselected according to the provisions of the Implementation Conformance Statement (ICS) and the Implementation Extra Information for Testing (IXIT).

In the case of profile testing, the selection process begins with the list of test cases applicable to the profile, which is part of the Profile Specific Test Specification (PSTS). The inappropriate test cases for the IUT are deselected, according to the provisions of the profile ICS and profile IXIT.

In the parameterization process, the parameters in the selected test cases are given appropriate values, according to the provisions of the appropriate IXIT (and possibly of the ICSs).

The MOT is then used in the conformance assessment process for an IUT, executing the test cases in a test campaign, resulting in the production of a conformance log.

5.4 Selected and parameterized test suites

Intermediate forms of test suites may or may not be created, depending upon when the derivation process occurs.

Such intermediate forms are known as

a) SATS: Selected Abstract Test Suites;

b) SETS: Selected Executable Test Suites;

c) PATS: Parameterized Abstract Test Suites;

d) PETS: Parameterized Executable Test Suites.

5.5 The Parameterized Executable Test Suites (PETS)

Among these various forms, only the ATSs are necessarily tangible.

Some MOT may generate the PETS automatically from the relevant ATS (given the ICS and IXIT) at the moment the test cases are actually run. Such an MOT does not exhibit an ETS, nor a SETS, nor a PETS, in a tangible form.

Nevertheless, what is executed is always a Parameterized Executable Test Suite.

6 Requirements concerning test realization

6.1 Introduction

The requirements concerning test realization address

a) the MOT as a whole;

b) the derivation process, from abstract to executable test cases;

c) facilities for producing a conformance log;

d) progression of the IXIT proforma;

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e) production of other documents.

6.2 Requirements concerning the Means of Testing

6.2.1 General functions

An MOT shall be provided for a single ATS, which complies with ISO/IEC 9646-2. The test realizer shall use only the version of the ATS specification which has the highest standardization status (*e.g.* DIS rather than CD).

The MOT shall provide

a) a realization of the Lower Testers, and if the Multi-Party Testing (MPyT) context is used, a realization of the Lower Tester Control Function (LTCF);

b) the specification of the Upper Tester, insofar as it is required by the test method;

c) the realization of the Upper Tester for the Single Party Testing (SPyT) Local test method and any MPyT test method in which the Upper Tester is outside the SUT;

d) optionally, the realization of the Upper Tester(s) for the SPyT Coordinated and Distributed test methods, if appropriate, or for MPyT test methods;

e) the specification of the Test Coordination Procedures (TCPs) in accordance with the requirements specified in the reference ATS specification;

f) the realization of the TCPs within the test system for the SPyT Local test method and any MPyT test method in which the Upper Tester is outside the SUT;

g) the realization of the TMP within the SPyT Lower Tester(s) for the Coordinated test method and if appropriate, for MPyT test methods.

6.2.2 Test cases for execution

The MOT shall include either the executable test cases derived from the abstract test cases of the ATS, or a means of deriving them.

The MOT shall be realized in compliance with the semantics of the test notation chosen in the ATS.

The MOT shall provide a means of deselecting the inappropriate test cases for an IUT, and parameterizing the selected test cases (whether they are at the abstract level or at the executable level), as indicated in 5.3.

The requirements for the selection process are expressed in ISO/IEC 9646-5, subclause 7.3.

The requirements for the parameterization process are expressed in ISO/IEC 9646-5, subclause 7.4.

6.2.3 Selection of the Basic Interconnection Tests

The MOT shall provide a facility for selecting the capability or behaviour test cases mentioned in the list of Basic Interconnection Tests (BIT), if such a list is specified in the reference ATS, and shall provide a facility for running them initially altogether, before the capability and behaviour tests.

The MOT shall also provide a facility for omitting those test cases indicated in the BIT list from the set of test cases selected for the capability and behaviour tests.

6.2.4 Execution of Parameterized Executable Test Suites (PETS)

The MOT shall include the capability of executing the PETS which result from the derivation, selection and parameterization processes.

