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Foreword

This European Telecommunication Standard (ETS) has been produced by the Methods for Testing and Specification (MTS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS provides rules and guidance on how to develop telecommunications conformance testing specifications with the final objective to standardize them.

ETSI has explored innovative solutions for the long term, and at present, a "proposer" in harmonized approaches to the pressing requirement of developing testing standards in various areas of telecommunications. It is also essential that ETSI remains aware of what is going on in the information technology area outside ETSI, in close relations with its own technical activities.

The production of conformance testing standards in ETSI has already started in various technical areas, and needs to be continued with the best harmonization of efforts.

ETSI TC-MTS recommends that the TC and STC chairmen in their role of co-ordinators of standard development ensure that the groups of experts working in conformance testing in their bodies are fully aware of the status of affairs in this area so that initiatives are co-ordinated properly. Special care should be devoted to the consistency of the methodology used (test specifications' structure, test notations, criteria for acceptance, etc.), to the need of not duplicating efforts and to the strategy of improving convergence for testing at the European and international levels.

With the co-operation of all ETSI members, an initial orientation towards a harmonized approach to conformance testing standards and practice is desirable and possible. This is why the TC MTS work program includes the production of a comprehensive methodology guide that will represent a further step forward in harmonization and consistency.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	31 July 1995
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	31 January 1996
Date of withdrawal of any conflicting National Standard (dow):	31 January 1996

Introduction

This ETS is one element of a series of documents produced during 1992 and 1993 by ETSI. These ETSs will provide a reference library of rules and guidance on how to standardize telecommunications conformance testing specifications in Europe. These rules and guidance take into account the state of the art, the international and European standards and reports already published on that matter, the specifics of test suite editing, and the practices of the ETSI and CEN secretariats for the production of European standards.

Although this ETS has been produced in order to become a reference document for ETSI, it is designed to be used in a wider European context, for example, as a technical basis for accreditation and specification purposes, as well as for European Commission initiated conformance testing programmes, e.g. the Conformance Testing Services (CTS) programme.

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1 Scope

This European Telecommunication Standard (ETS) specifies a methodology for developing telecommunications conformance testing specifications with the final objective to standardize them.

This ETS defines the components to be produced when specifying a European conformance Testing Standard (TS) in the domain of telecommunications.

The methodology specified in this ETS is, in principle, applicable to domains other than telecommunications, e.g. Open Systems Interconnection (OSI). However, the limits of such an application of the methodology outside telecommunications testing are not defined, and each group defining test specifications are responsible for deciding if any part of this methodology is applicable.

This methodology applies to conformance TSs for protocols, for profiles, for information objects, for interfaces, and for services.

NOTE 1: The methodology of this ETS is generic, in the sense that it applies to protocols, to profiles, to information objects, etc. Following the example of ISO/IEC 9646 (references [5] to [12]), the terminology employed is also generic, e.g. Implementation Conformance Statement (ICS), Implementation eXtra Information for Testing (IXIT). However, in order to avoid confusing the readers who are familiar with the protocol-related terminology, the non-generic terms (Protocol Implementation Conformance Statement (PICS), Protocol Implementation eXtra Information for Testing (PIXIT), etc.) have been kept in the titles of clauses and subclauses.

The test of physical aspects, such as "layer 1", analogue measurements, Electro-Magnetic Compatibility (EMC), is not covered by this ETS. However, part of the methodology may be still be applied, e.g. the concepts of ICS, IXIT, Test Purposes (TPs), and Test Suite Structure (TSS).

This ETS provides the rules for standardization bodies developing telecommunications conformance TSs.

NOTE 2: One objective of this ETS is the use, when relevant, within standardization bodies. For this purpose, within ETSI, it has the same value as an internal Technical Committee Reference Technical Report (TCR-TR).

This ETS is applicable to organizations such as Conformance Testing Services (CTS) programmes, pre-standardization institutions, private institutions, which develop conformance testing specifications with the objective of contributing them for the purposes of European telecommunications standardization.

This ETS contains two types of information, following a twofold objective:

- it **clarifies** the principles of the ISO/IEC 9646 (references [5] to [12]) testing framework and methodology, as well as the concept of profile;
- it **defines additional criteria** for European telecommunications TSs, whereby it constitutes a "European telecommunications profile" of the ISO/IEC 9646 (references [5] to [12]) methodology, containing its own recommendations.

This ETS is consistent with the normative references listed in clause 2. This ETS extends the current principles contained in ISO/IEC 9646 (references [5] to [12]), in particular in the field of the combination of TPs, and concerning the choice of a single Abstract Test Suite (ATS).

For conformance testing in the "voluntary domain" (i.e. outside the regulatory domain), for instance by the suppliers to support their commercial claims for conformance, TSs are normally published as I-ETS, or ETS, depending on their role and their maturity.

This ETS addresses telecommunications TS methodology for the voluntary domain.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETR 153: "Methods for Testing and Specification (MTS); Guidance on the production and completion of System Conformance Test Report (SCTR) and Protocol Conformance Test Report (PCTR) proformas".

[2] ETR 141: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; The Tree and Tabular Combined Notation (TTCN) style guide".

[3] PNE-Rules (1991): "CEN/CENELEC Internal Regulations - IR; Part 3: Rules for the drafting and presentation of European Standards (PNE-Rules)".

[4] EN 45001 (1989): "General criteria for the operation of testing laboratories".

[5] ISO/IEC 9646-1 Edition 2 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts" (including DAM1 and DAM2, to be published).

[6] ISO/IEC 9646-2 Edition 2 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 2: Abstract Test Suite Specification" (including DAM1 and DAM2, to be published).

[7] ISO/IEC 9646-3: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 3: The Tree and Tabular Combined Notation".

[8] ISO/IEC 9646-3 AM 1: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 3: The Tree and Tabular Combined Notation. Amendment 1: TTCN Extensions (concurrent TTCN)".

NOTE 1: ISO/IEC 9646-3 AM 1 will be included in the next edition of ISO/IEC 9646-3, which will contain TTCN and concurrent TTCN in the same standard.

[9] ISO/IEC 9646-4 IS Edition 2: (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 4: Test Realisation" (including DAM1 and DAM2, to be published).

[10] ISO/IEC 9646-5 IS Edition 2: (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 5: Requirements on test laboratories and clients for the Conformance Assessment Process" (including DAM1 and DAM2, to be published).

[11] ISO/IEC 9646-6 IS (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 6: Protocol Profile Test Specification".

[12] ISO/IEC 9646-7 DIS (1993): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statements".

NOTE 2: The clauses of ISO/IEC 9646 (references [5] to [12]) referenced in this ETS are from edition 2: 1994 (unpublished). Although the contents of ISO/IEC 9646 have changed, it is useful to know the references to edition 1: 1991. The correspondence is as follows:

Edition 1: 1991	Edition 2: 1994
Part 2, clause 12	Part 2, clause 11
Part 1, annex B	Part 2, annex A

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, all the definitions in ISO/IEC 9646 (references [5] to [12]) apply.

In addition, the following definitions apply, or have been re-formulated for clarification:

Abstract Test Method (ATM) (Abstract Testing Method): Definition of ISO/IEC 9646-1 [5], subclause 3.3.5, applies.

NOTE 1: The ISO definition, complemented with the explanation of ISO/IEC 9646-2 [6], subclause 11.1.7, properly specifies that the ATM contains "enough detail to enable Abstract Test Cases (ATCs) to be specified for this test method". This means that the ATM is a detailed description of the testing architecture. Conversely, the four methods for Single Party Testing (SPyT) context, Remote, Local, Distributed, Coordinated, are called **ATM categories**.

Abstract Test Suite (ATS): Definition of ISO/IEC 9646-1 [5], subclause 3.3.6, applies.

NOTE 2: Confusion should be avoided between the ATS (collection of test cases, written in Tree and Tabular Combined Notation (TTCN)), and the **ATS specification**. The ATS is just one component of the ATS specification.

ATS specification: Definition of ISO/IEC 9646-1 [5], subclause 3.3.7, applies.

NOTE 3: The ATS is just one component of the ATS specification. The list of components of an ATS specification is specified in ISO/IEC 9646-2 [6], clause 14, and in this ETS clause 7.

ATM category: One of the four families of ATM defined in ISO/IEC 9646-2 [6], for SPyT: Remote, Local, Distributed, Coordinated.

NOTE 4: The term ATM category is not an ISO/IEC 9646 term. However, it is in line with ISO/IEC 9646, see ISO/IEC 9646-2 [6] subclause 11.3.1.

base specification: A specification of a protocol, telecommunication service, interface, abstract syntax, encoding rules, or information object.

NOTE 5: This definition extends the definition in ISO/IEC 9646-1 [5], subclause 3.3.10, to telecommunication services and interfaces.

NOTE 6: A base specification is anything that can be profiled. A base specification is defined by opposition to a **Profile**, which constrains optionalities in one or several base specifications.

NOTE 7: Confusion should be avoided between base specification (on which a profile can be based), and reference specification, which is the reference to a testing specification.

base specification ICS: An ICS related to a base specification. A PICS is a particular case of base specification ICS, applied to base specifications of protocols.

base specification TS: A base specification TS is a conformance TS specified for a base specification.

base standard: A standardized base specification, e.g. as an ITU-T Recommendation, an ISO standard or an ETS.

component (of a profile): A component of a profile is a single protocol, telecommunication service, or interface, or a combination of one or more protocols, telecommunication services, or interfaces, with zero or more information objects upon which a profile is based and which are to be tested in combination.

NOTE 8: Definition of ISO/IEC 9646-6 [11], clause 3, is extended to telecommunication services and interfaces.

functional subset (of a protocol): A grouping of protocol features (Protocol Data Units (PDUs), mechanisms), that is specified in a protocol specification, and that realizes a protocol function. The functional subsets of a protocol do not overlap and their sum covers the total function of the protocol. An example of a functional subset is a role, like responder and initiator. As far as testing is concerned, a functional subset can be tested with a single test configuration.

reference specification: It is a standard which specifies a base specification, or a set of base specifications, or a profile, or a set of profiles, and for conformance against which test specifications are written.

reference standard: Synonymous to reference specification.

Testing Standard (TS) or **conformance TS:** A document, or a set of documents, containing a conformance testing specification.

Test Management Protocol (TMP) specification: A document containing the TMP, and a TMP implementation statement proforma.

untestable TP: A TP that cannot generate an ATC for a given ATM.

3.2 Terms which can cause confusion

Derivation: The word **derivation** (and its derivatives) should be used carefully, because it may have several meanings:

a) a TP is **derived** from a conformance requirement;

b) a Test Suite Structure & Test Purposes (TSS&TP) is **derived** from a base specification or from a profile specification;

c) an ATC is **derived** from a TP;

d) an ATS is **derived** from a TSS&TP;

e) an executable test case is **derived** from an ATC;

f) an Executable Test Suite (ExTS) is **derived** from an ATS.

Therefore, the meaning should be determined in accordance with each context.

NOTE: The meanings given in e) and f) are not used in this ETS.

Entry: The term **Entry** (e.g. in a PICS proforma) shall not be used. It is ambiguous and was dropped from ISO/IEC 9646-7 [12]. Instead, the terms **Item**, **Question**, **Status (value)**, **(support) Answer** should be used. Their definition is in ISO/IEC 9646-7 [12], clause 3.

3.3 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

ACSE	Association Control Service Element
AOW	Asian Oceanian Workshop
ASP	Abstract Service Primitive
ATC	Abstract Test Case
ATM	Abstract Test Method
ATS	Abstract Test Suite
CMIP	Common Management Information Protocol
CTP	Combined Test Purpose
CTR	Common Technical Regulation
CTS	Conformance Testing Services
DECT	Digital European Cordless Telephone
DIS	Draft International Standard
EG	Expert Group (EWOS term)
EMC	Electro-Magnetic Compatibility
ETS	European Telecommunication Standard

NOTE 1: The acronym for an Executable Test Suite should be avoided, because it introduces a confusion with an ETS in ETSI. However, in this ETS, an Executable Test Suite is abbreviated by "ExTS" (see below).

ETG	EWOS Technical Guide
ETR	ETSI Technical Report
ExTS	Executable Test Suite

NOTE 2: Although possible, the use of "ExTS" is discouraged, and the use of the full expansion "Executable Test Suite" is recommended.

FTAM	File Transfer Access and Management
ICS	Implementation Conformance Statement
ISDN	Integrated Services Digital Network
IT & T	Information Technology and Telecommunication
ITSTC	Information Technology Steering Committee
IUT	Implementation Under Test
IXIT	Implementation eXtra Information for Testing
MHS	Message Handling Service
MMS	Manufacturing Message Services
MOT	Means Of Testing
MPyT	Multi-Party Testing methodology
OIW	Open Systems Environment Implementors' Workshop
OSI	Open Systems Interconnection
PAP	Public Access Profile (DECT)
PCO	Point of Control and Observation
PCTR	Protocol Conformance Test Report
PDU	Protocol Data Unit
PETS	Parameterized Executable Test Suite
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
PSDN	Public Switched Data Network
PSTS	Profile Specific Test Specification
PTS	Profile Test Specification
RL	Requirement List
SCS	System Conformance Statement
SCTR	System Conformance Test Report
SOGITS	Senior Official Group for Information Technology Standardization
SOGT	Senior Official Group for Telecommunication
SPyT	Single Party Testing
SUT	System Under Test
TBR	Technical Basis for Regulation
TCP	Test Co-ordination Procedures
TM-PDU	Test Management Protocol Data Unit
TMP	Test Management Protocol
TP	Test Purpose(s)
TS	Testing Standard
TSS	Test Suite Structure
TSS&TP	Test Suite Structure & Test Purposes
TTCN	Tree and Tabular Combined Notation
TTCN.GR	TTCN Graphic Rendition
TTCN.MP	TTCN Machine Processable
VT	Virtual Terminal
XRL	eXtra Requirement List

4 Introduction to conformance testing

4.1 What is conformance testing?

4.1.1 Context and history of conformance testing

Although everybody is convinced that testing is an essential development step in a modern industrial environment, the testing activities can easily become a matter of contention between the tester and the developer. To prevent any dispute, it has become a good practice, in the Information Technology and Telecommunication (IT & T) area, to have initial agreements on the test of a product, as early as the product itself is specified. The developers and the testers specify together, and approve, the test criteria and the test procedures to be applied at each step.

When the product is to include an implementation of a set of international standards specifying communications protocols issued by ISO, ITU-T, ETSI, CEN, etc. it becomes possible to specify the test criteria and procedures with a quality comparable to that of the protocol standards themselves.

Since 1983, there is a world-wide consensus on how to achieve this: develop, in the same open and voluntary environment as the protocols themselves, a general conformance testing methodology, applying to all protocols, plus a collection of conformance TSs to cover all protocols.

This is being achieved via:

- the standardization of a common testing methodology, which has reached a good level of stability and a wide applicability (test of protocols, of objects, generalization of the concept of ICSs, multi-party testing, profile testing);

- the world-wide and European determination to publish standardized conformance testing specifications, as the technical basis to certification systems.

The standardization of conformance testing covers the methodology and the test specifications accompanying the reference standards. It does not cover the test tools.

Conformance testing is also used as a basis for terminal equipment approval, within the framework of the European Directive 91/263/EEC (commonly known as the Terminal Directive). Parts of the test specifications are then referenced by regulatory documents, called Common Technical Regulations (CTRs).

4.1.2 Scope of conformance testing

Conformance testing is concerned with the assessment of the extent to which an implementation or system conforms to a specification.

It should be emphasized that exhaustive testing is impractical on both technical and economical grounds - and even theoretically impossible - and that, therefore, conformance testing cannot guarantee conformance to a specification.

Conformance testing is **not** concerned with the validation of the protocol specifications, nor with the assessment of performance, reliability, robustness, unless explicitly stated as a conformance requirement in the reference specification.

Conformance testing shall not add constraints in addition to standards. Conformance testing means testing against the conformance requirements (see subclause 4.2.1) in the standards. The publication of conformance TSs shall not be an indirect means to constrain a technology more than the reference standards themselves do.

4.2 Conforming implementation

According to ISO/IEC 9646-1 [5], a Conforming Implementation "satisfies both static and dynamic conformance requirements (see subclause 4.2.1 of this ETS), consistent with the capabilities stated in the ICS (see subclause 4.2.2 of this ETS)".

It is essential to distinguish between a conformance requirement (part of a standard) and a conformance statement (accompanying an implementation).

4.2.1 Conformance requirement

A conformance requirement is an elementary piece of a specification, stating what an implementation is required to do or not to do.

A conforming implementation satisfies the conformance requirements contained in the specification.

ISO/IEC 9646-1 [5], subclause 5.2, clarifies the notion of conformance requirement, by distinguishing:

- mandatory, conditional, or optional conformance requirements;

- positively or negatively stated conformance requirements;

- static and dynamic conformance requirements.

ISO/IEC 9646-1 [5], subclauses 5.3 and 5.4, defines dynamic and static conformance requirements:

- "Dynamic conformance requirement: one of the requirements which specifies what observable behaviour is permitted by the relevant specification(s) in instances of communications";

- "Static conformance requirement: one of the requirements that specifies the limitations on the combinations of implemented capabilities permitted in a real open system which is claimed to conform to the relevant specification(s)".

4.2.2 Conformance statement

A conformance statement is associated with an implementation or a system.

A supplier states in a conformance statement which type of conformance is claimed for an implementation or system.

A conformance statement is the result of the filling of a dedicated proforma, ICS or System Conformance Statement (SCS) proforma, by the supplier.

4.3 Technical objectives of conformance testing

For communication products, the chief objective of conformance testing is to increase the probability that different implementations of the same standard will interoperate.

NOTE 1: In the regulatory sector (i.e. type approval of terminal equipment in the framework of the European Directive 91/263/EEC), conformance testing aims at ensuring that:

- terminal implementations will not harm the public network;
- terminal implementations will interoperate with the public network to the extent for the purpose of establishing, modifying, charging for, holding and clearing connection;
- terminal implementations will interoperate via the network, in justified cases.

Conformance testing will provide a certain degree of confidence that a product implementation has the required capabilities according to the relevant standards. It will not be exhaustive, due to technical and economic limitations.

NOTE 2: Clearly, the higher degree of confidence a conformance test will offer, the more expensive it will be (e.g. the more test cases the test suite will contain). The art of the conformance test specifier resides in finding the good compromise, so that the test campaigns provide a reasonable level of confidence at a reasonable cost. Optimization will be sought: best ratio coverage/cost.