6.2.5 Conformance of a Means of Testing (MOT)

The test realizer shall provide a statement of conformance of the MOT to the reference ATS specification, indicating any subset of the ATS that is not supported (see 6.3.4).

The test realizer shall identify all restrictions for test execution required by the MOT beyond those stated in the reference ATS specification (*e.g.* limiting value ranges provided in the IXIT).

NOTE - The test realizer should note any requirements for a comprehensive testing service stated in the ATS specification. The test realizer may wish to develop an MOT for each of the required ATMs in order that a test laboratory may provide a comprehensive testing service.

6.2.6 Conformance log

The MOT shall provide a facility for generating a conformance log (see 6.4).

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6.3 Requirements concerning Executable Test Suite (ETS) derivation

6.3.1 Introduction

Requirements in 6.3 shall apply to all ETSs, including SETS or PETS, whether tangible or not.

6.3.2 Conformance to the reference ATS specification

An ETS shall be derived from a single reference ATS specification.

For an ETS to conform to the reference ATS specification, it shall comply with the requirements stated in 6.3.3 to 6.3.5 below. It shall also conform to the requirements stated in the reference ATS specification itself, and in the other parts of the multi-part conformance testing standard, if applicable (*e.g.* TMP).

6.3.3 Correspondence between abstract and executable test cases

Each executable test case shall be the realization of a single abstract test case, and shall be selectable for execution on an individual basis.

All sequences of test events comprising an abstract test case shall be capable of being realized in the executable test case.

The test purpose and verdict assignments of each abstract test case shall be maintained in the corresponding executable test case.

The MOT shall not perform checking on the validity of Protocol Data Unit (PDU) parameters received from the IUT in addition to that which is defined in the abstract test case. Any further checking which the test system might be capable of performing is outside the scope of this standard and shall not contribute to the verdict assignment for each test case.

Test group relationships defined in the reference ATS specification shall be maintained in the ETS. Each test group composed of a named set of test cases in the ATS shall be represented in the ETS as a named set of executable test cases.

The ATS includes a mapping of the abstract test case(s) to the ICS proforma and partial IXIT proforma questions (see ISO/IEC 9646-2: 1994, clause 14). This mapping shall be maintained in the ETS.

6.3.4 Subsetting the Abstract Test Suite

The ETS derivation process generally results in the derivation of all abstract test cases of the ATS. However, it may be acceptable to derive an ETS for certain subsets of the ATS. If a subset is created, the exclusion of a set of test cases shall be consistent with the test selection process for an IUT, with respect to the mapping between the ICS proforma(s) (and IXIT proforma(s)) questions and the test cases in the ATS.

NOTE - This means that the test cases which are mandatory for all IUTs would always be included in the subset, but the test realizer can choose not to realize particular sets of test cases which are optional or conditional and therefore will not be required to test particular classes of IUTs.

Thus the subset of the ATS which is realized shall be equivalent to one or more of the potential SATS.

6.3.5 Derivation process independence

In the MOT, the derivation process shall lead to the same PETS being executed for a given IUT, regardless of when the derivation process occurs relative to the selection and parameterization processes.

NOTE - See A.2.1, figure A.1.

The application of the selection and parameterization processes for a particular IUT is the responsibility of the test laboratory, in the test preparation phase.

6.4 Requirements concerning conformance log

As stated in 6.2, the MOT shall provide a facility for generating a conformance log.

A conformance log is a human-readable record of information produced as a result of a test campaign, sufficient to record the observed test outcomes and verify the assignments of test verdicts.

This information combines the observations of the actual test events which occur when the PETS is run against an IUT, with information which relates those events to the abstract test cases concerned.

A conformance log may be used in the production of conformance test reports and in the resolution of disputes and queries which may arise during or as a result of the conformance assessment process.

A conformance log shall include

a) a unique identification of the conformance log that includes time and date of the start of the execution of the PETS;

b) an identification of the MOT, date of origin, version number, and ETS identification (if any);

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c) an indication of the start and of the end of each test case and, if the MPyT context is involved, which Lower Testers were started and stopped, including a unique reference to the abstract test case as specified in the ATS (*e.g.* TTCN test case reference or TTCN test case identifier);

d) the PDUs sent by the Lower Tester(s) to the IUT, and received by the Lower Tester(s) from the IUT, including a record of the detailed information contained in the PDU parameters and user data;

e) the abstract test events, as specified in the relevant abstract test case; these include all Abstract Service Primitives (ASPs) observed by the Lower Tester(s), all test events sent and received via the Test Coordination Procedures by the Lower Tester(s), including information to and from the Upper Tester(s), and an identification of the relevant points at which they occurred (*e.g.* Points of Control and Observation (PCOs) or TTCN Coordination Points);

f) if the MPyT context is used, all test events sent and received by the LTCF, including an identification of the relevant points at which they occurred (*e.g.* TTCN Coordination points);

g) all information regarding preliminary results;

h) an indication of the result for each test case; this will be verdict assignment, abstract or executable test case error, or abnormal test case termination;

i) a time stamp or ordering sequence for all test events logged by the Lower Tester in the order that they are observed;

j) any additional information required by the ATS.

NOTE - An example of j) above is when an abstract test case written in TTCN specifies that preliminary result information (in the verdict column) or labels (in the label column) shall be recorded in the conformance log if the corresponding test event occurs.

A conformance log shall display all names, abbreviations and values, using the terminology and conventions defined in the protocol specification, abstract syntax (if any), encoding rules (if any), or ATS (with precedence given to the first two named).

The MOT shall have the ability to produce the conformance log on paper. It is also recommended that a machine-readable form of the conformance log be made available, with equivalent contents.

NOTE - See annex A, clause A.3, for guidance on the production of conformance logs.

6.5 Requirements on the progression of the IXIT proforma(s)

The partial IXIT proforma(s) shall be progressed to take into account the MOT. To achieve this, the test realizer shall augment the partial IXIT proforma(s) by adding those additional questions that need to be answered in order to prepare the MOT for a particular IUT.

The test realizer shall include in the augmented partial IXIT proforma(s) all the information concerning the realization of the ATS, which the client needs for completing the IXIT.

The test realizer should refer to ISO/IEC 9646-5, subclause 6.4.5 and produce the augmented partial IXIT proforma(s) in such a way as to facilitate the production of a complying IXIT proforma by the test laboratory.

The resulting augmented partial IXIT proforma(s) shall be provided to the test laboratory, in order that it can fulfil its requirements as specified in ISO/IEC 9646-5, subclause 6.4.5.

6.6 Requirements concerning other documentation

Documentation shall accompany the MOT, in order to enable the test laboratory to perform test operations in conformance with the reference ATS specification, and in compliance with ISO/IEC 9646-5 with respect to information to be provided to the client.

The documentation shall include

a) identification of the MOT, date of origin, version number, and ETS identification (if any);

b) name and version number of the International Standard or ITU-T Recommendation for the protocol specification (and the service definition if appropriate); name and version number of the reference ATS specification, together with lists of technical corrigenda to the protocol specification which have been taken into account;

c) description of the MOT (see A.4.3 for guidance);

d) specification of the TCPs and of the Upper Tester(s), as and when required by the reference ATS specification;

e) the test cases, if any, which cannot be executed due to limitations in the MOT;

NOTE - Such limitations should be exceptions, and should occur only if particular abstract test cases could not feasibly be realized.

f) description of those procedures for test execution which are to be performed by the test laboratory and/or the client, and which are specific to the MOT;

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g) statement of conformance to the reference ATS specification;

h) statement of compliance with this part;

i) guidance for interpreting the conformance log.

If test realizers detect errors in any of the abstract test cases or detect any abstract test case which addresses erroneous or ambiguous requirements in the relevant specification, then the test realizers shall identify those test cases in the documents accompanying the MOT.

NOTE - The test realizers should also forward defect reports which identify the problem(s) to the organization responsible for the maintenance of the relevant specification.

7 Compliance

An MOT complies with this part of ISO/IEC 9646 if and only if all the requirements stated in clause 6 are satisfied.