4.4 The need for standardized test specifications

This ETS takes into account the following recommendations from ETSI/EWOS/PT005, endorsed by the European Commission Senior Official Group for Telecommunication (SOGT) and the Senior Official Group for Information Technology Standardization (SOGITS) in 1991:

a) "European certification requires mutual recognition, which implies harmonized test reports and standardization of test specifications." (subclause 2.3.1-1 of the PT005 technical report).

b) "Recognition arrangements (in the European certification system) need the standardization of test specifications for the demonstration of equivalence on which harmonization is based."

   "Common test specifications and harmonized test systems which are developed in accordance with these common test specifications are therefore the basis for harmonized test services." (subclause 2.3.1-2 of the PT005 technical report).

c) "Standardization of test specifications is important for accreditation bodies in order to properly assess that test laboratories use the ExTSs in accordance to the test specification requirements." (subclause 2.3.1-3 of the PT005 technical report).

d) "To achieve equivalent test reports and equivalent certificates between the different European test laboratories and certification bodies, standardization of test specifications on which tests are based appears essential." (subclause 2.3.1-4 of the PT005 technical report).

e) "Standardization of test specifications will provide a common starting point and lead to a beneficial public debate between suppliers, users, test laboratories and certification bodies."

   "Test tool developers, test labs and suppliers need standardized test specifications because they reduce the investment in different products and improve the economics on maintenance and support of their test tools and services." (subclause 2.3.1-5 of the PT005 technical report).

f) "ISO/IEC 9646 (references [5] to [12]) should be adopted as a European standard, so that all European conformance testing activities are aligned with the stable part of the international state of the art."

"Public availability of high quality up-to-date test specifications is indeed critical. This means standardized test specifications. Any infrastructure built-up for conformance testing in the OSI and telecommunications area is useless if the development and issuance of test specifications standards is not actively pursued."

5 Conformance testing applied to base specification or to profile

Reading guide:

- if testing against a base specification is undoubtedly concerned, go to clauses 6 and 7;

- if testing against a profile is undoubtedly concerned, go to clauses 8 and 9;

- if it is not clear whether testing against a base specification or testing against a profile is concerned, read this clause.

The difference between base specifications and profiles is a matter of structure of the documents which specify the technology that will be tested.

In the case of a base specification, it is a "one-shot" definition. A technology is specified in a standard or in a set of standards which tackle the different aspects of the technology.

In the case of a profile, it is a definition in several stages (generally two): the profile refines a technology specified in a base specification (or several base specifications). The test specification will reflect this structure (base + refinement), with the objective to identify the tests which apply to base specification only, to profile only, to both base specification and profile.

In order to decide between base specification testing and profile testing, two questions need to be examined:

a) identification of profiles: do profiles exist for the technology to test?

b) choice of target for test specifications: if profiles have been identified, is it required to produce test specifications for the base specification, or for the profile?

5.1 What is a base specification?

As defined in subclause 3.1, a base specification is a specification (generally standardized) of a protocol, telecommunication service, interface, abstract syntax, encoding rules, or information object.

A base specification is anything that can be profiled. A base specification is defined by opposition to a **profile**, which constrains optionalities in one or several base specifications.

5.2 What is a profile?

A profile identifies a consistent set of chosen options from a base specification or from a set of base specifications, in order to provide a given function in a given environment.

By restricting choices among the options available in the base specifications, a profile increases the probability that systems will interoperate, i.e. perform together the given function to which the profile is aimed at.

The base specifications upon which a profile is based are called components of this profile.

The concept of profile is twofold (this sometimes induces confusion):

- multiplicity: a profile may retain options in a set of base specifications;

- refinement: a profile restricts the choices of options in the base specifications. It may also specify additional conformance requirements.

In other words, a profile specifies a superset of subsets of base specifications.

Generally, a profile will comprise these two dimensions (multiplicity, refinement). It is the case, for instance, of OSI profiles which retain options in the different layers of the OSI model. These profiles are often represented by a "brick-wall" figure:

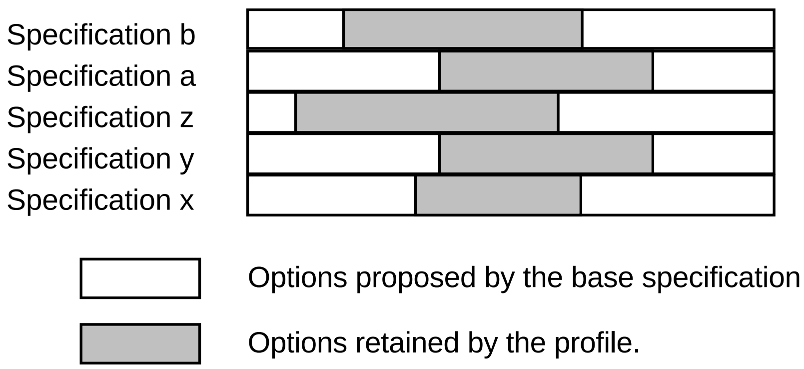

Figure 1: Profile concept on a layered model

An extreme is the profile which only refines a base specification (no multiplicity): Such a profile is restricted to only one base specification. Here, the difference between the base specification and the related profile(s) mainly concerns the support of optional elements. The profile may also impose additional technical normative requirements.

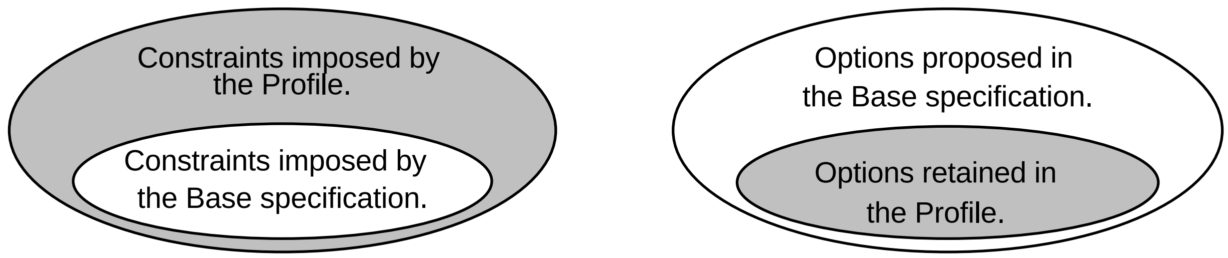

Figure 2: A profile which only refines one base specification

Another theoretical extreme is the case of a profile which does not constrain any options, but only specifies a set of base specifications which should be implemented jointly (multiplicity, no refinement). Such an extreme is rare.

The profile approach may be repeated: successive requirements may be added by profiles of profiles. This means that, in the general case, a profile may constrain options in base specifications, but also in other profiles. A profile upon which other profiles are based is often called a common profile.

Profiles are defined in ISO/IEC 9646-6 [11], with the following characteristics:

A profile shall:

- identify the base specifications belonging to it;

- make specific choices among options and range of values available in each base specification.

A profile shall not:

- contain any requirement contradicting with the base specifications ones (e.g. a parameter mandatory in the base specifications cannot be optional in the profile);

- contain a restriction on dynamic conformance requirements in reception.

A profile may:

- contain conformance requirements more specific and limited in scope than those of the base specifications.

From a procedural point of view, and in the Information Technology and Telecommunication (IT&T) area, the principles of the European functional standardization are defined in memorandum M-IT-01.

5.3 Examples of profiles

5.3.1 In EWOS, CEN/CENELEC

In EWOS/CEN (mainly the OSI technical area), profiles are generally European profiles of international (ISO) standards, refining these international standards according to the European requirements, and selecting them according to specific functions aimed at (profiles used to be called functional standards).

These profiles are defined in memorandums M-IT-01 (general) and M-IT-02 (a directory, updated at intervals) issued by the Information Technology Steering Committee (ITSTC).

These European profiles are divided into:

a) application profiles (layers 5 to 7): A;

b) telecommunications profiles (layers 1 to 4): T;

c) relays (R), data stream (Q), characters (S), etc.

The regional activities are mainly aimed at creating international harmonization.

This is done through co-operation between EWOS, the Open Systems Environment Implementors' Workshop (OIW) and the Asian Oceanian Workshop (AOW).

EXAMPLES:

M-IT-02 codes and EN/ENV		Name of profile
- A/FT11	41204	File Transfer Access and Management (FTAM) - "Simple File Transfer (unstructured)"
- A/FT3	41205	FTAM - "File management"
- A/3211	41201	Message Handling Service (MHS) 1984 - private/public to public
- A/MH12	n/a	MHS 1988 - User Agent to Message Store
- T/C12	41105	Tr. classes 0-2 on Public Switched Data Network (PSDN), switched access

5.3.2 In ETSI

In ETSI, the notion of profiles generally arises from a complex structure of ETSI standards, the ones refining options of the others; often, both the profiles and the base specifications referred to in the profiles are ETSI standards; the "base specifications" of ETSI profiles may also be ITU-T Recommendations.

An ETSI profile does not always follow a "layered" approach.

In ETSI, a profile is not always identified as such. Being aware that a standard in reality specifies a profile is essential in order to specify conformance testing for it.

EXAMPLES:

ETS 300 173-1 to 8: Digital European Cordless Telephone (DECT) is a base specification, defining an "air interface standard, allowing to design systems that can provide cordless telecommunications in different contexts".

ETS 300 173-9: DECT Public Access Profile (PAP) defines the technology in order to provide interoperability between different manufacturers for voice telephony.

ETS 300 075: Videotex processable data specifies a protocol for file transfer.

Under development: is a "File Transfer over Integrated Services Digital Network (ISDN)" profile, aiming at "selecting the parameters carried by lower layer protocols (e.g. code points for HLC, LLC, etc.)", and at "selecting facilities offered by the File Transfer protocol described in ETS 300 075 and EN 41 216 (ISP 10607) "Simple FTAM". Selection of the appropriate parameter values in order to have an option free kernel protocol."

In the last example, the term "profile" does not appear anywhere. It is, however, a real profile definition.

5.4 Structure of a profile specification

Physically, a profile specification is a document which specifies conformance requirements, where possible, by reference to the conformance requirements of the referenced base specifications.

A profile specification may also contain conformance requirements specific to the profile, concerning the domains covered by the base specifications (e.g. tackling a given protocol), and conformance requirements not related to a given protocol (e.g. inter-layer dependencies).

The following figure illustrates the structure of a profile specification on the example of several protocols. The dotted ellipses mean "inclusion by reference of a selection of requirements".

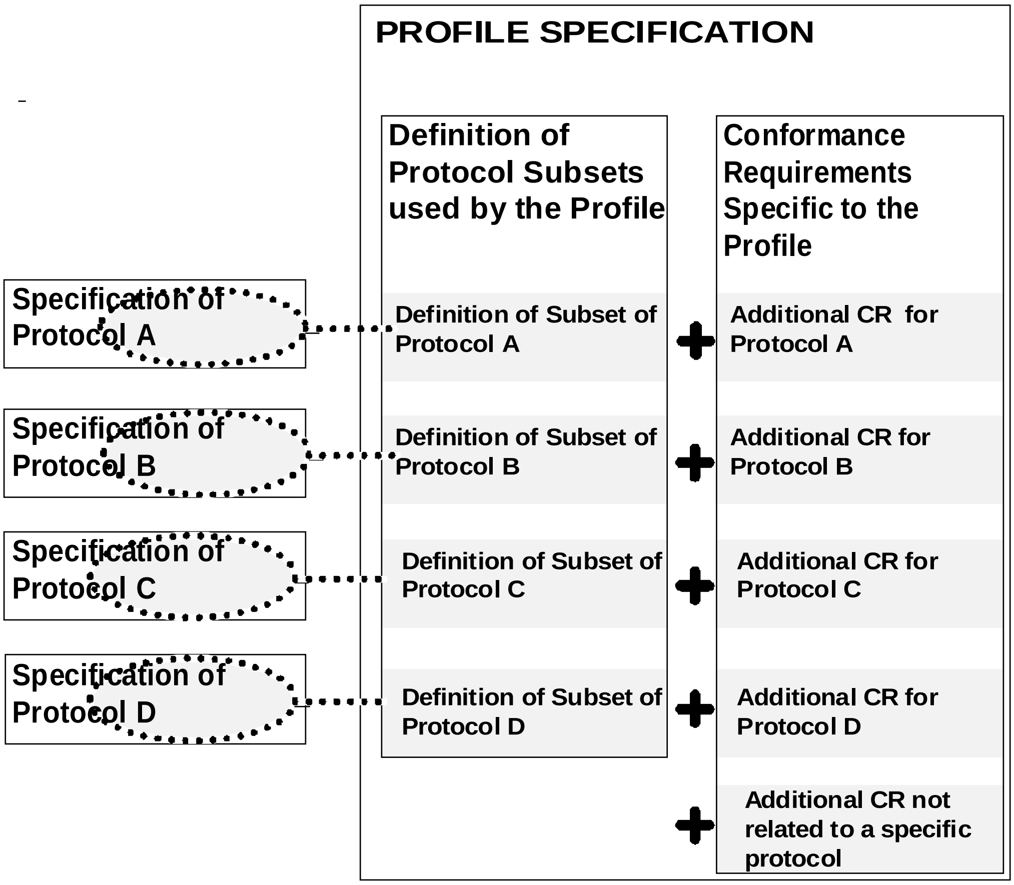

Figure 3: Specification of a profile made of protocols

5.5 Conformance to a profile

ISO/IEC 9646-6 [11] specifically deals with protocol Profile Test Specifications (PTS). ISO/IEC 9646-6 [11] clause 6 describes the meaning of conformance to a profile.

Conformance to a profile means conformance to the retained options in the set of base specifications which it references. Hence, conformance to a profile implies conformance to the set of base specifications.

However, conformance to the set of base specifications does not necessarily imply conformance to the profile.

5.6 Conformance testing applied to base specification

This is the simple case: the straightforward application of the methodology specified in ISO/IEC 9646, Parts 1 to 5 (references [5] to [10]) and Part 7 [12].

The test cases in the conformance testing specification directly apply to the conformance requirements in the base specification.

The components of a test standard for a base specification are shown in clause 7 of this ETS.

5.7 Conformance testing applied to profile

The originality comes from the fact that the test specification reflects the structure "base + refinement", with the objective to identify the tests which apply to base specification only, to profile only, to both base specification and profile.

The PTS is specified, where possible, by reference to test cases of the base specification test specification, exactly as the profile was specified, where possible, by reference to the conformance requirements of the base specification[1)].

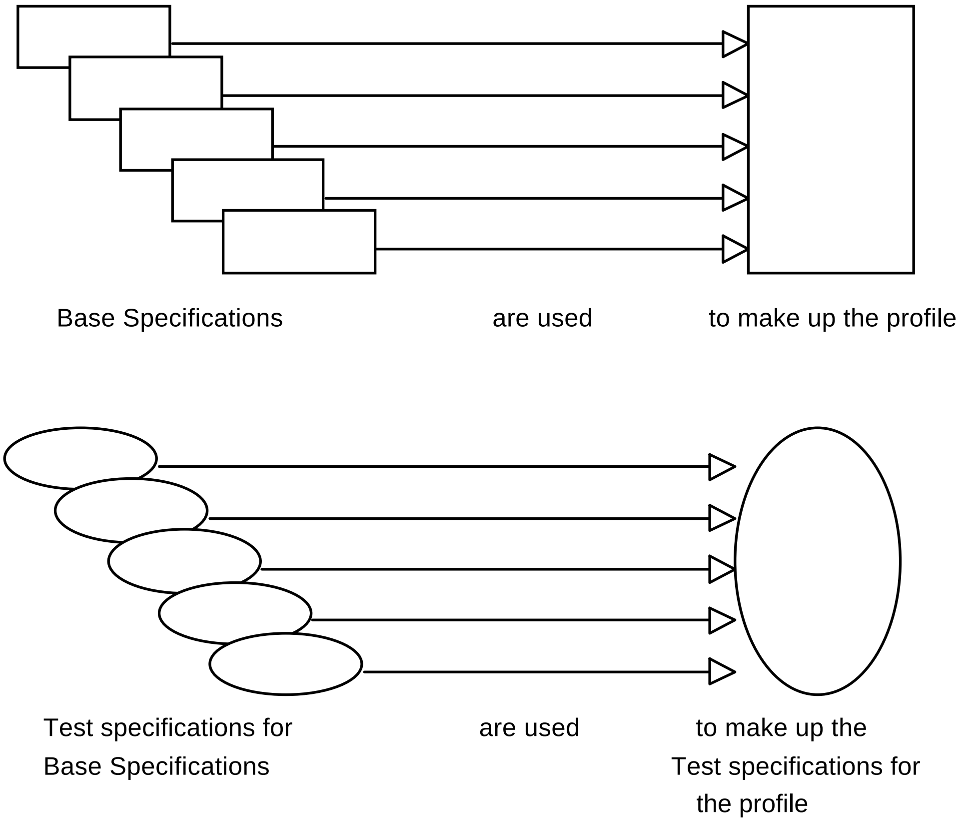

Figure 4: PTS specified from base specification test specifications

A PTS will thus contain material defining how to use the test specifications for the base specifications, and additional material specific to the profile.

The components of a test standard for a profile are shown in clause 9 of this ETS.

5.8 Decision criteria: base specification of profile testing?

It is essential to clearly determine, at the beginning of a conformance testing project, if the test specifications have to be produced for base specifications or for profiles. This is under the responsibility of the ETSI Technical Committee, or EWOS Expert Group (EG), which steers the project.

NOTE 1: In the case of EWOS, only profiles are concerned.