NOTE - The primary means of verifying that an MOT implements the four functions associated with test realization (*i.e.* derivation, selection, parameterization, execution) resides in the conformance log.

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Annex A
(informative)

Additional Guidance on test realisation

A.1 Additional guidance on the Means of Testing (MOT)

A.1.1 Introduction

This annex gives guidance on how the four abstract testing functions defined in ISO/IEC 9646-1, subclause 7.4, namely the Lower Tester, the Upper Tester, the TCPs and the LTCF, can be defined or realized in an MOT. The LTCF is only applicable in the MPyT context.

NOTE - A test system may be able to accommodate several MOTs.

A.1.2 Realization of a Lower Tester

A.1.2.1 Functions

A.1.2.1.1 For every SPyT Abstract Test Method (ATM) defined in ISO/IEC 9646-2, the primary focus for coordination and control of the test is the Lower Tester. The functions of the Lower Tester in SPyT are

a) to run executable test cases which are derived from abstract test cases;

b) to record the verdict and preliminary results for each test case in accordance with the ATS;

c) to control and observe the test events which are included in an abstract test case (these events include generation and receipt of PDUs, ASPs, generation and receipt of Test Management PDUs (TM-PDUs), events related to TCPs).

A Lower Tester is part of the real system, referred to as the test system. The test system and the SUT together provide the underlying service, below the lowest protocols in the IUT.

A.1.2.1.2 In the MPyT context, there may be several Lower Testers. Each Lower Tester performs the following functions:

a) to run, for each abstract test case, the part of the corresponding executable test case associated with a single Point of Control and Observation (PCO) (or with a set of PCOs which need to be handled together by the same Lower Tester);

b) to record the preliminary results as specified in the corresponding part of the abstract test case;

c) to control and observe the test events which occur and which are relevant to the corresponding part of the abstract test case

A.1.2.2 Lower Tester techniques

The entities in a Lower Tester, peer of the IUT, can be designed according to different techniques, for example:

a) encoder/decoder - simply encodes and decodes the ASPs and PDUs as required for the test case being run, without being an implementation of the protocol in question;

b) enhanced implementation - an implementation of the protocol concerned, modified by the addition of an error generator, configuration module or similar device to ensure that invalid or unusual ASPs or PDUs can be generated as required by the test case being run.

A.1.3 Realization of an Upper Tester

An MOT provides a realization of, or a specification of, the functions of an Upper Tester, according to the ATM used in the ATS.

The Upper Tester can take different forms, for example:

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a) a software implementation of the Upper Tester (which may or may not be independent of the design of the SUT and IUT), installed in the SUT above the IUT, with a mapping region that interfaces with the local realization of the ASPs;

b) a human operator - the functions of an Upper Tester are performed by a person having access to a user interface that maps onto the IUT service boundary and accesses and manipulates the realization of the appropriate ASPs;

c) a notional Upper Tester - *i.e.* the upper layers of the SUT are used to realize the functions of the Upper Tester, without any additional mechanism being installed; this can be used to realize the SPyT Remote test method and similar MPyT test methods.

A.1.4 Realization of TCPs between a Lower Tester and an Upper Tester

There are many ways in which the TCPs between a Lower Tester and an Upper Tester can be realized, *e.g.* with or without synchronization, with or without using a communication channel additional to the one used between the Lower Tester and the IUT, etc.

Several common types of TCP implementation for an Upper Tester can be identified:

a) human operator - the functions of an Upper Tester are performed by a person having access to a user interface that maps onto the IUT service boundary; this operator synchronizes with the Lower Tester, the progress of which can be detected by various means; *e.g.* via a set of prompting messages from a user interface of the Lower Tester;

b) scenario interpreter - the Upper Tester is realized by a remote scenario interpreter; it takes its instructions from files generated in conjunction with the Lower Tester installation, with a mapping region between it and the IUT service boundary;

c) TMP - the Upper Tester is synchronized with the Lower Tester by means of a TMP, which uses the service provided by the IUT and its underlying layers, and the corresponding functions of the Lower Tester.