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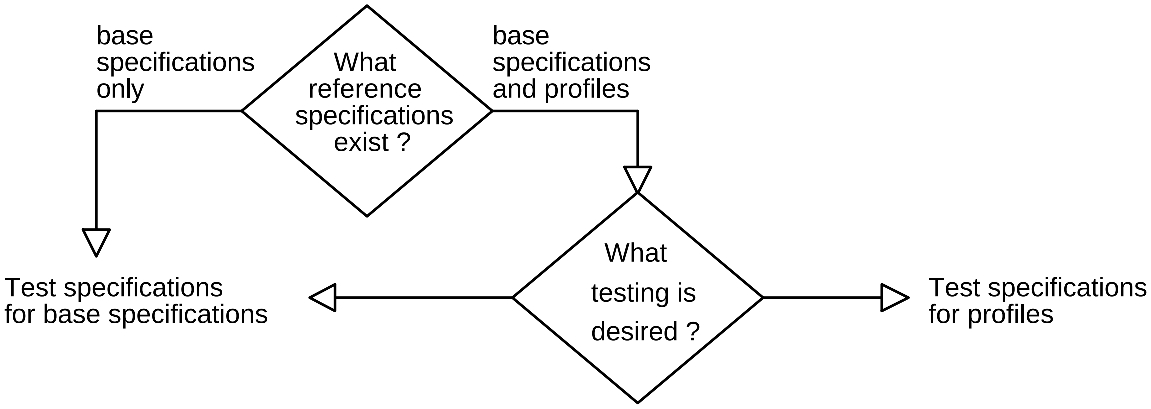
1) And what happens if a profile test specification has to be produced, while no test specification pre-exist for the base specification? See subclause 9.1.

In order to decide between base specification testing and profile testing, two questions need to be examined:

a) identification of profiles: do profiles exist for the technology to test? In other words: What are the reference specifications?

b) choice of target for test specifications: if profiles have been identified, is it required to produce test specifications for the base specification, or for the profile?



5: What kind of test specifications have to be produced?

The second question "What testing is desired?" is not simple; if profiles exist (and, hence, also the base specifications upon which the profiles are based) what is desirable as a test specification?

In theory, both should be produced: test specifications for base specifications; and test specifications for profiles.

In practice, the following recommendations should be applied:

Recommendation 1: When profiles exist, the priority of the development of abstract test specifications is the coverage of profiles.

Recommendation 2: Test specifications for the base specifications are needed when other profiles exist or are likely to exist in the future.

Test cases specified in the context of a given profile may be applicable in the context of another (or a future other) profile. Re-use of test cases should not be prevented by the definition of an ATS in a profile-specific context.

However, this does NOT mean that the test cases should be modified or made more complex in order to apply to more than one profile. It means that, when a test case may apply to several profiles, this should be clearly identified as soon as possible, and that the profile testing methodology shall be used. In particular, base standard testing methodology (for instance writing a PICS for a profile) shall never be applied to a profile.

The concrete application of **Recommendation 2** when it is required to produce test specifications for one given profile is the following:

Recommendation 3: When a test specification needs to be produced for a given profile and no test specification exist for the base specifications, initially identify the tests which are applicable to the base specification and those which are applicable to the profile only[2)].

The rationale for **Recommendation 1** is the following (assuming, in this rationale, that profiles exist):

a) base specifications are full of options, some of them are not compatible between each other; hence, testing according to base specifications does not necessarily bring confidence of interoperability of real systems;

EXAMPLE: The typical example is the case of national variations. Some base specifications (mainly in ETSI) encompass many optionalities, open to very different national variations. These standards are "general frameworks", allowing in an open compromise different possibilities of implementation.

b) a mutual recognition of test results (the objective of standardized testing) is more reliable if testing is performed against profiles, when they exist.
As a matter of fact, if the testing is performed against base specifications for real products (which implement profiles, or at least different subsets of the base specification, aimed at achieving different functional objectives), very different sets of test cases have to be run for the different products (selection of test cases according to ICS and IXIT, after test case selection expressions);

c) in the context of a profile, assumptions can be made on the other parts of a system e.g. adjacent layers. This allows to specify an ATM and ATCs which are realistically applicable. Defining tests for a base specifications without knowing anything on the other parts of a System Under Test (SUT) often leads to either defining tests incompletely (e.g. without specifying what is contained in the data part of the PDUs sent) or to defining tests which are totally inapplicable, since they suppose a perfect control of an interface of the protocol under test, without taking into account that in a real product this interface is under the control of another protocol implementation, part of the profile.

NOTE 2: The points a) and b) of this rationale rely upon the "refinement" dimension of a profile; the point c) relies upon the "multiplicity" dimension.

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2) See subclause 9.1.

6 The PICS and other base specification ICS; a companion document for base specifications

This clause deals with the ICS for base specifications.

A common example of ICS for a base specification is the PICS, or protocol ICS. A PICS is a particular case of ICS, applied to base specifications of protocols.

The main difference between a base specification ICS (e.g. a PICS) and a profile ICS (see clause 8) is that the base specification ICS proforma is a single document, whilst the profile ICS proforma is a structured collection of documents.

A PICS proforma is a document designed by the protocol specifiers. More generally, a base specification ICS proforma is a document designed by the base specification specifiers. It is a normative part of a reference specification, according to ISO/IEC 9646 (references [5] to [12]).

Specification of an ICS proforma is not, thus, a test specifiers' business.

However, the ICS proforma shall exist prior to the design of an ATS.

If the existing ICS proforma appears to be incomplete or erroneous, conformance testing people will issue change requests, exactly as they do when they identify errors in the reference specification itself.

If no ICS proforma exists, conformance testing people will ensure that one is produced and approved by the relevant committees (i.e. has reached a sufficient level of stability - this does not necessarily mean full standardization) before they start working on the conformance TS.

NOTE: In most cases conformance testing people will have to produce the ICS proforma themselves. It is a profitable familiarization with the reference standard.

ISO/IEC 9646-7 [12] standardizes the method of specification of ICSs.

6.1 Objective of the PICS (base specification ICS)

Testing conformance of an implementation against a base specification[3)] requires that:

a) the set of conformance requirements to be met by a conforming implementation is documented by the protocol specifiers.
This set is identified by the base specification, and reflected in the ICS proforma;

b) the set of capabilities retained in this implementation is also documented by the product implementor, which makes a "statement".
The set of implemented capabilities is documented by filling up the ICS proforma, which becomes the (completed) ICS.

The ICS has two main objectives: to be the reference document for the conformance assessment process related to the Implementation Under Test (IUT); outside the context of conformance testing, to provide an overview of the implementation. ISO/IEC 9646-5 [10] describes the manifestation of the ICS proforma and the ICS, along the relations between a test laboratory and its client, during the conformance assessment process.

---

3) The base specification ICS is also useful in the case of profile testing, as a component of the profile ICS (see clause 8).

Concerning the conformance assessment process, the (completed) ICS is:

- used as the description of the IUT for the static conformance review;
- used as an element of description of the IUT capabilities for the test case deselection;
- used as an element of description of the IUT for the test suite parameterization;
- used as a reference document for the analysis of the results;
- attached to the final test report;
- possibly used as a component of a profile ICS or several profile ICSs.

Outside the conformance testing context:

- the ICS is used to provide an overview of the capabilities supported by the implementation;
- the ICS may be used to statically check the interworking capacities of two implementations;
- the ICS proforma is a standard checklist of the static conformance requirements of the base specification.

6.2 What is a PICS proforma (base specification ICS proforma)

An ICS proforma is a set of tables containing questions (to be answered by an implementor), and limitations on the possible answers.

It basically contains two types of questions:

- questions to be answered by either "YES" or "NO", related to whether a feature (ranging from a macroscopic functional unit to a microscopic PDU) has been implemented or not. The allowed answers, which reflect the base specification, are documented in the ICS as the STATUS; the answers constitute the SUPPORT;
- questions on numerical values implemented (for timers, for sizes of messages, for numerical parameters of PDUs, for frequencies, etc.). The legitimate range of variation of this value, which reflects the base specification, is documented in the ICS as the ALLOWED VALUES. The answers constitute the SUPPORTED VALUES.

Each question in the ICS proforma has a unique reference[4)].

6.3 PICS (ICS) proforma and TS

The ICS proforma shall exist prior to the design of a TS.

Being a structured synopsis of a standard, the ICS proforma is a structuring element for TSS&TP definition, at the level of the TSS hierarchy concerned with the different aspects of the protocol[5)].

The ATS refers to ICS questions, in order to deselect and parameterize the test cases. Test case selection expressions are a part of the ATS (see ISO/IEC 9646-3 [7]). The ICS shall never refer to the ATS.

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4) Several styles are possible for attributing references to PICS items (see subclause 6.5.5).
5) Other levels of the TSS hierarchy are concerned, for instance, with the types of tests (valid/invalid, etc.).

6.4 Semantics of PICS (ICS) proforma status notations

The semantics of the ICS status notations are sometimes misleading. The purpose of the following text is to bring some clarification.

Informative annex A of ISO/IEC 9646-7 [12] provides guidance on the meaning of ICS status values.

The meaning of a status is different according to the nature of the item to which it applies, e.g. a role or major capability, a PDU in reception, a PDU in transmission, a parameter.

Two general principles are always true:

- a status is STATIC, even if it is conditional and may take different values according to the support of other features. Its value is either fixed or evaluated ONCE as the result of a conditional expression in which other SUPPORTS are the variables, and cannot change dynamically during the functioning of the IUT. Neither status nor support ever depend on a given instance of communication;

- an ICS question (hence, the associated status) is related to a conformance requirement in the reference standard. When this conformance requirement defines a particular protocol feature, the implementation of the SEMANTICS of this feature is subject to the ICS question.
  "Supported" means that if the feature is used, it is used in conformance with the standard, and under the circumstances specified in the standard.

A frequent misunderstanding comes from the fact that:

a) the ICS qualifies the status and support of a conformance requirement; and

b) the conformance requirement determines the use of a feature.

Point b) is only documented in the base standard. The ICS proforma remains silent on how the conformance requirement determines the use of a feature.

Thus, the ICS qualifies the use of the feature indirectly, and implicitly, i.e. by reference to a conformance requirement in the reference standard.

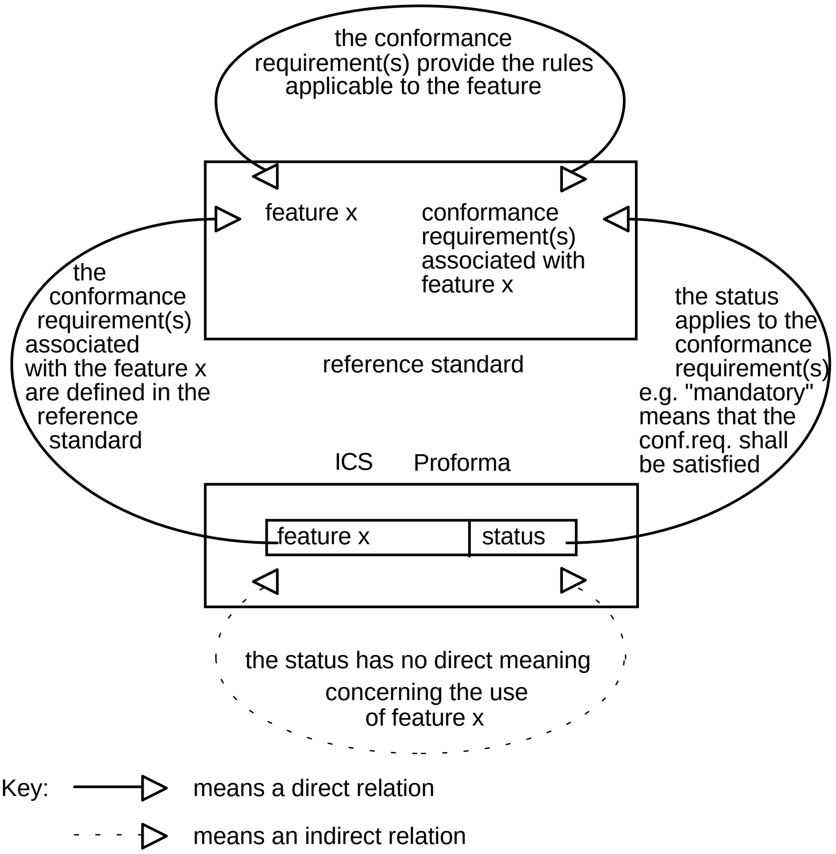


Figure 6: Relationship between ICS and reference standard: indirect relation between status and feature

EXAMPLE: X.400 protocol

Feature: the parameter "alternate recipient allowed".

Conformance requirement: "the parameter shall be present if requested by the message originator (at the user interface)".

ICS Status: Mandatory.

Although this feature is mandatory, the ICS does not say anything on the conditions of presence of this parameter.

As a result, the way a status constrains the use of a feature is not documented in the ICS. The status has a precise meaning concerning the conformance requirement, it has not a direct meaning concerning the feature.

For instance, the fact that a feature is mandatory does not mean that it will always be "present", or "observed". It means that the conformance requirement has been satisfied by the implementation, and that the IUT cannot "refuse" to exhibit the proper behaviour if it is placed in conditions where a conformance requirement from the standard requires it to do so.

Therefore, the same notation "mandatory[6] will be used for features which shall always be present and observed, as well as for features the presence of which depends on the state of a protocol machine, or even on the initiative of the upper layer or of the user application.

---

6) In order to solve this ambiguity, **several classes** of "mandatory" have sometimes been defined. Such an approach is not allowed for this ETS.

This is the case of service-driven events. Sending a PDU belonging to an implemented capability may depend upon the initiative of the upper layer or a user application, that drives the protocol machine through service interaction. The capability, therefore, remains "optional to be used", although it is a mandatory requirement to implement it. In this case, it means that no conformance requirement defines a context in which the IUT would be obliged to use the function.

In the case just described, whether a sending capability may be observed or not depends on the test method (responsible for the access provided to service interfaces), and on the implementor's choices on the SUT. It is documented in the IXIT[7].

6.5 PICS proforma (base specification ICS proforma) criteria

This subclause provides quality criteria that a base specification ICS proforma shall satisfy. It prescribes the application of ISO/IEC 9646-7 [12] and provides additional rules.

6.5.1 ISO/IEC 9646 criteria

The basic criteria of ISO/IEC 9646-7 [12] shall be satisfied.

6.5.2 Additional criteria

NOTE 1: ISO/IEC 9646-7 [12] has been written with the intention to encompass all kinds of notations having been used hitherto in a number of different contexts. Additional rules are necessary.

The criteria specified in annex A of this ETS shall be satisfied.

NOTE 2: An ICS style guide is currently under development in ETSI, TC MTS. This note will be replaced with a statement "The ICS proforma should follow the criteria specified in the ICS style guide, DTR/MTS-00004" when the document is available.

6.6 Standardization of a PICS (ICS) proforma

ISO/IEC 9646-7 [12] makes the distinction between an ICS proforma and an ICS proforma specification. The ICS proforma is part of the ICS proforma specification, and by filling it in gets turned into an ICS. The ICS proforma specification is the published document through which an ICS proforma is standardized.

ISO/IEC 9646-7 [12], subclause 8.2 provides the requirements for ICS proforma specifications: clauses that shall be contained, copyright release.

An ICS proforma shall contain a copyright release clause: see ISO/IEC 9646-7 [12], subclause 8.2.7 and also subclause 10.1.4 of this ETS.

In accordance with ISO/IEC 9646-7 [12] (subclause 8.2.1), an ICS proforma shall be an annex to:

a) an ICS proforma specification making up an independent stand-alone standard, or;

b) an ICS proforma specification making up a part of a multi-part standard, or;

c) the base specification itself.

7) The PIXIT answers, just as the PICS answers, are used in the test case selection expressions.

7 TS for a base specification

This clause provides:

- a checklist, and an overview showing dependencies, of the components of a TS for a base specification;

- the definition of the components;

- a definition of the "amendment" components.

A TS for a base specification shall include at least all the mandatory components listed in subclauses 7.3 and 7.4, and comply with ISO/IEC 9646 Parts 1 to 3 (references [5] to [7]) and Part 7 [12].

All the components of a TS shall follow the minimal quality criteria provided in this clause.

According to the definitions of ISO/IEC 9646 (references [5] to [12]) and this ETS, the conformance testing terminology distinguishes between:

- the conformance testing specification (standard or set of standards containing all the material relevant for testing);

- the ATS specification (a subset of the former, which contains the ATS and related information);

- the ATS (a subset of the former, which is the set of ATCs).

The contents of a conformance testing specification (for a base standard) are listed in table 2 and detailed in subclause 7.4.

The contents of an ATS specification, and the packaging rules, are given in table 5 (clause 10).

NOTE: ISO/IEC 9646-2 [6], clause 14, defines the minimal contents of an ATS specification. Table 1 clarifies how the ISO requirements are reflected in this ETS. In addition, some components are added in this ETS (which are not in the ISO list). They are:

- the ATS conventions;

- the Protocol Conformance Test Report (PCTR) proforma;

- the list of untestable TPs;

- the ATS to TP mapping.

Table 1: Mapping of items in ISO/IEC 9646-2 [6], subclause 14.1 and this ETS

ISO/IEC 9646-2 [6] subclause 14.1 item		How it is dealt with in this ETS
a)	Mapping of ATC to ICS proforma	Contained in the ATS because TTCN is used.
b)	Partial IXIT proforma	A partial IXIT proforma is one component of the ATS specification.
c)	Mapping of ATC to IXIT proforma	Contained in the ATS because TTCN is used.
d)	Order of ATC for presentation in a PCTR	A PCTR proforma is part of the ATS specification.
e)	Restrictions on the order of ATC for execution	Specified with the ATM (see subclause 7.4.2).
f)	Identification of test cases or test groups which shall be realized by a conformant Means Of Testing (MOT)	An ATS specification contains a conformance clause (see subclause 10.1.6).
g)	Requirements on Test Co-ordination Procedures (TCP)	TCP is part of the ATS specification, or dealt with in the ATS if concurrent TTCN is used (see subclause 7.4.5).
h)	Test cases for testing UT implementation	Part of the ATS (if ATM requires).
i)	Timing information	Together with the specification of the ATM (see subclause 7.4).

7.1 The production process

A project producing a TS for a base specification is generally faced with one of these two situations:

a) producing a TS for base specification from scratch;
b) correcting or modifying a TS.

Case b) generally consists in producing a TS for base specification on the basis of an existing test specification for a profile.

This clause deals with the production (in both cases above) of a conformance testing specification containing a single test suite for a base specification.

ISO/IEC 9646 (references [5] to [12]) allows the specification of several test suites per protocol (generally corresponding to several ATMs). This case is treated in annex B.

It is strongly recommended that there should be only one ATS per protocol, because multiple ATSs cost more to implement, and raise the question of equivalence of coverage and test results.

A single ATS may use several test methods.

EXAMPLE 1: A single protocol may encompass several functional subsets, for instance an "initiator role" and a "responder role". A single protocol may then need different ATMs to test its different functional subsets (e.g. distributed ATM for the initiator role, remote ATM for the responder role);

EXAMPLE 2: When multi-party testing is to be used, in order to test all aspects of behaviour of an implementation of a multi-party protocol, it is likely to be necessary to use different multi-party ATMs, i.e. different configurations of lower testers, upper testers, etc.