A.1.5 Realization of the Lower Tester Control Function (LTCF)

In the MPyT context, the LTCF has the following functions:

a) to control the Lower Testers, and possibly also the Upper Testers, in accordance with the requirements of each relevant abstract test case;

b) to record the verdict and relevant preliminary results, if any, as specified in the corresponding part of the abstract test case.

The LTCF may need to be realized as a combination of software to be run in the test system and procedures to be fulfilled by human test operators.

A.1.6 Realization of Test Coordination Procedures (TCP) in Multi-Party Testing (MPyT) context

A.1.6.1 Communication between Lower Tester(s) and Upper Tester(s)

The realization of communication between Lower Tester(s) and Upper Tester(s) is described in A.1.4.

A.1.6.2 Communication between Lower Testers and the LTCF

Communication between Lower Testers and the LTCF can be realized in a variety of ways, either by direct connection within the test system, if they are all located in the same system, or by a completely separate link, which may use techniques similar to the TCP or TMP defined between LT and UT in ISO/IEC 9646-2.

A.1.6.3 Communication between Lower Testers

Realization of the communication between Lower Testers is similar to their communication with the LTCF.

If the Lower Testers are in separate test systems, the TCPs can be realized by some appropriate protocol.

NOTE - This method can be used when there is no Upper Tester, to test a relay system for instance.

A.1.6.4 Communication between Upper Testers

Upper Testers are local to the SUT (unless they are used in the Local test method or the equivalent within an MPyT context). Therefore, communication between Upper Testers is dependent upon the capabilities of the SUT. The TCPs might be realized in software or by the interaction of a human operator with the SUT.

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A.1.6.5 Communication between Upper Testers and the LTCF

Communication between the LTCF and Upper Testers should either be realized by communication via one of the Lower Testers or by human operator communication, as described in A.1.4 a).

A.1.7 The realization of a multi-protocol Means of Testing (MOT)

An MOT for a multi-protocol IUT should provide a derivation, selection and parameterization process for a multi-protocol ATS.

The selection of test cases should be realized by evaluating the selection expressions in the ATS according to the provisions of the ICS and IXIT of each protocol and information object covered by the ATS.

A.1.8 The realization of a Means of Testing (MOT) for a profile

An MOT for a profile is realized by using in sequence an MOT for each of the ATS referenced in the PTS-Summary.

In addition, there is a need for an MOT realizing the additional profile specific ATS from the PSTS, if any.

The deselection of test cases for a given ATS for a profile is done in two steps:

a) preselection of test cases appropriate for the profile: this preselection uses the list of applicable test cases supplied by the profile test specifiers in the PSTS (see ISO/IEC 9646-6);

b) deselection of test cases not appropriate for an IUT, based on the profile ICS and the profile IXIT.

NOTE - Test cases which are out of service may also be deselected by the test laboratory.

A.2 Additional guidance on the Executable Test Suite (ETS) derivation process

A.2.1 Overview

The derivation process can occur

a) during test realization;

b) during the installation of the MOT by the test laboratory;

c) during test preparation, intermixed with the selection and the parameterization processes, for a particular IUT;

d) during test operations, as a result of interpreting or compiling the ATS.

Figure 1 illustrates the many possibilities of combining the test derivation, selection parameterization and execution processes which are described in clause 5 (Test realization overview), and for which requirements are specified in clause 6.

When testing a profile, the PETS derivation / execution process has to be performed for each ATS which is referenced in the PTS-Summary.

A.2.2 Inputs to Executable Test Suite (ETS) derivation

The test realizer has to consider the following inputs:

a) the reference ATS specification for a particular component to be tested, and containing the specification of the TCPs;

b) the ICS proforma(s);

c) the partial IXIT proforma(s), normally attached to the reference ATS specification.

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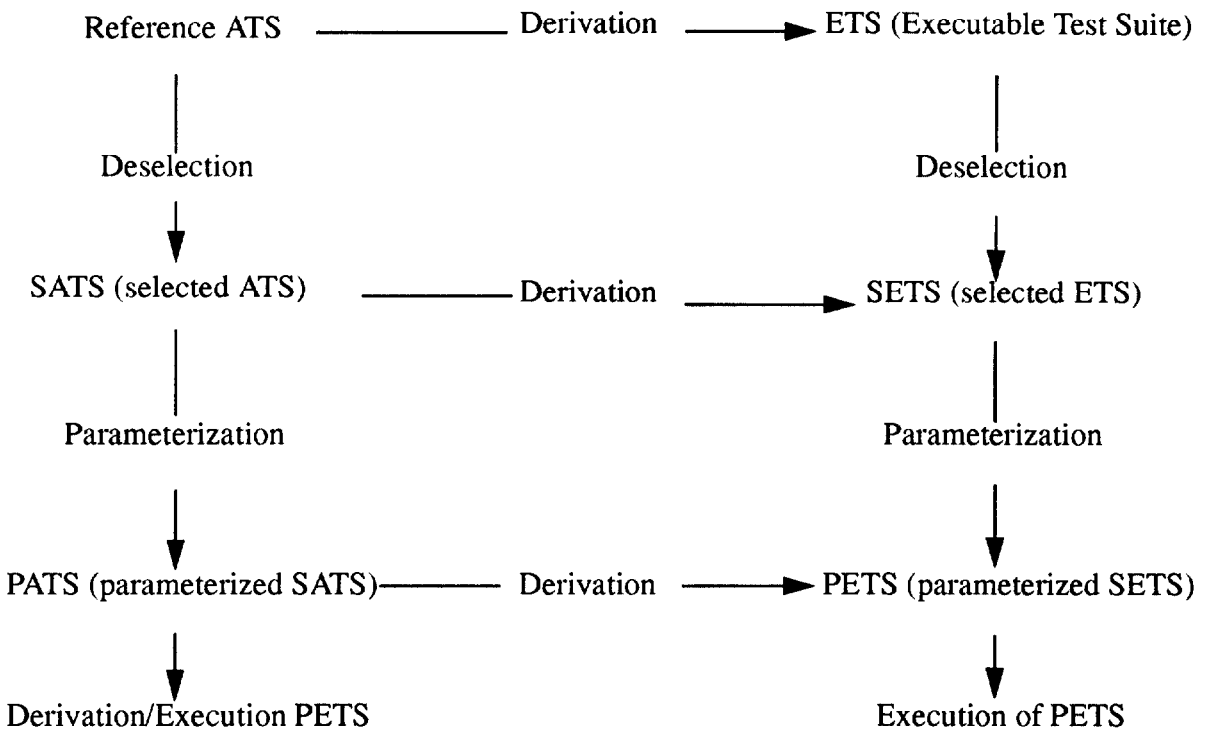

Figure 1 - The PETS derivation/execution process

A.2.3 Executable Test Suite (ETS) maintenance

Once the capability of executing a PETS has been implemented in an MOT, and the MOT is in use, the test realizer may receive problem reports from the test laboratories. Problems may arise with the execution procedures, or with conformance to the reference ATS specification. The test realizer should in such circumstances make available the appropriate corrections.

The test realizer should also provide an update of the MOT every time there is an update to the ATS specification (see also the final paragraph and note of 6.6).

A.3 Additional guidance on conformance log

In order to produce a conformance log it is necessary to

a) record the actual test events in their order of occurrence during the execution of the PETS;

b) analyse this information with respect to the relevant selected and parameterized abstract test cases, mapping the actual test events onto the abstract test events and recording all other necessary information.

There are requirements only on the information to be recorded in the conformance log, and how it is to be expressed.

The analysis of the ordered list of actual test events can be built into, and performed after the execution of, each executable test case; it may also be performed as a distinct process after the execution of the PETS, or performed by some combination of these techniques. The means of performing this analysis, and the timing of this analysis with respect to the execution of the PETS, are not standardized.

As specified in 6.4, the MOT shall have the ability to produce the conformance log on paper. It is also recommended that a machine-readable conformance log, with equivalent contents, be made available.

The process of producing the conformance log can be illustrated conceptually as in figure 2.