When several test methods are used, they should relate to non-overlapping subsets of the tested protocol. Each individual conformance requirement of a protocol should be tested by only one ATM. There should never be alternative methods to test a conformance requirement.

This is illustrated in figure 7.

NOTE: ISO/IEC 9646-1 [5], subclause 3.3.22, defines a test suite as a complete set of test cases. This implies that alternative ways to test the same conformance requirements are not possible inside a test suite. When alternative ways to test the same conformance requirements are retained (i.e. overlapping test methods), multiple ATSs are produced, which falls into the case of annex B, discouraged above.

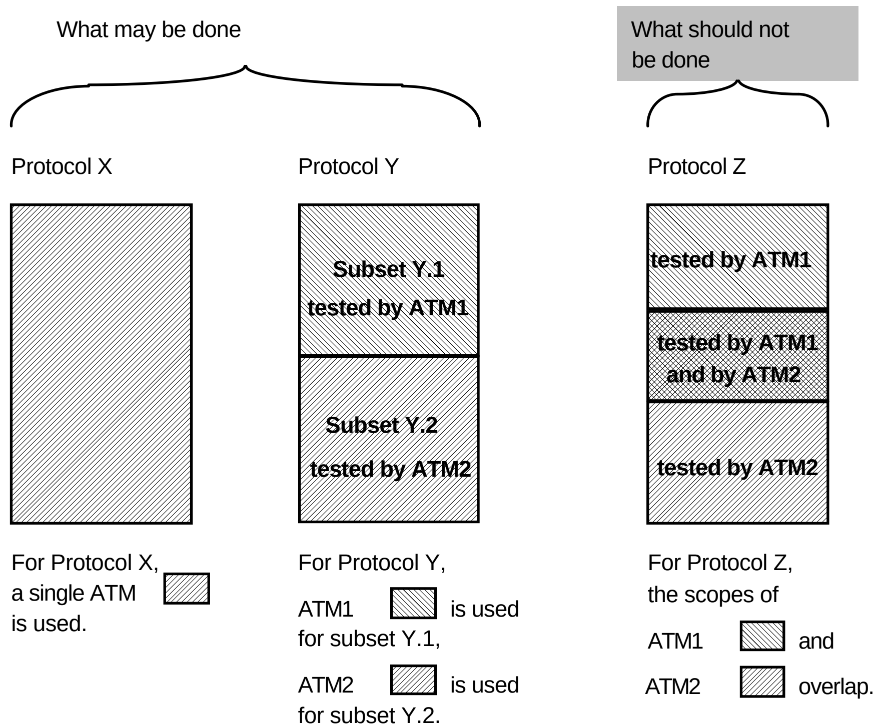


Figure 7: The domains of use of different ATMs should not overlap

The reason for recommending a single ATS per protocol is twofold:

- economic considerations dictate that multiple ATSs (for multiple ATMs) increase the cost of developing the ExTS and the cost of using the ATMs for both the test laboratories and their clients;

- technical considerations reveal that, when multiple ATSs are used, it is difficult to offer comparability of the test reports produced for different SUTs.

When profiles exist, and when testing in the context of profiles, the same recommendation should apply:

It is strongly recommended that there should be only one ATS for testing each protocol, irrespective of the profile context in which it is tested. However, the profile testing methodology offers appropriate tools to specify replacement test cases when the ones specified for the base specification cannot apply directly.

However, if it is not possible to use the same ATS for the protocol in the different profile contexts, because a distinct testing architecture cannot be avoided for each profile, the recommendation of developing a single ATS should then be understood in the context of one given profile. It then becomes a MINIMAL recommendation:

It is strongly recommended that there should be only one ATS per protocol in the context of a given profile.

For instance, a protocol X may need to be tested "embedded" under different applications, which require different ATMs. This is illustrated in figure 8.

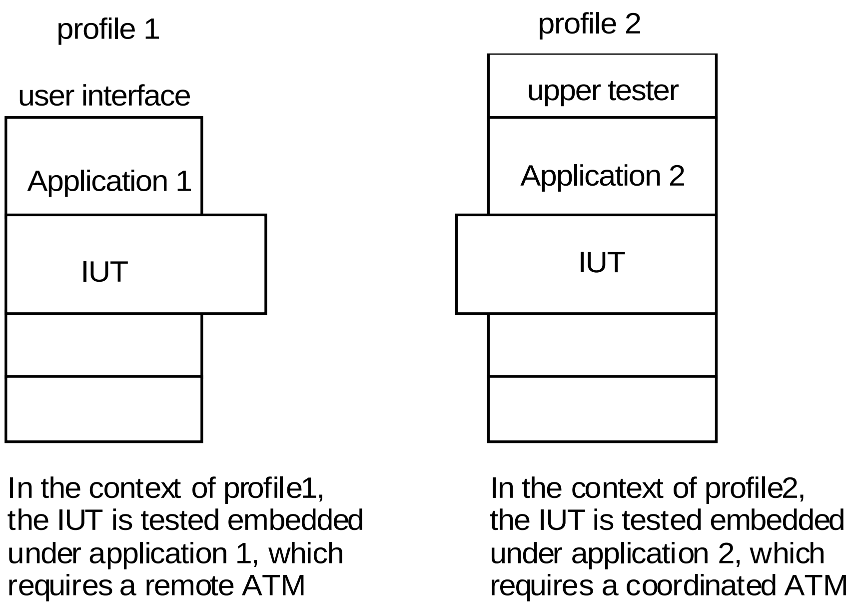
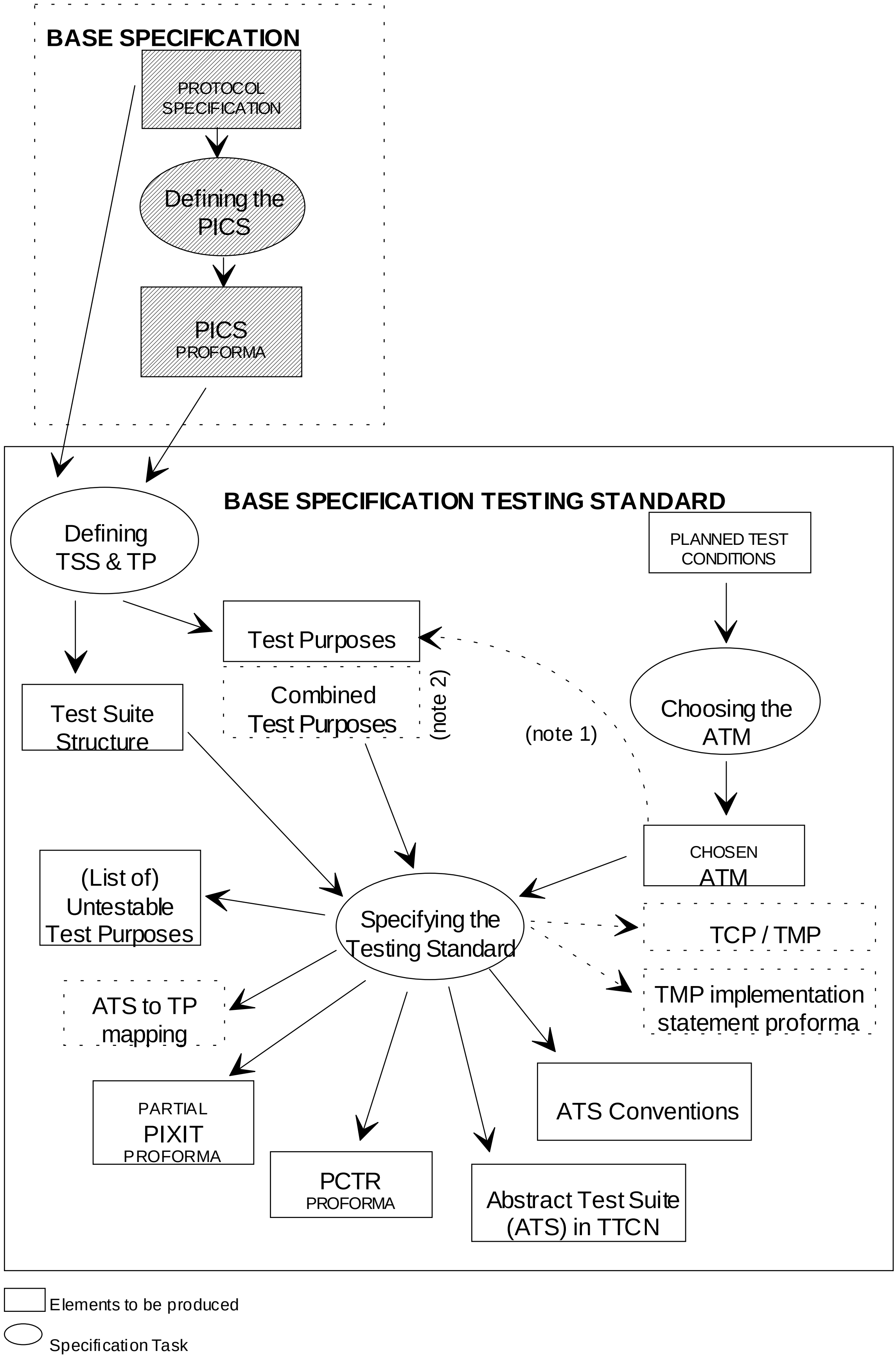


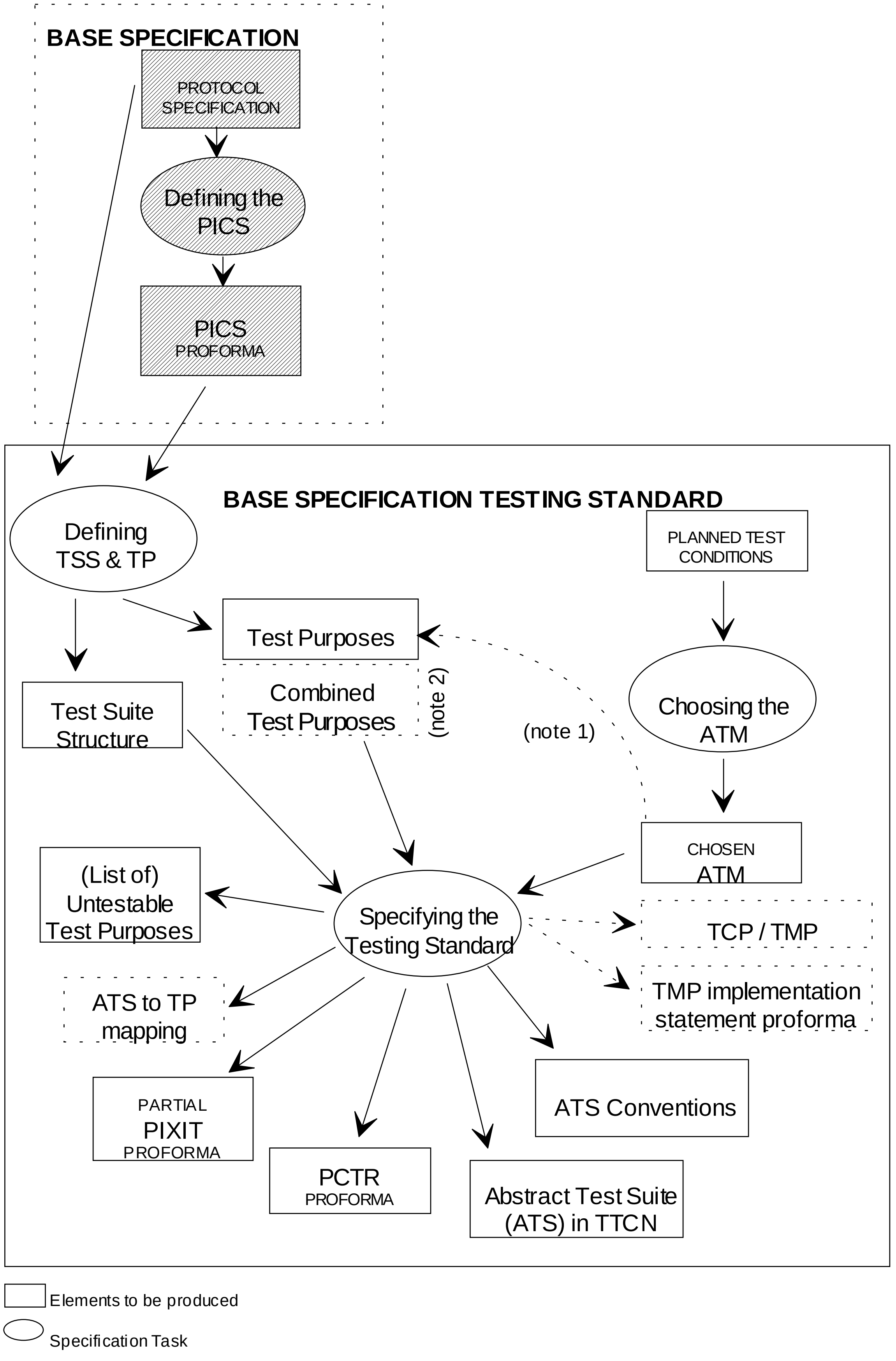
Figure 8: Example of "one ATM per protocol in the context of a given profile", applied to two profiles

For the test of profiles, refer to clause 9 of this ETS.

Annex B discusses the justification of the choice of a single ATS in more detail.

7.2 Synopsis of components and their dependencies


BASE SPECIFICATION
PROTOCOL SPECIFICATION
Defining the PICS
PICS PROFORMA
BASE SPECIFICATION TESTING STANDARD
Defining TSS & TP
PLANNED TEST CONDITIONS
Test Purposes
Combined Test Purposes
(note 2)
Test Suite Structure
(note 1)
Choosing the ATM
CHOSEN ATM
(List of) Untestable Test Purposes
Specifying the Testing Standard
TCP / TMP
TMP implementation statement proforma
ATS to TP mapping
PARTIAL PIXIT PROFORMA
PCTR PROFORMA
Abstract Test Suite (ATS) in TTCN
ATS Conventions
Elements to be produced
Specification Task



NOTE 1: In practice, the ATM may inflect the style of the TPs, but in a controlled manner (see subclause 7.4.1.2).

NOTE 2: It is defined a "Combined Test Purposes (CTPs)" component, in complement to the TPs. This is an extension to ISO/IEC 9646-2 [6], which allows combination of TP but only specifies general rules on the matter (see subclause 7.4.1.3).

Figure 9: Synopsis of the components and their dependencies

Figure 9 shows the components that belong to a base specification, and to a TS for the base specification. The aim of this description is to provide the reader with a global and consistent view of the overall process. Therefore, tasks and components are presented in a very macroscopic manner.

The components in dotted boxes are "waiver possible", because they depend on the context.

The respective components are described further in this clause.

7.3 Checklist of components

Table 2: Checklist of components for base specification testing specification

Component	Reference in this ETS	Status	Comment
Components associated with base specification:			
ICS proforma (PICS, or other ICS, e.g. Object ICS)	clause 6	M	**The ICS proforma shall exist prior to the design of an ATS, as part of the base specification.**
Components making up TS:			
TSS	7.4.1.1	M	(note 1).
TPs	7.4.1.2	M	(note 1).
CTPs	7.4.1.3	O	(note 2).
ATM	7.4.2	M	
ATS conventions	7.4.3	M	
ATS	7.4.4	M	
Test Coordination Procedures	7.4.5	O	In a SPyT context, if ATM requires, and if Concurrent TTCN is not used.
TMP	7.4.5	O	If ATM requires
TMP implementation statement proforma	7.4.5	O	Shall be present if TMP is present.
Partial IXIT proforma	7.4.6	M	
PCTR proforma	7.4.7	M	Europe only (note 3).
untestable TPs	7.4.8	O	Should be kept minimal.
Abstract test selection rules	7.4.9	O	Optional and transitional: **shall be finally included in the TTCN tables** (ISO/IEC 9646-3 [7]).
ATS to TP mapping	7.4.10	O	If no common (ATS and TP) numbering.
Amendments:	7.5		Also in TS.
TSS&TP amendment	7.5.1	O	
ATS amendment	7.5.2	O	

NOTE 1: TSS and TPs are in the same physical document TSS&TP.
NOTE 2: It is specified a "CTPs" component, in complement to the TPs. This is an extension to ISO/IEC 9646-2 [6], subclause 10.3.3, which allows combination of TP but only specifies general rules on the matter.
NOTE 3: The System Conformance Test Report (SCTR) is deliberately absent from this list of components. According to ISO 9646-1 [5], the SCTR applies to base specification testing. However, SCTR proforma tailoring is only relevant for profiles, and no SCTR proforma need be part of a conformance test specification for a base specification.

Key: M: Mandatory.
O: Optional.

NOTE: The components defined table 2 are logical components. The packaging of the TS (i.e. which physical documents contain which logical components) is provided in subclause 10.1.1.

7.4 Definitions of the components and criteria

7.4.1 TSS&TP

TSS&TP are defined in ISO/IEC 9646-2 [6], clause 10.

The TSS&TP are tightly related to each other, and referred to as TSS&TP. Their design is of the utmost importance, for it determines the whole conformance TS.

The TSS reflects the coverage of the reference specification by the TS: it is a synopsis of "which tests are performed on which aspects of the reference specification". The conformance requirements and the ICS proforma of the base specification are an essential source of cross-reference to check that the coverage of the test suite specified by the TSS&TP is acceptable.

The TSS&TP shall contain:

- a description of the TSS (a graphical representation is encouraged);

- the identification of the Test Group Objectives, and their prose description (optional but encouraged) see ISO/IEC 9646-2 [6], subclause 10.3.1;

- the TPs in prose;

- the CTPs in prose (optionally).

Examples of TSS&TP documents can be found in the work done by ISO/IEC/JTC1/SC21/ULCT group, which was a leader in implementing those concepts (session, presentation, Association Control Service Element (ACSE), FTAM, TP).

7.4.1.1 TSS

See ISO/IEC 9646-2 [6], subclause 10.2.

The TSS is independent of the ATM.

7.4.1.1.1 General rules and recommendations

The following rules shall be applied:

1) adopt a top down approach when deriving the TSS from the base specification.

2) when no technical constraint forbids it, structure the TSS as a tree.
Exceptions can be made to the strict tree structure: ISO/IEC 9646-2 [6] allows a given TP to belong to more than one test group. When such a situation occurs, references shall be used instead of replication.
In particular, Basic Interconnection tests often belong also to the Capability tests group, and Capability tests often belong also to the Valid Behaviour group.

3) It is recommended to cover a priori all the groups listed in ISO/IEC 9646-2 [6], subclauses 10.2.1 and 10.2.2. When an item is irrelevant for a given base specification, it shall be justified and explicitly mentioned in a note.

In addition to these rules, the different levels of the TSS should be as follows:

1st level: the name of base specification should be placed at the top of the TSS, e.g. FTAM;

2nd level: test groups related to the "major functions", or "roles" of the base specification (generally clearly identified in the ICS proforma). In the example of FTAM:

- Initiator (I);
- Responder (R);

3rd level: pre-defined groups of tests according to the "nature" of the tests:

- basic interconnection tests;
- capability tests;
- valid behaviour tests;
- invalid behaviour tests;
- inopportune behaviour tests;

4th level: pre-defined groups of tests according to the "functional aspect" tested:

- state event transitions;
- parameter variations;
- parameter combinations;
- timers (can also be found at level 3);
- etc.;

≥ 5th level: groupings relevant to the base specification, for instance name of functional units, then of PDUs, etc. In the example of FTAM:

- kernel;
- read;
- write;
- file access;
- limited file management;
- etc.

The levels given here are indicative, and can be swapped.

7.4.1.1.2 Recommendation concerning the testing of "state transitions"

The testing of actions related to transitions between states only constitutes one group among the different kinds of tests in the TSS. For instance, "encoding variation", "parameter variation", "parameter combination", "timer" groups are often equally essential.

The natural facility to give a structure to tests related to transition between states, and to assess the coverage of a finite state machine by TPs related to the transitions, has often led to inopportune over-consideration of this test group and the neglecting the others.

It is recommended to avoid giving more importance to the "state event transitions" than to the other groups like "encoding variation", "parameter variation", "parameter combination" and "timer".

7.4.1.1.3 Recommendation concerning the "inopportune" groups

It is recommended to limit the inopportune testing to conceivable situations, i.e. situations to which a real implementation is likely to be faced.

Any event which it is not possible to generate according to the standard should not be considered.

It does not make sense to walk through all the "empty boxes" of a state table. The tests of inopportune events may justify the use of a state sampling approach.

This makes all the difference between a systematic TP derivation from the protocol and an optimized TP design.

7.4.1.1.4 Recommendation and rule concerning the "variation" groups

Clarification on the concept of variation groups (parameter variations, timer variations).

These groups are called "variation" groups because they generally comprise several TPs, aimed at testing different values of a considered parameter or timer.

However, the fact that several values are tested is not in itself essential.

What is essential, is the fact that the TPs are focused on the parameter or the timer: they are aimed at checking that the IUT complies with conformance requirements related to the parameter or the timer.

For instance, they check that a timer expires within the proper delay, that a parameter sent by the IUT is in the proper interval of values allowed by the reference standard.

There shall be groups of TPs focusing on the use of parameters and timers by the IUT.

These groups do not necessarily contain variated values (i.e. several test cases exercising the IUT with different values). They may contain variated values - it is sometimes relevant, for instance to check that an IUT can accept parameters at the two boundaries of the allowed interval.

The test of several values (e.g. at the boundaries of an allowed interval) is relevant when it actually increases the probability of finding errors.

It is more often relevant in the case of lower layers and simple types than in the case of complex syntaxes.

It is recommended, in order to avoid any ambiguity, to drop the "variation" name, and call these test groups "Parameter", "Timer".

7.4.1.1.5 Rules and recommendations concerning the naming conventions

Unfortunately, very different naming (abbreviating) conventions have been used in TSS standardized in Europe, and it is not desirable to impose any given one.

Whatever convention in chosen, it shall be described explicitly in the TSS&TP (for all the groups). All the groups shall have full names and abbreviated names (1 to 3 letters).

The recommended convention for pre-defined groupings (levels 3 and 4 in subclause 7.1.1.1) is as follows:

- basic interconnection tests: BIT
- capability tests: CA
- valid behaviour tests: BV or V
- invalid behaviour tests: BI or S (syntactically invalid)
- inopportune behaviour tests: BO or I (inopportune)

- state event transitions: SE
- parameter variations: PV
- parameter combinations: PC
- timer variations: TI

Examples of TSS:

EXAMPLE 1: FTAM:

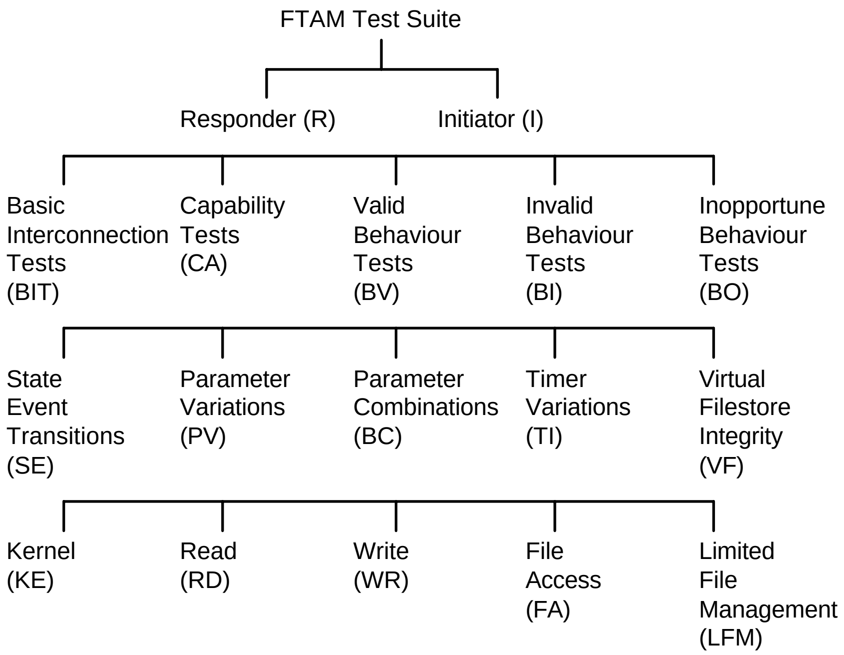


Figure 10: Example of FTAM TSS

EXAMPLE 2: ISDN V.5.1 interface:

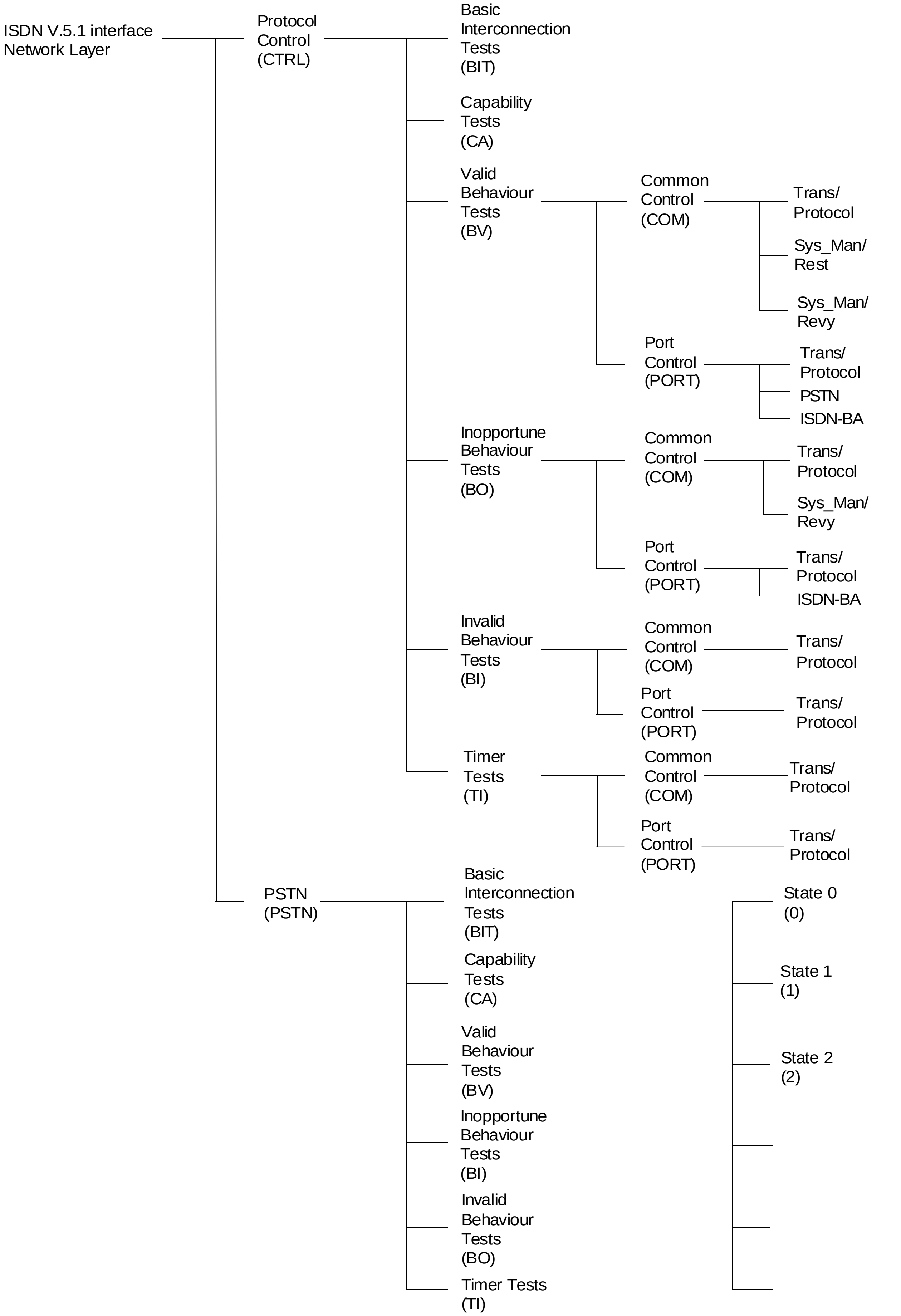


Figure 11: Example of ISDN V.5.1 interface TSS

7.4.1.2 TPs

Conforming to ISO/IEC 9646-2 [6], subclause 10.3, a TP shall focus on a single conformance requirement of the reference specification, or on a set of conformance requirements.

A TP shall only be based on a conformance requirement, or set of conformance requirements, related to the externally observable[8)] behaviour of the IUT. (The test method may place additional constraints on observability, but those constraints shall not be taken into account at TP level).

The expression of a TP shall not be limited to checking a state or a state transition of a protocol state machine. Even when the TP is based on a state transition, it shall contain:

- either the description of an externally observable behaviour resulting from the state transition, for instance the transmission by the IUT of a given message;

- or the precise means to check that the IUT is in the desired state, for instance by experimenting a protocol mechanism that can only be reached in the desired state.

In both cases, the TP shall specify the unambiguous, explicit and exhaustive checks to be performed. No check can be performed by a test case if it is not mentioned in the TP.

Each TP shall also specify:

- the initial conditions (e.g. the state) of the IUT before the test is to be run;

- the unambiguous and explicit IUT expected behaviour.

EXAMPLE 1: What shall not be done:

TP1: "Check that the IUT enters state AN2.0 after receipt of a PORT_CONTROL message containing ...".

EXAMPLE 2: What may be done:

TP2: "Check that the IUT sends a COMMON CONTROL ACK after receipt of a COMMON CONTROL message containing ... , as a result of state transition S1 $\rightarrow$ S2.".

TPs focusing on a set of conformance requirements (this is admitted in ISO/IEC 9646-2 [6]) shall be limited to the case of profile-specific test specification (see subclause 9.4.4.) or to the combination of TPs, bound to follow the mechanism given in subclause 7.4.1.3.

A clear explanation of the relation between TPs and the conformance requirements in the reference specification shall be provided.

It is encouraged to provide also in the TP a reference to the subclause in the reference specification where the conformance requirement is expressed.

The definition of the TPs is theoretically (according to ISO/IEC 9646-2 [6]) independent of the ATM. However, the knowledge of at least one ATM is useful during the design of the TPs.

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8) Observable according to the reference standard.

The approach of ISO/IEC 9646-2 [6] is:

a) write the TPs in a generic way;

b) choose an ATM;

c) examine which TPs can be derived into ATCs according to the ATM. The TPs which cannot be derived in ATCs, are put in the untestable TPs list (see subclause 7.4.7).

This approach is mainly justified if several ATMs are to be used with the same set of TPs for the same protocol.

This ETS encourages the use of an approach which slightly differs from the theory: write the TPs after having chosen the testing architecture and, therefore, the ATM.

The justification for recommending to design the TPs based on the testing architecture is that the knowledge of the accessible Points of Control and Observation (PCOs), and functions available at those PCOs, leads to more concrete and accurate TPs. The production of ATCs from such TPs is then more reliable, since the TPs specify precisely the checks that need to be performed at which interfaces.

However, with respect to ISO/IEC 9646 (references [5] to [12]), a deviating approach does not mean a deviating result. The resulting TSS&TP still conforms to the ISO/IEC 9646 (references [5] to [12]) principles.

The only difference between this approach and ISO/IEC 9646 (references [5] to [12]) principles is that the style of the TPs which can generate test cases according to the chosen ATM may be slightly influenced by the knowledge of the ATM. They will generally be more precise than if they had been written without any hint on the ATM.

The influence of the ATM on the TPs should be controlled:

- in each TP, a clear distinction shall be made between ATM-independent text and possible ATM-dependent text used for enhancing the TP;

- the actions and events specified in the TP shall refer to the tested protocol, and not to the TCP or the TMP.

If a TP is useful for the coverage of the important requirements of the specification, then a TP shall be produced, whether or not it is testable according to the ATM.

The coverage of the conformance requirements of the reference specification by the TPs is never absolute nor complete, and no method exists to objectively evaluate it. ISO/IEC 9646-2 [6], subclause 10.4, gives only general guidance to evaluate it subjectively.

However, the standardized TPs mean that a consensus has been achieved in a standardization committee (e.g. TC in ETSI, EG in EWOS) on the fact that the standardized TPs provide the desirable level of coverage of the reference specification. Furthermore, providing a list of untestable TPs (see subclause 7.4.8) is useful in order to document what is not covered by the ATS due to the choice of the ATM.

The TPs shall be designated by the same numbering/referencing scheme as the TSS.

There should be a clear relationship between the TPs and ICS items. It should be possible to determine logically[9)] from the ICS if it is appropriate or not to deselect the ATC corresponding to this TP.

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9) Logically does not mean easily. It means that by means of a logical expression, which may be complex, and which may involve a reference to several items of the PICS.

7.4.1.3 CTPs

7.4.1.3.1 Why combine TPs?

Even though the implementation of the test cases is more and more automated (TTCN compilers, etc.), as well as their execution (automated test campaign, automatic production of test reports, etc.), it is generally accepted that the final cost of a test campaign directly depends on the size of the ATS (even though other factors, such as the complexity of the tests, should also be taken into account). This is especially due to the final test result analysis, that is generally performed by a human, and that should concern all the test cases, irrespective of whether they resulted FAIL, PASS, or INCONCLUSIVE.

The objective is to reduce the number of test cases, but to keep a good coverage[10)] of the base specification by the TS. Coverage is the key to the confidence in the test results.

Thus, in order to reduce the number of test cases, it is not possible to simply drop some TPs. This would reduce the coverage, which is not admissible. As a consequence, it is sometimes advisable to combine TPs.

ISO/IEC 9646-2 [6],subclause 10.3.3 allows the combination of TPs. It also gives the example of individual parameter TPs related to the same PDU. This case is frequent: combination of individual parameter TPs is used as soon as a TTCN constraint checks the validity of several parameters of a received PDU.

NOTE: As ISO/IEC 9646-2 Edition 2:1994 [6] is not published yet, subclause 10.3.3 is reproduced hereafter:

"As part of the process of designing the TSS&TP, it is suggested that TPs be identified initially for each conformance requirement (e.g. specific parameter) that is to be tested. As a second stage, TPs for combinations of related conformance requirements may be specified. If this is done:

a) a new TP covering a combination of related conformance requirements shall be written referencing those TPs which cover the individual conformance requirements;

b) an indication shall be given that one ATC is to be produced for that new TP, rather than a distinct test case for each of the referenced TPs that have been superseded;

c) each superseded TP shall remain in the set of TPs, but shall identify the new TP which superseded it."

The objective of this subclause is to provide a methodology in case combination of TP is felt necessary. It is not to discuss in which cases it may be opportune to combine TPs. The main interest of providing a methodology is to avoid having the experts combining TPs implicitly, i.e. combining TPs which de facto cover several conformance requirements, without expressing the unitary TPs.

Combination of TPs is aimed at reducing the size of the resulting ATS. It should not be employed if it is deemed detrimental to the practicality or reliability of the resulting ATS.

Subclause 7.4.1.3 is not in contradiction with ISO/IEC 9646 (references [5] to [12]). The principles given in ISO/IEC 9646-2 [6], subclauses 10.3.3 and 10.3.4 have been respected.

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10) The coverage here means coverage of the base specification by the test purposes. Metrics do not exist to measure this coverage. ISO 9646-2 [6], subclause 10.4, gives only general guidance to evaluate it subjectively.
Note also that the notion of coverage of the base specification by the test purposes and the notion of coverage of the test purposes by the ATS are very different. In the latter case, it is possible to calculate a coverage ratio. It is the percentage of test purposes corresponding to ATCs. But this latter coverage of TPs by ATS has a limited meaning, since it depends on the quality of the TPs.

Before the use of TP combination is fully clarified by the international community, ISO/IEC, and ITU-T, the use of TP combination in an ATS intended to be contributed to ISO/IEC or ITU-T should be made only in agreement with the recipient standardization body.

In addition, annex C provides guidance on the combination of TPs by answering the question: "When to combine TPs?".

7.4.1.3.2 How to combine TPs

Combination of TPs is optional. If it is used, it shall follow the rules given in subclause 7.4.1.3.2.

Rule 1: **The TSS shall show all the individual TPs, i.e. before their combination.**

As a matter of fact, the TSS is **the** synopsis of a TS which documents the coverage of the base specification by the TS.

Rule 2: **A list (TP list) of all the individual TPs (before combination) shall be provided.**

Rule 3: **A second list (CTP list) of CTPs shall be provided. This list contains both:**

- **the TPs which are the result of a combination (CTPs);**
- **the original TPs which have to be implemented without being combined, or a reference to them in the TP list.**

The objective of rule 3 is the following: there should be ONE list documenting the TPs to be implemented into ATCs. This role is played by the CTP list.