NOTE - It is intended that the test laboratory retains, as a minimum, either the ordered list of actual test events or the machine readable version of the conformance log.

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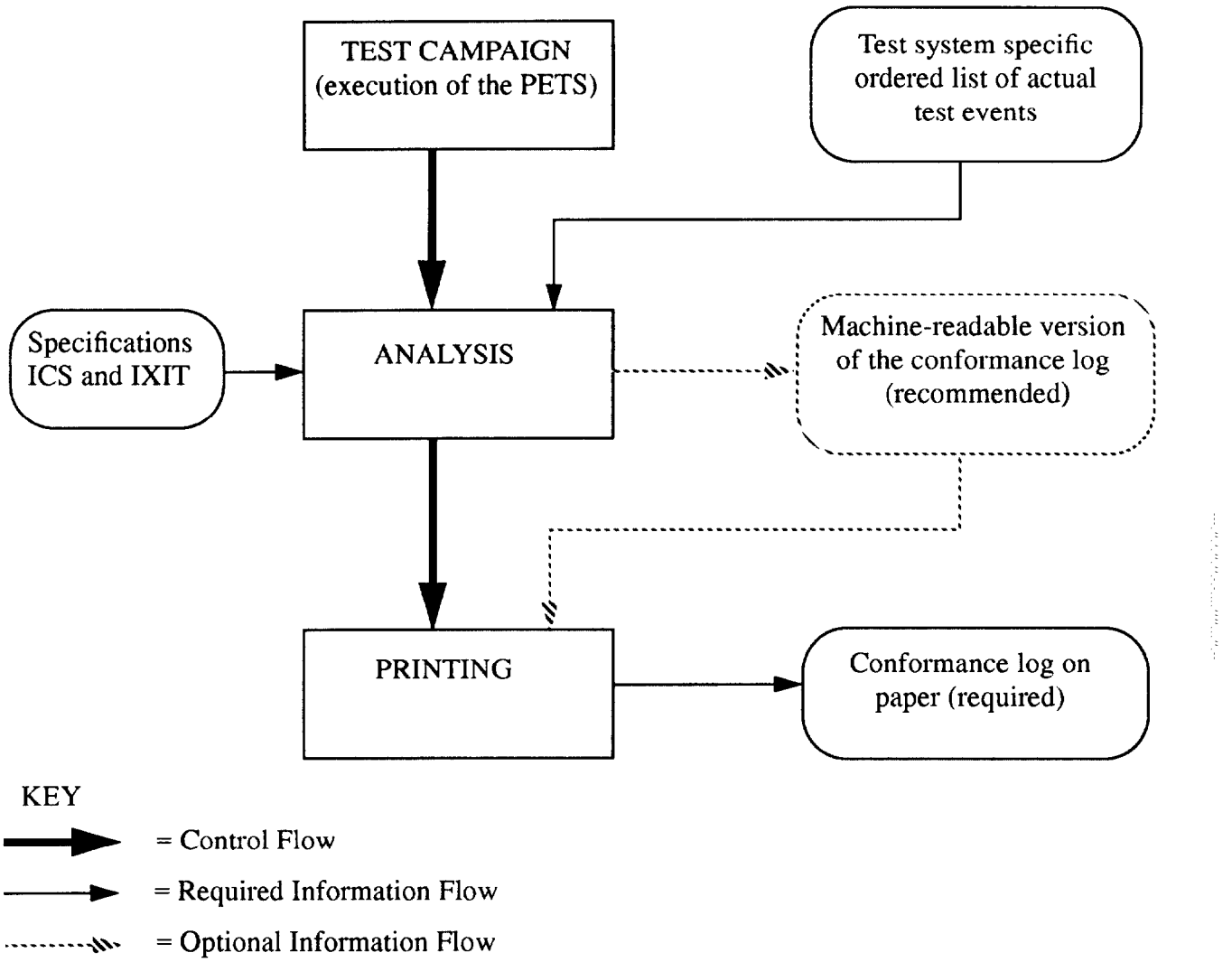

Figure 2 - Conformance log production

A.4 Additional guidance on documentation

A.4.1 Introduction

In addition to the requirements specified in 6.4 and 6.5, the preparation of the following documents is recommended:

a) test system information;

b) MOT description;

c) test laboratory client information;

d) test laboratory operating instructions.