There will be 1 to 1 mapping between an item in the CTP list and a test case of the ATS (or an untestable TP). The process of writing ATCs should have ONE input, which is the CTP list.

The rules 1 to 3 are illustrated as follows:

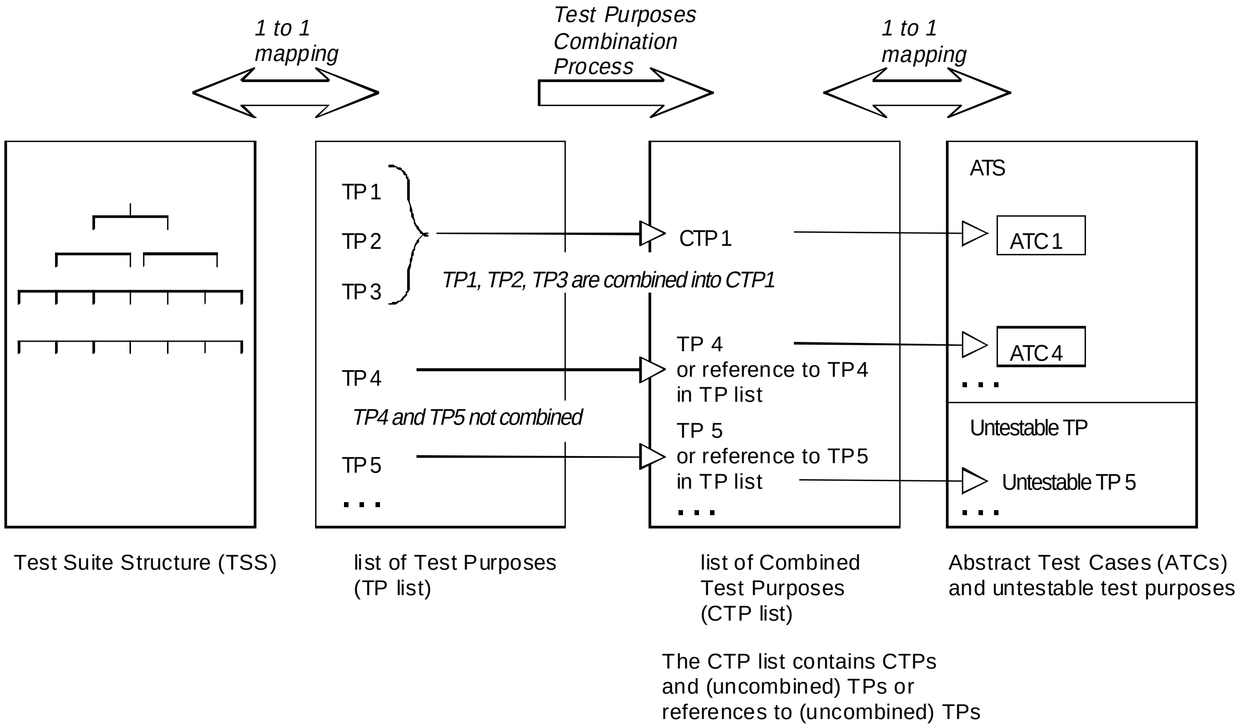

Figure 12: The principle of TP combination

It is important to note in this schema that there will be a 1 to 1 mapping of CTP and ATCs. There is NO combination of ATCs.

Rule 4: **A CTP shall contain the reference of each original TP that was combined in it.**

Rule 5: **A TP that was combined in a CTP shall be accompanied in the TP list with the reference of the CTP that superseded it.**

Rule 6: **A TP may be combined with various other TPs into several CTPs, provided that the TP will get selected with at least one CTP whenever that TP is relevant.**

A safe way to apply rule 6 is to replace it with rule 6A, which is simpler, but risks to preclude cases where combination would have been useful.

Rule 6A **If several TPs are likely to be de-selected according to different criteria[11), they shall not be combined.**

Rule 7: **If, when ATCs are produced, a CTP appears to be de-selected according to different criteria[12), it shall be decombined[13).**

Rule 8: **If, according to the test method, a TP is known[14) to be untestable, it shall not be combined.**

Rule 9: **If, when ATCs are produced, a CTP appears to be untestable, it shall be decombined.**

The Rules 5 to 8 are explained by the fact that, clearly, combination of TPs should not prevent the testing of one aspect of the protocol just because another aspect cannot be tested.

Rule 10: **The combination of TPs is always done following an AND law: a CTP checks all the aspects individually checked by the original TPs which have been combined.**

A PASS shall only be obtained if each of the TPs that make up the CTP have been effectively satisfied.

In other words, combining TPs shall not make it possible to "miss" a non-conformity. A PASS means that ALL the aspects HAVE BEEN CHECKED.

Combining TPs may only lead to a "coarse" FAIL, requiring more analysis to identify which initial TP relates to the failure, i.e. which aspect of the protocol is non-conformant.

In practice, combination of TPs uses a formulation like: "Check that ...(TP1)... AND ...(TP2)..."

Rule 11: **TPs of Invalid Behaviour group or Inopportune Behaviour group shall not be combined if they are based on different invalidities[15).**

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11) i.e. the derived test cases are likely to be subject to different test case selection expressions.

12) i.e. the test case selection expression contains a combination of different criteria obviously related to the original test purposes that were combined.

13) i.e. a defect report should be issued and the CTP replaced in the CTP list with the original TPs that were combined.

14) Theoretically, the test purposes do not depend on the test method. Practically, the test method should be known when the test purposes are written. See subclause 7.4.1.2.

15) What is meant here is that several invalidities **shall not be sent at the same time to the IUT.** It is possible, however, to envisage a combined invalid behaviour test purpose e.g. to check that, on receipt of a PDU with parameter *x* set to the erroneous value *y*:

a) the IUT is able to send back an error_report PDU; and

Rule 12: **Providing a TP which in fact is a CTP, without expressing the contained unitary TPs shall not be done. This is called implicit combination. Implicit combination means providing only a CTP without expressing the contained TPs.**

A fortiori, a test group A in the TSS shall not contain CTPs combining TPs that should belong to a test group B. The test group B shall not be omitted under the pretext that the test group A in fact contains CTPs.

Rule 13: **The only exception to rule 12 is the case of combined TPs for parameters. A formulation like "check that all the parameters of a PDU sent by the IUT are valid" is acceptable. It is an implicit combination of TPs focused on the test of the individual parameters.**

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b) that on an error_report PDU sent by the IUT, the reference to the incoming PDU which caused the error is present.

7.4.1.3.3 TSS for CTPs

The rules for combination here above specify that a TSS&TP shall contain:

- TSS (corresponding to TP);
- TP;
- CTP (if relevant).

Optionally, it may also be interesting to provide the structure of the CTP list, i.e. a TSS corresponding to CTP. While the TSS (for TP) is necessary to document the coverage of the base specification, the "TSS for CTP" may be useful to show the structure of the future ATS.

The TSS for CTP can be based on the TSS (for TP).

NOTE: Generally, the CTPs will no longer fit into the TSS (for TP).

The CTP combining TPs from a unique group can be attached to this group.

The CTP combining TPs from different groups will probably need new groups to be created.

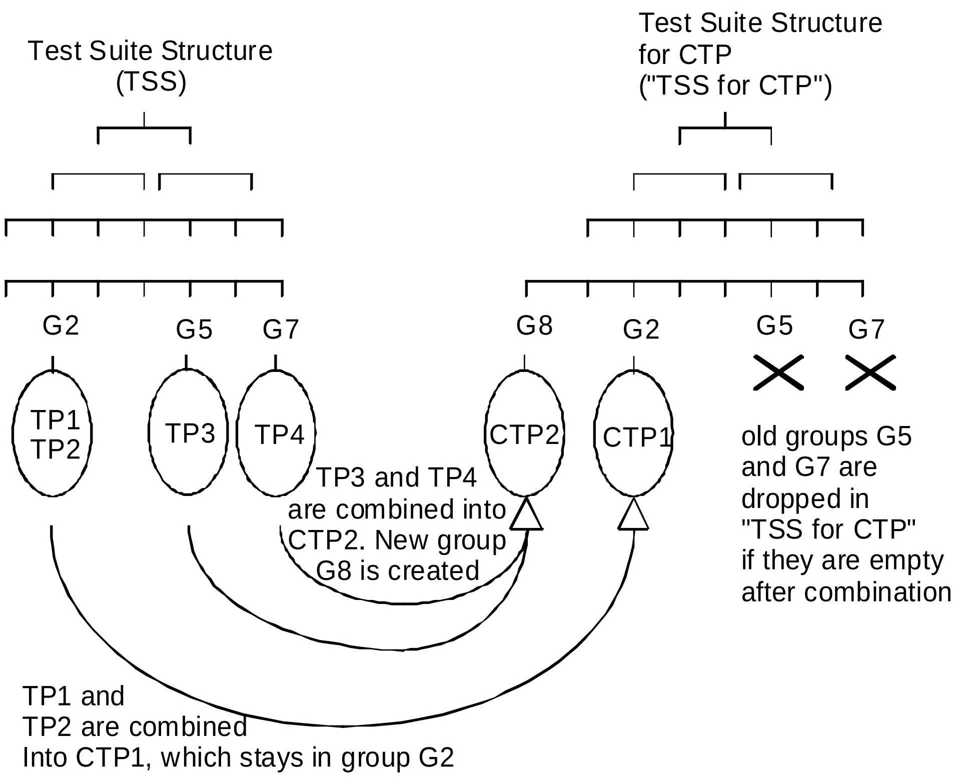

Figure 13: TSS for CTP" and TSS

7.4.2 ATM

The choice of the ATM shall be documented in detail, including in particular:

- the name of the ATM category (Local, Remote, Distributed, Coordinated) as in ISO/IEC 9646-2 [6], if applicable - specific test methods may be designed if the ISO/IEC 9646 (references [5] to [12]) methods (oriented towards the test of layered systems) do not apply;

- the assumptions on the other parts in the SUT. Typically, in the case of embedded methods, assumptions on the layers above and under the tested layer;

- the thorough description of the PCOs allowing to have access to the SUT;

- the thorough description of the test architectures: the Upper Testers, the Lower Testers, the other Test Components. A single ATS may use several test architectures, called then Test Configurations (in this case, they are declared in a TTCN ad-hoc table, and each ATC specifies the test configuration it uses and creates the test components[16]).

The use of graphical descriptions for PCOs and Test Architectures is strongly recommended.

Annex D provides informative guidance on the choice of an ATM.

The order in which the test cases are to be executed may, if necessary, be specified together with the ATM.

In case some timing information needs to be specified, it shall appear together with the specification of the ATM.

7.4.3 ATS conventions

A prose documentation of the conventions used in the ATS shall be provided, whatever style is chosen.

This documentation of ATS conventions shall contain at least:

- the naming conventions for all the TTCN components;

- the description of the strategy used for based constraints;

- the description of the strategy concerning the use of parameters (e.g. in constraints), the use of Boolean expressions, etc.;

- the description of the strategy concerning the structure of test steps, the use of defaults;

- a clear statement of whether implicit or explicit encoding is used;

- the description of the strategy concerning the use of ASN.1.

It should contain as much information as possible helping human understanding of the ATS.

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16) This implies the use of the concurrent TTCN defined in ISO 9646-3 AM 1 [8].

7.4.4 ATS

The ATS shall follow:

- ISO/IEC 9646-3 [7]: TTCN notation (International Standard version - Draft International Standards (DISs) shall be precluded). TTCN Graphic Rendition (TTCN.GR) and TTCN Machine Processable (TTCN.MP) forms shall be produced;

- ISO/IEC 9646-3 AM 1 [8]: Concurrent TTCN notation, if needed;

- The European TTCN style guide, ETR 141 [2].

  NOTE: Proper reference to be provided as soon as ETSI/EWOS PT 59 finishes its work.

The ATS shall be produced on a TTCN-dedicated editing tool which offers a function of validation of the syntax and of static semantics. Both TTCN.MP and TTCN.GR shall be processed on the same TTCN-dedicated editing tool.

If the Coordinated method is used, the ATS shall contain test cases for testing that the UT conforms to the requirements of the TMP specification (see ISO/IEC 9646-2 [6], subclause 14.1, item h). It may also contain test cases for controlling (e.g. initializing) the UT.

The mapping between the ATCs and the TPs should be documented in the Test Suite Overview, which should contain:

- either a statement that the mapping is explicit by naming conventions;

- or a reference to the ATS to TP map section of the ATS specification if this component is provided (see subclause 7.4.10).

7.4.5 TCP

In the case of Single-Party Testing, and if the ATM requires, TCP may need to be specified. In this case, information shall be provided in accordance with ISO/IEC 9646-2 [6], subclause 11.2.4.

It is encouraged, however, to use Coordination Messages of Concurrent TTCN for exchanging information between UT and LT. If this is done, the TCP are dealt with in the ATS itself, and it is no longer needed to specify them as a separate component of the ATS specification.

If the selected test Method is the co-ordinated one, a TMP shall be specified.

The TMP shall be produced in accordance with ISO/IEC 9646-2 [6], clause 13.

A TMP has to convey from the lower tester to the upper tester a request for an action at the IUT service interface, and to convey back to the lower tester the record of the observation of an event at the IUT service interface.

The TMP specification is a real protocol definition which includes the semantic actions to be taken on the IUT side.

In accordance with ISO/IEC 9646-2 [6], clause 13, the TMP shall be accompanied with a TMP implementation statement proforma, which shall include at least one item for each of the Test Management Protocol Data Units (TM-PDUs).

7.4.6 Partial PIXIT proforma (partial IXIT proforma)

The IXIT proforma is a questionnaire containing questions related to the parameterization of the MOT and of the IUT, or related to the IUT behaviour which is actually triggerable and observable. The use of the answers to IXIT questions is the same as in the case of ICS, i.e. parameterization of test cases, AND selection of test cases: the IXIT, in conjunction with the ICS, will be used by the test laboratory to produce the Parameterized Executable Test Suite (PETS). See ISO/IEC 9646-4 [9], annex A.

The partial IXIT proforma shall not be produced before the ATS.

The partial IXIT proforma shall be produced according to ISO/IEC 9646-5 [10], annex C.

The partial IXIT proforma is a part of the conformance TS.

Definitions:

The partial IXIT proforma: is specified by the test suite specifier and relates to question concerning the parameterization of the ATS. It also contains questions affecting test case deselection, such as the IUT observable behaviour and the procedure to trigger it.

The augmented partial IXIT proforma: is specified by the test realizer on the basis of the partial IXIT proforma. It "augments" the content of the partial PIXIT by adding questions concerning the parameterization of the particular MOT. The augmented partial PIXIT proforma will be used by the test laboratory as a basis for the production of the **IXIT proforma** (additional questions may be added by the test laboratory).

The partial IXIT proforma shall contain the list of all parameters for which the ATS requires values.

It will concern information on the layer to be tested and on the ancillary layers. In the case of embedded methods, the IXIT may also concern layers above the tested one.

7.4.7 PCTR proforma

The PCTR proforma shall be produced in accordance with ISO/IEC 9646-5 [10], in particular annex B.

NOTE: The requirements of EN 45001 [4] (equivalent to the ISO Guide 25) have been taken into account in ISO/IEC 9646-5 [10].

The PCTR proforma should also be produced in accordance with ETR 153 [1]. In particular, ETR 153 [1] provides guidance on the application of EN 45001 [4] criteria.

PCTRs provide, for each implementation tested, detailed information about the IUT configuration, test method and environment and the test results for every test case executed.

7.4.8 Untestable TPs

The feasibility of the specification of the ATC corresponding to a given TP depends on the ATM chosen. Therefore, for ATM with a limited coverage (ex Remote method) some TPs may not be derivable into ATCs.

In case there are untestable TPs in the TSS&TP, their list shall be produced.

In case there are no untestable TP, it shall be clearly stated.

The list of untestable TP shall be provided even when the TPs have been designed after having chosen the ATM.

7.4.9 Abstract selection rules

This is a temporary complement to ATS which have not been written in TTCN International Standard (IS) version, and thus do not contain a test case selection expressions table.

In the normal situation, TTCN IS is used, and selection expressions are part of the ATS.

7.4.10 ATS to TP map

This is normative material which has to be produced when the referencing system of the ATS is different from the referencing scheme of the TSS&TP.

The normal situation is to have control on the referencing schemes when the ATS is developed. In this case, the same scheme shall be employed for both TSS&TP and ATS.

The only circumstance in which the two referencing schemes of TSS&TP and ATS may be different, and thus make necessary the production of an ATS to TP map section is when both the ATS and the TSS&TP are imported.

The ATS to TP map is a detailed description of the correspondences between the two referencing systems.

Each ATC shall always relate to one and only one TP (or CTP).

7.5 Amendments

This subclause only applies to the production of conformance testing specifications in standardization bodies.

When existing standardized material is to be reused, corrective changes or additional components have to be produced. They constitute an amendment to the existing TS.

The two main reasons for taking such corrective actions are:

- change requests have been produced and the technical changes have been agreed upon. This mainly happens at the time of implementation, for TSs which have been issued without having been validated;

- the existing TSS&TP does not provide sufficient coverage, which deserves to be enhanced.

These two situations are not mutually exclusive.

NOTE 1: This applies to the case of a pre-existing standardized testing specification. The case of a non-standardized existing testing material (e.g. deliverable from CTS programme) reused to produce a TS is different. The resulting work is a first edition of a new standard, without any amendment.

NOTE 2: In ETSI, amendment procedures are defined in the ETSI Technical Assembly working procedures.

7.5.1 TSS & TP amendment

A TSS&TP Amendment consolidates all the changes applicable to the current version of the TSS&TP standard. It may reflect additions, corrections, or deletions of TPs.

7.5.2 ATS amendment

An ATS amendment consolidates all the changes applicable to the current version of the ATS specification standard.

It may reflect:

- a TSS&TP amendment;

- corrections of ATCs.

8 Profile ICS proforma

The profile ICS plays the same role in the context of a profile as the base specification ICS (e.g. PICS) plays (see clause 6) in the context of a base specification. It follows the rules of ISO/IEC 9646-7 [12].

However, the nature of the proformas used in the context of a profile ICS is different, because:

- the ICS of the base specifications making up the profile are re-used;

- the constraints specified by the profile in addition to the base specifications are documented.

As in the case of the base specification ICS, the proformas are part of the set of reference specifications in which the profile is specified, i.e. the proformas accompany the base specifications and the profile specification.

8.1 Objective of the profile ICS

Similar to testing against a base specification, testing against a profile requires that (compare with subclause 6.1):

a) the set of conformance requirements to be met by a conforming implementation is documented by the profile specifiers.
In the context of a profile, this set is identified by the base specification (reflected in the base specification ICS proforma) and in the profile specification (reflected in the profile Requirement List (profile RL));

b) the set of capabilities retained in this implementation is also documented by the product implementor, which makes a "statement".
The set of implemented capabilities is documented by filling up the ICS proforma, which becomes the (completed) profile ICS.

Concerning the conformance assessment process, the profile ICS is used:

- as the description of the IUT for the static conformance review;

- as the description of the IUT capabilities for the test case deselection;

- as the description of the IUT for the test suites parameterization;

- as a reference document for the analysis of the results;

- the components of the profile ICS are attached to the final test report.

Outside the conformance testing context, the profile ICS:

- is used to provide an overview of the capabilities supported by the implementation;

- may be used to statically check the interworking capacities of two implementations.

8.2 What is a profile ICS proforma?

A profile is specified by reference to base specifications (see subclauses 5.2, 5.3, 5.4, and figure 3).

Following the same logic, a profile ICS will make use of the ICS proformas specified for the base specifications.

Hence, no new proforma is defined to cover the whole profile. The "profile ICS proforma" (defined in ISO/IEC 9646-1 [5]) is in fact a collection of documents. It is not a new document.

Base specification proformas will be used, and a specific proforma for the profile will be specified as a complement if needed: the profile-specific ICS.

Hence, the profile ICS proforma is the collection of:

- the ICS proformas of each base specification belonging to the profile;
- the profile-specific ICS proforma;
- the profile RL.

And the profile ICS is the collection of:

- the (completed) ICS of each base specification belonging to the profile;
- the (completed) profile-specific ICS;
- the profile RL.

All these documents are defined in ISO/IEC 9646-7 [12].

If the ICS proformas are not available for each base specification concerned by the profile, the missing ICS will have to be produced. **Those ICS shall be associated to the base specifications, independently of the profile.**

In particular, writing a "PICS for a profile" shall be precluded (see subclause 5.8).

The following figure shows the contents of a profile ICS proforma and of a (completed) profile ICS. This figure is to be read in conjunction with figure 3 which shows the components of a profile specification.

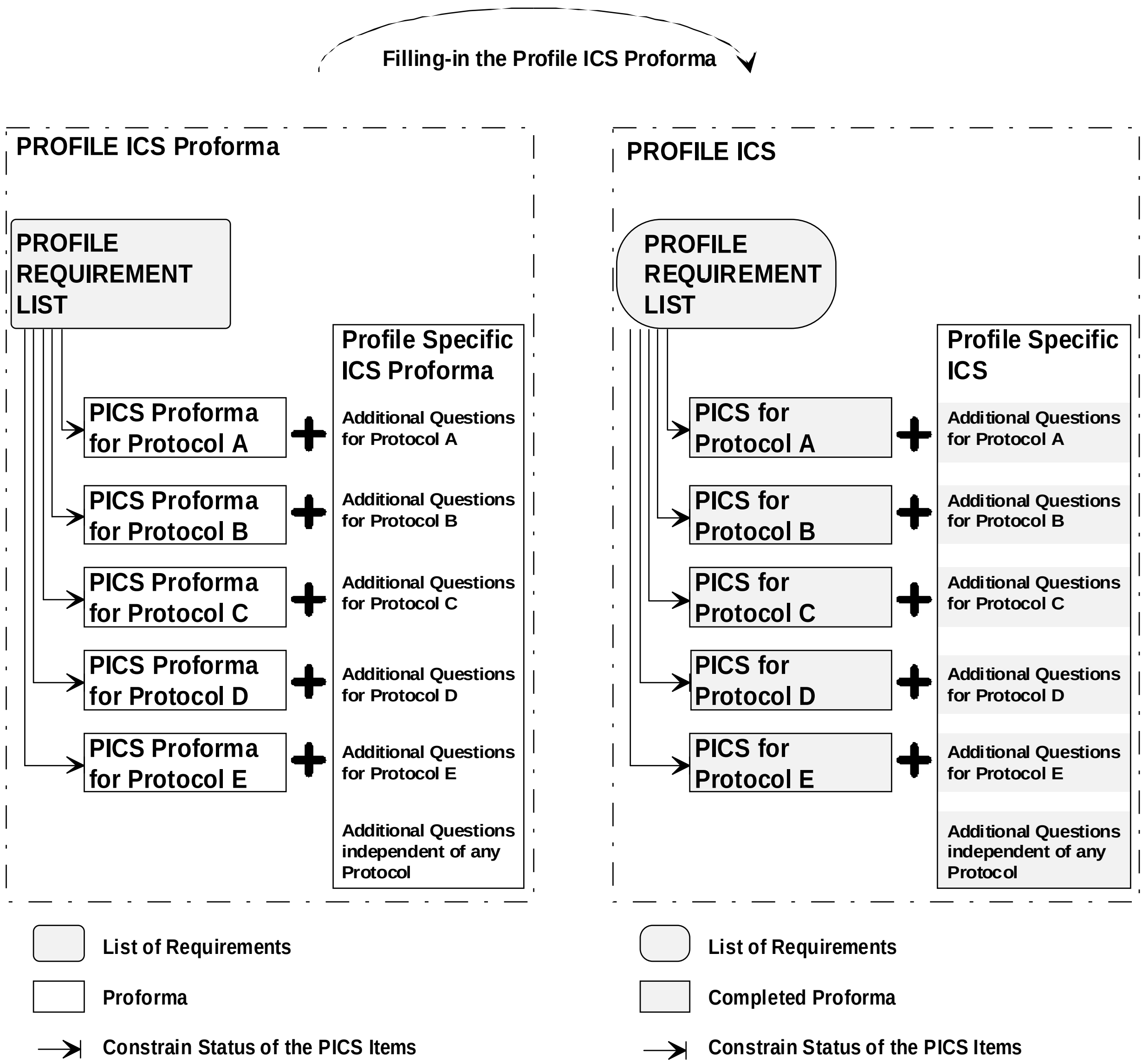


Figure 14: Components of profile ICS proforma and of profile ICS

8.2.1 Profile requirement list profile RL

A profile RL is a document designed by the profile specifiers. It is a normative part of a profile specification. Therefore, the specification of a profile RL is not a test specifiers business.

However, the profile RL shall exist prior to the design of an ATS.

ISO/IEC 9646-7 [12], subclause 6.4, standardizes the method of specification of profile RLs.

A profile RL is not a proforma. It does not contain questions, but restricts the acceptable answers to the questions in the base specification ICS proformas relevant to the profile.

ISO/IEC 9646-7 [12], subclause 6.4, reads that "to use a profile RL, each table needs to be put alongside the corresponding table from the relevant ICS proforma." In order to achieve this, the profile RL shall follow the structure of the relevant PICS proformas, and use the same referencing schemes.

Practically, a profile RL is produced by copying the tables from the relevant ICS proformas, and replacing the columns according to the profile RL needs. The items for which the profile RL does not change the status expressed in the base specification PICS, should not appear in the profile RL. The corresponding lines should be dropped.

The profile RL shall contain a full reference to the PICS proformas of all the base specifications relevant to the profile.

8.2.2 Profile-specific ICS proforma

The profile-specific ICS proforma is defined in ISO/IEC 9646-7 [12], subclause 6.3.4. It is required when requirements related to the profile cannot be mapped onto existing items in the base specification PICS(s).

In practice, a profile-specific ICS proforma is frequently not required.

When a profile-specific ICS proforma is required, it shall satisfy the same criteria as a PICS. See clause 6 and annex A.

8.3 Profile ICS proforma and TS

All the components of the profile ICS proforma shall exist prior to the design of a profile TS.

The ATSs for a profile contain references to PICS questions and to profile-specific ICS questions.

8.4 Profile ICS and conformance assessment process

The various components of a profile ICS are used as a support to the conformance assessment process.

8.4.1 Profile ICS and static conformance review

The static conformance review for a profile is carried out by a laboratory in three steps:

a) all the answers in the base specification PICS are checked to be in accordance with the status in the base specification PICS;
b) all the answers in the base specification PICS are checked to be in accordance with the profile status in the profile RL;
c) all the answers in the profile-specific ICS are checked to be in accordance with the status in the profile-specific ICS.

8.4.2 Profile ICS and test case parameterization, de-selection

The ATSs relevant to the profile contain references to PICS items, and may contain references to the profile-specific ICS items.

These references are used to set the values of test suite parameters, which are also used as variables in test case selection expressions.

The selection and parameterization of test suites for a profile is done as follows by a laboratory:

- in the case of a reference to a PICS item, the value is set according to the PICS (support) answer given by the supplier, unless the profile requirement list specifies a more constraining profile support for the concerned item, in which case, the profile support overrides the PICS (support) answer;

- in the case of a reference to a profile-specific ICS item, the value shall be set according to the profile-specific ICS (support) answer.

For the selection of test cases, the laboratory can also use the "pre-selected" list of test cases provided in the Profile Specific Test Specification (PSTS).

8.4.3 Profile ICS components attached to test reports

The reader of a test report needs to know which profile the IUT was tested against.

The PICS corresponding to the base specifications are attached to the PCTRs.

However, this information is not sufficient, because:

a) the profile status in the profile requirement list has overridden the PICS (support) answer at the time of test case selection and parameterization (see subclause 8.4.2);

b) the PICS (support) answers can be dependent on the profile against which conformance is claimed (conditional support answers are allowed in ISO/IEC 9646-7 [12], subclause 9.3.2).

For this reason, an explicit reference to the profile requirement list shall be attached to the PCTRs if the PCTRs are issued without a SCTR (if the SCTR is provided, it shall contain the reference of the profile RL).

If the SCTR is provided for a profile, the profile-specific ICS shall be attached to the SCTR.

The concept of attachment is used as in ISO/IEC 9646-5 [10] annex A, i.e. is provided "a reference to a copy of the document included in the package of documents".

9 TS for a profile

This clause provides:

- the principles of profile testing;

- a checklist, and an overview showing dependencies, of the components of a TS for a profile;

- the definition of the components.

A TS for a profile shall include at least all the mandatory components listed in the checklist of subclause 9.4, and comply with ISO/IEC 9646 Parts 1 to 5 (references [5] to [10]) as well as with Part 6 [11], specifically devoted to profile testing.

All the components of a TS shall follow the minimal quality criteria provided in this clause.

9.1 Principles of profile testing

A test specification for a profile is called PTS.

As drafted in figure 4, a PTS is specified, where possible, by reference to test cases of the base specification test specification.

More precisely, the PTS uses:

- a collection of ATSs for the base specifications concerned by the profile;

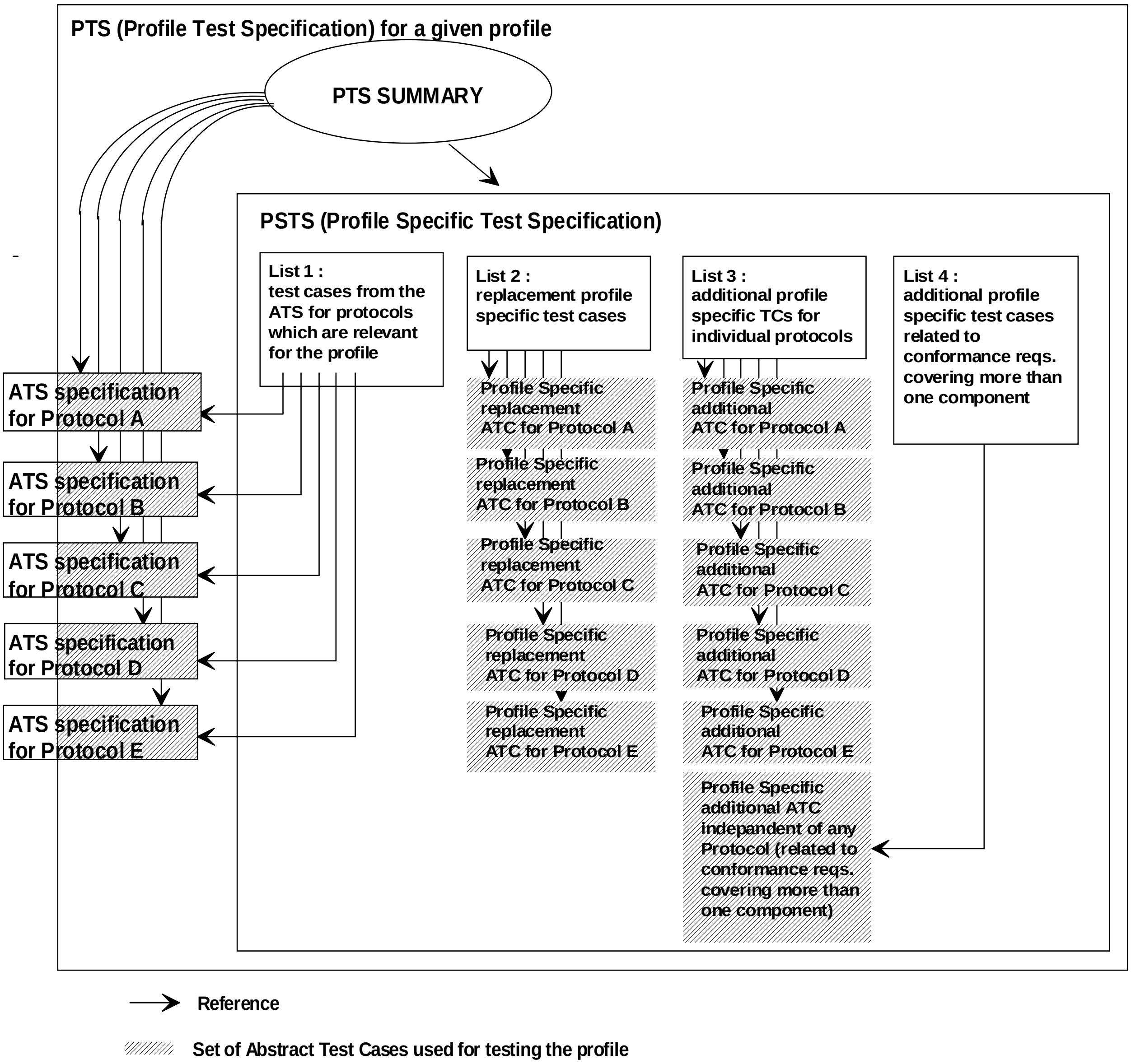
- a PSTS, containing additional test cases required for the profile only, as well as a definition of the subset of the base specifications tests applicable to the profile.

A structuring document called PTS-Summary provides a list of all the ATSs applicable to the test of the profile: ATSs for base specifications and PSTS.

Figure 15 describes the principle of use of the different ATSs within the framework of profile testing, as well as the structuring role of the PTS-Summary. It should be read in conjunction with:

- figure 3 (profile in relation to protocol base specifications); and

- figure 14 (profile ICS proforma in relation with PICS proformas and profile RL).



NOTE 1: This figure does not contain all the components of the PSTS (the PSTS also contains TPs, IXIT proformas, selection expressions, etc.). This figure only contains those components of the PSTS that are related to test cases.

NOTE 2: This figure shows that the test cases from the protocol ATS relevant for the profile are referred to from the PTS-Summary AND from the PSTS. Yes, this is redundant, since the list given in the PSTS ("List 1") is automatically derived from the selection expressions contained in the protocol ATS and the profile RL. See subclauses 9.5.1 and 9.5.2.

Figure 15: PTS in relation with the different ATSs and the PSTS; role of the PTS-Summary

9.2 A word on the production process

A project producing a TS for a profile is generally faced with one of these three situations:

a) producing a PTS based on existing TSs for the base specifications;

b) producing a PTS from scratch for the whole profile;

c) producing an incomplete PTS from scratch; limited to "one only protocol in the profile".

Case a) is ideal but rarely encountered.

Case b) is frequently encountered. The method followed shall be to produce, in accordance with the profile test methodology:

- a set of base standard test specifications (protocol ATS), limited[17)] to the features of the base standard retained in the profile;

- the normal structuring components of a PTS, e.g. a PTS-summary (compare with subclause 9.2);

- a profile-specific test specification.

Case c) is also frequently encountered, especially in EWOS when an EG starts the production of test specifications for "a given protocol or layer, according to the European profiles". A similar method as for case b) shall be applied i.e. production of:

- a base standard test specification, limited to the features of the base standard retained in the profile;

- (optionally) the normal structuring components of a PTS, e.g. a PTS-summary (compare with subclause 9.2), limited to one protocol;

- a profile-specific test specification, limited to the profile conformance requirements related to one protocol.

17) i.e. the shaded part of the ATS for protocol, in figure 15.