A.4.2 Test system information document

An MOT is adapted to a specific test system. This document should contain the following information related to that test system:

a) type and configuration of the equipment;

b) operating system name and version number;

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c) name and version number of Lower Tester(s);

d) name and version number of the realization of the Upper Tester(s), if provided by the test realizers;

e) equipment and/or procedures necessary to link the test system to the IUT for testing purposes (*i.e.* service provider);

f) equipment and/or procedures necessary to link the Upper Tester(s), if any, to the IUT for testing purposes;

g) name, location and contact information for the organization responsible for maintaining and giving advice on the MOT (including the ETS).

A.4.3 Means of Testing (MOT) description document

This document should contain descriptions of the following aspects of the MOT, with respect to the reference ATS specification:

a) Lower Tester(s): a description of the executable test notation and its mapping onto the abstract test notation (for example, onto TTCN); a description of how the ASPs are controlled, observed and stored, and a demonstration that the method chosen realizes the sequencing rules laid down in the abstract test cases; a description of the LTCF in the case of MPyT context;

b) Upper Tester(s): a description of how the ASPs are controlled, observed and stored - except for the SPyT Remote test method and similar MPyT test methods - to show how the requirements on Upper Tester functions are met;

c) test coordination: a description of the mapping of the TCPs to their realization; the requirements for this are specified in the reference ATS specification;

d) communication between testers: a description of how the Lower Testers communicate between them, with the LTCF and with the Upper Testers;

e) selection process: a description of the use of the ICS and IXIT in deselecting abstract test cases not appropriate for testing the IUT;

f) parameterization process: a description of the use of the ICS and IXIT in parameterizing selected test cases for testing the IUT;

g) facilities to produce a conformance log.

A.4.4 Test laboratory client information document

In this document, the test realizer should provide the following information to enable the test laboratory to inform its client how to prepare the SUT for testing:

a) Upper Tester: if this component is supplied, a description of how to map its interface to the appropriate realization of the service boundary, any assumptions made about implementation of the service definition, or any assumptions made about the capabilities or resources available within the SUT; if the Upper Tester is not supplied, a description of how to implement it should be included; such a description includes the TMP if there is one; a description of how the UTs communicate;

b) test coordination: what the client has to do to implement the TCPs; a description of how to do any manual coordination between the SUT and the Lower Tester if this is necessary; any relevant timing information, *e.g.* the expected performance of the TMP;

c) underlying service: indicate that the client has to provide a sufficiently reliable (N-1) Service and, as far as possible, explain how this is to be achieved (without referring to a particular computer).

A.4.5 Test laboratory operating instructions document

In this document, the test realizer should provide information that will assist and guide the test laboratory in the execution of tests on the MOT, the diagnosis of problems and the re-running of tests if necessary. This should include:

a) test preparation: how to use ICS and IXIT to perform test deselection of the inappropriate test cases and parameterization of the selected ones on the MOT;

b) test execution: a description of how to run tests on the Lower Tester, and how to analyse the results;

c) execution control: the definition of the level of detail of control over the execution of test cases; the operating instructions should describe how test cases are executed and thereby implicitly define how many test cases may be executed as a single execution unit; an extreme case is when there is one single command for the entire test campaign (Basic Interconnection Tests, capability tests, and behaviour tests); the other extreme is when there is a command for every single test step in every single test case in the ETS;

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d) conformance logging: control of its execution; how the contents of the conformance log can be mapped back to the standardized test events in the reference ATS specification;

e) Upper Tester(s): a description of any initial confidence tests to be performed on the Upper Tester(s) and how to obtain the stored test events from the Upper Tester(s);

f) TCPs: a description of how to do any manual coordination among the Lower Tester(s), the Upper Tester(s) and, in the MPyT context, the LTCF.

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