9.3 Synopsis of components and their dependencies

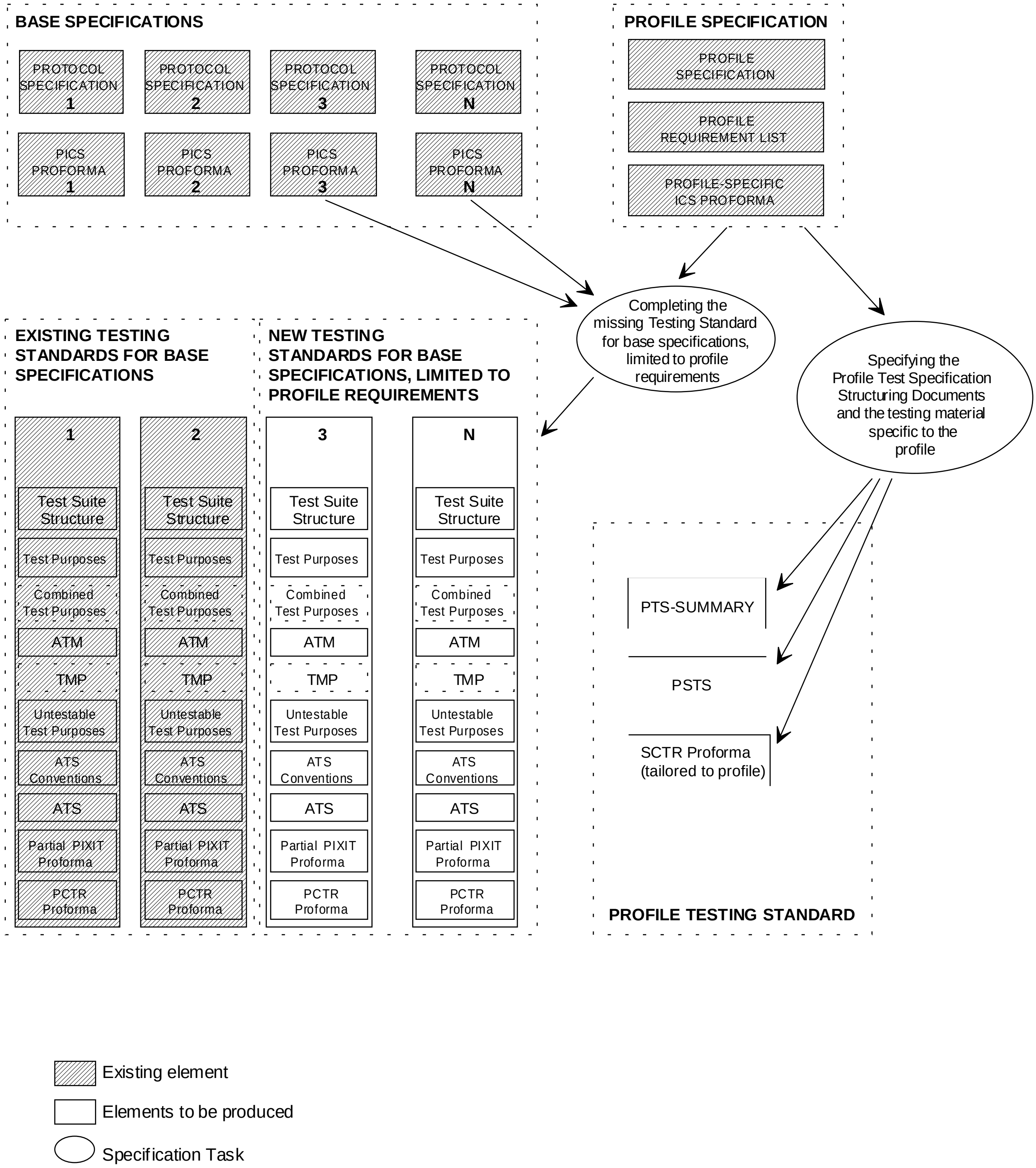


Figure 16: Synopsis of the components and their dependencies

Figure 16 shows, in the general case, the components that belong to a profile, to the base specifications used by the profile, to the (existing and missing) TSs for the base specifications, and to the profile TS itself. The aim of this description is to provide the reader with a global and consistent view of the overall process. Therefore, tasks and components are presented in a very macroscopic manner.

The components in dotted boxes are "waiver possible", because they depend on the context.

The respective components are described further in this clause.

9.4 Checklist of components

Table 3: checklist of components for a PTS

Component	Reference in this ETS	Status	Rule or comment
Components associated with base specifications:			
$\sum$ PICS proformas (or other ICS, e.g. Object ICS)	clause 6	M	**The PICS proformas shall exist prior to the design of an ATS for all the base specifications used by the profile**
Components associated with the profile:			
Profile RL	8.2.1	M	**The profile RL shall exist prior to the design of an ATS, as part of the profile specification.**
Profile-Specific ICS	8.2.2	M	**The profile-specific ICS shall exist prior to the design of an ATS, as part of the profile specification.**
Base specifications TSs:			
	clause 7	M	**TSs shall exist for all the base specifications used by the profile, covering at least the conformance requirements concerned by the profile.** (note 2)
Components making up profile TS:			
Profile-Specific Test Specification (PSTS)	9.5.1	M	
PTS-summary	9.5.2	M	
SCTR proforma tailored for profile	9.5.3	M	(note 1)

NOTE 1: This is not a new concept: SCTRs and SCTR proformas are mentioned in ISO/IEC 9646-1 [5] and ISO/IEC 9646-5 [10]. This ETS requires the production of a SCTR proforma tailored for the profile as a component of any PTS.

NOTE 2: Two cases then appear:
- if, for a base specification, the TS already exists, it shall be used;
- if, for a base specification, the TS does not exist, it shall be developed prior to the development of the profile testing specification itself, but it will be incomplete, because in practice limited to the aspects of interest for the profile.

Key: M: Mandatory.
O: Optional.

The components defined in table 3 are logical components. The packaging of the TS (i.e. which physical documents contain which logical components) is provided in subclause 10.1.1.

9.5 Definitions of the components and criteria

9.5.1 Profile-specific test specification

The PSTS is not limited to "those aspects of profile testing not covered by the protocol ATS", but is a structuring document of a PTS, complementary to the PTS-summary.

The PSTS shall follow ISO/IEC 9646-6 [11], which, in particular, defines its contents as follows (some notes are added):

a) the following lists of relevant ATCs:

   1) a list of test cases from each ATS which is applicable to the profile. The list of test cases shall be equivalent to the result of applying a fictitious profile ICS indicating support of all allowed profile options to the selection expressions of the relevant ATS;

   NOTE 1: a1) is redundant with the PTS-summary reference to the various ATSs for the protocols.

   2) a list of test cases identifying which ATCs from the list identified in a1) are to be replaced by which test cases from the PSTS;

   3) a list of additional test cases for testing profile conformance requirements not covered by the base ATS(s). Ideally, this list should be empty;

   4) a list of the test cases of the additional ATS which are related to profile specific conformance requirements covering more than one component;

b) the following set of relevant ATCs:

   1) test cases replacements identified by item a2);

   2) the ATCs identified by item a3). If possible, these test cases should be generalized and migrated to the ATS specification;

   3) the test cases of the additional ATS identified in a4);

c) the following set of relevant TPs:

   1) new or modified TPs related to those test cases identified in a2) and a3);

   2) a TSS&TP for the additional ATS identified in a4);

d) information specifying the parameterization of all relevant ATCs in the form of:

   1) modifications to existing partial IXIT proformas;

   2) a partial profile eXtra Requirement List (XRL) giving additional requirements relating to existing partial IXIT proformas;

   3) a partial profile specific IXIT proforma;

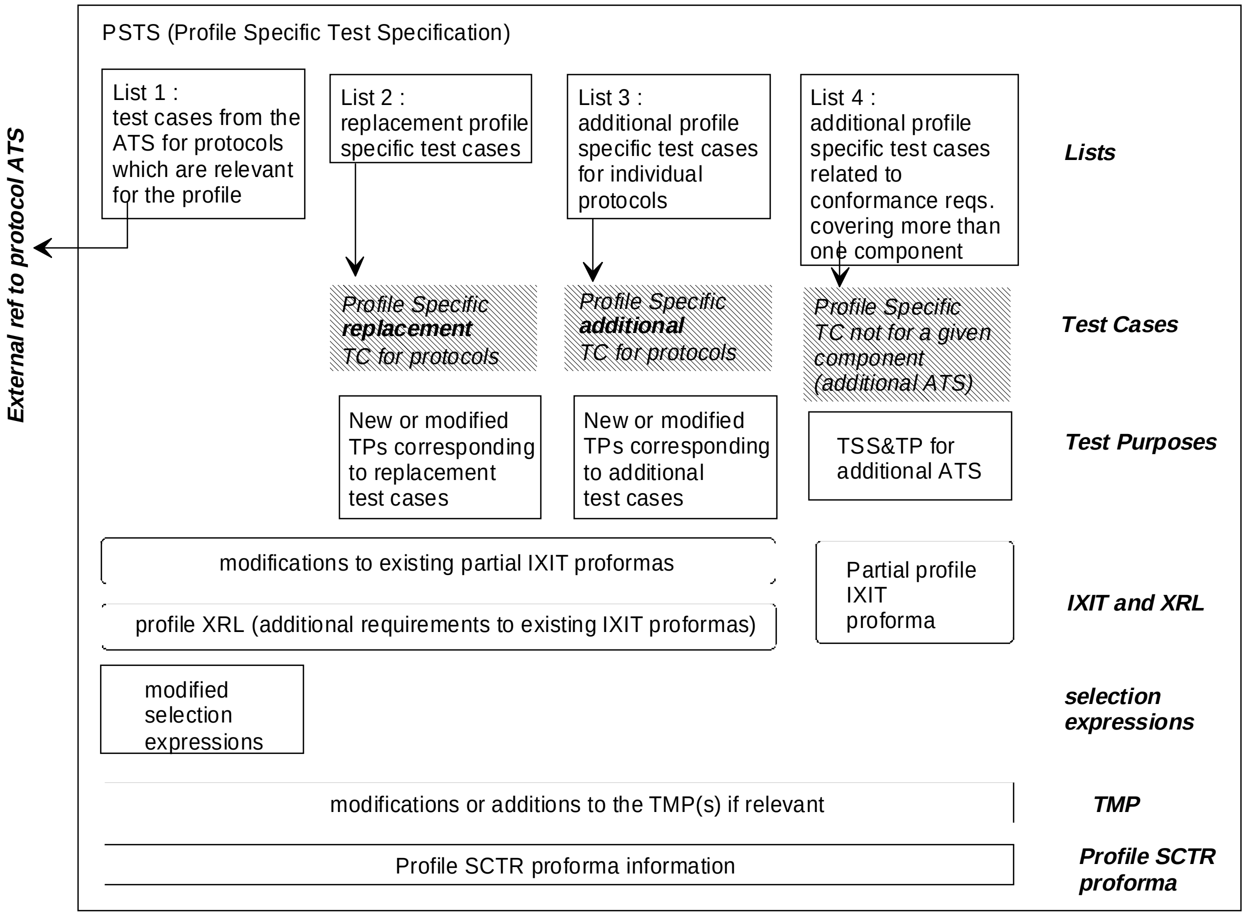
   NOTE 2: The partial profile specific IXIT proforma should contain the information related to the testing of the profile which are inappropriate in the base specification IXIT. For instance, those related to the parameterization of the testing environment or to the configuration of the IUT in order to constrain them to restrict their operations to these allowed by the profile.

e) modified selection expressions related to test cases identified by the list a1), referring as necessary to the profile specific ICS and/or IXIT proformas, or modified partial IXIT proformas;

f) modifications or additions to the TMP(s), if relevant;

g) profile specific information to be included in an SCTR proforma produced based on the template given in annex A of ISO/IEC 9646-5 [10]. According to this ETS, a full SCTR proforma tailored to the profile shall be provided. See subclause 9.5.3.

Figure 17 summarizes the contents of a PSTS.



NOTE 1: This structure of components is very complex because ISO/IEC 9646-6 [11] is designed to be as generic as possible, and, hence, covers "the worst possible case". It is deemed that experience will show how to use this generic structure in a practical way. In the meantime, it is advised that specifiers of test standards for profiles keep the PSTS as simple as possible, by restricting the number of its constituting elements to the minimum necessary.

NOTE 2: A single PSTS may be specified for several closely related profiles, in order to avoid duplication of most of the PSTS information. In this case, it shall be clear which components of the PSTS are relevant to each profile.

Figure 17: Contents of a PSTS

9.5.2 PTS-summary

The PTS-summary is the essential structuring document of a PTS. It provides a list of all the ATSs applicable to the test of the profile: ATSs for base specifications and PSTS.

It shall follow ISO/IEC 9646-6 [11] requirements.

The contents of a PTS-Summary shall be as defined in ISO/IEC 9646-6 [11], subclause 8.2.

9.5.3 SCTR proforma tailored to the profile

ISO/IEC 9646-1 [5] and ISO/IEC 9646-5 [10] define an SCTR and an SCTR proforma.

ISO/IEC 9646-5 [10], subclause 8.2.1, requires that "if a SUT is tested for support of more than one profile, a separate SCTR shall be produced for each profile".

This ETS adds the following requirement: an SCTR proforma, tailored to the profile, shall be produced for each PTS.

The SCTR proforma tailored to the profile shall follow:

- the rules for SCTR proformas: ISO/IEC 9646-5 [10];
- the profile SCTR proforma shall contain the explicit references to the profile, to the PTS, to the profile requirement list, to the profile XRL (if it exists), to the profile specific ICS, to the profile specific IXIT.

The profile SCTR proforma should also follow ETR 153 [1]

9.5.4 Profile IXIT XRL

The profile IXIT XRL is defined in ISO/IEC 9646-1 [5], and shall be produced (if needed) according to ISO/IEC 9646-2 [6] and ISO/IEC 9646-6 [11].

It is an optional document, which specifies restrictions on the allowed answers to the base specification IXIT questions, in order to meet the requirements of the PTS.

In practice, the XRL is rarely needed.

The XRL does not appear as a stand-alone component in table 3, because it is a part of the PSTS, which is a mandatory component in table 3.

9.5.5 Profile IXIT proforma

The profile IXIT proforma is not a new component. Similar to the profile ICS proforma, which was a collection of documents (compare with subclause 8.2), the profile IXIT proforma is composed of:

- the partial IXIT proformas of the base specifications TSs;
- the partial profile-specific IXIT proforma associated with the PSTS;
- (optionally) the XRL.

The profile IXIT proforma does not appear as a stand-alone component in table 3, because it is a part of the PSTS, which is a mandatory component in table 3.

10 Standardization of test specifications

This clause deals with the packaging i.e. the "physical" aspects of a conformance TS, as a document or a set of documents.

10.1 Physical contents of a conformance TS

10.1.1 Structure of a conformance TS

A conformance TS comprises several "logical" components, as described in clause 7 for base specifications, and in clause 9 for profiles.

This subclause provides the rules and preferences for "packaging" these "logical" components into standards.

Two sets of rules are provided, one for the case of base specifications, one for the case of profiles.

10.1.1.1 Conformance TS for a base specification

The rules provided in this subclause are designed to allow maximum flexibility.

The possibility of grouping the conformance testing specification with other specifications in the same standards should benefit by the same flexibility. In particular, it may happen that a testing specification is grouped with its reference standard (being another part of the same multipart standard), but this is not a generality. Such a grouping should be decided on a case by case basis, it is certainly not a requirement.

Table 5 provides the packaging rules for the TSs for base specifications.

This table defines three groups:

- the TSS&TP, composed of logical components 1 to 3;
- the ATS specification, composed of logical components 4 to 9;
- the TMP specification, composed of logical components 10 and 11.

These groups shall not be further subdivided[18)], except for the PCTR proforma or the partial IXIT proforma, which may constitute independent stand-alone standards or parts of multipart standards.

These three groups TSS&TP, ATS specification, and TMP specification (the TMP specification being optional) shall form independent stand-alone standards or independent parts of one or more multipart standards.

These three groups shall not be standardized together in the same stand-alone standard or part of a multipart standard.

18) In particular, it is precluded to use different parts of a multipart standard for different components 1 to 7 of the same conformance testing specification.

The reason for standardizing these groups separately is the following:

a) the TSS&TP and the ATS specification should be embodied in separate standards or parts of standards, because the status of the TSS&TP on one hand, and the status of the ATS specification on the other hand, are generally established according to different criteria.
The TSS&TP reflects a committee consensus on what coverage of the reference specification by the TS is desired (see subclause 7.4.1.2). As such, the TSS&TP may be proposed for definitive status (ETS, EN) standardization following a committee decision.
The ATS specification may need to be published with a provisional status (e.g. I-ETS), until it has been effectively validated by an implementation on a real test system. See subclause 10.2.4.
Even in the case where an ATS is produced by the same project as the TSS&TP, other ATSs may be designed later corresponding to the same TSS&TP.
Moreover, the maintenance of TSS&TP and of ATSs need no systematic synchronization.
As a consequence, TSS&TP and ATS specification benefit by being standardized separately;

b) the TMP specification should be an independent standard or part of standard. This rule is drawn from a recommendation in ISO/IEC 9646-2 [6], clause 13.

NOTE: The information concerning the TCP, if any, is standardized as a component of the ATS specification, whilst the TMP, if any, is standardized apart.

Table 4: Standardization rules for base specification test specification components

Group, and contained logical components	Rules for packaging
TSS&TP	
1) TSS 2) TPs 3) CTPs (if they exist)	**The components 1 to 3 shall be grouped in the same document, either a standard or a part of a standard. The components 1 to 3 shall appear in this order.**
ATS specification	
4) ATM 5) Untestable TPs 6) ATS conventions 7) ATS to TP map 8) TCP information (if required for the ATM in question)	**The components 4 to 9 shall be grouped in the same document, either a stand-alone standard or a part of a multi-part standard. The components 4 to 9 shall appear in this order.**
9) ATS (TTCN)	**The ATS in TTCN shall form a normative annex to the ATS specification (note 1).**
10) PCTR proforma	**The PCTR proforma shall either:** **a) form a normative annex to the ATS specification (this is strongly recommended (note 2)); or** **b) form an independent stand-alone standard; or** **c) form part of a multi-part standard.** **In any case, a copyright release clause shall be included in the annex or the standard containing the PCTR proforma.**
11) Partial IXIT proforma	**The partial IXIT proforma shall either:** **a) form a normative annex to the ATS specification (this is strongly recommended (note 2)); or** **b) form an independent stand-alone standard; or** **c) form part of a multi-part standard.** **In any case, a copyright release clause shall be included in the annex or the standard containing the partial IXIT proforma.**
TMP specification (optional)	
12) TMP (optional)	**The TMP (if it exists) shall be a normative annex to the ATS specification** (document containing the components 4 to 9), or an independent stand-alone standard or part of a multi-part standard.
13) TMP implementation statement proforma	**The TMP implementation statement proforma shall exist if the TMP exists. It shall be in the same stand-alone standard or part of multi-part standard as the TMP itself.**

(continued)

Table 5 (concluded): Standardization rules for base specification test specification components

NOTE 1: The reasons for isolating the ATS in TTCN from the other components are that the ATS in TTCN follows its own editing rules does not follow the PNE-Rules [3] (compare with subclause 10.1.4) and that this annex can be substituted with the TTCN.MP in electronic form.

NOTE 2: The proformas being separate standards or parts of standards should remain exceptional, and is justified, for instance, when a partial IXIT proforma is common to several ATS specifications. In that case, it will preferably be an independent document. For instance, the test of the different **roles** of a protocol may use different ATSs e.g. one ATS for the initiator role, another ATS for the responder role. These ATSs may sometimes share the same IXIT proforma.

The reason for this preference is that the partial IXIT proforma, and the PCTR proforma are only meaningful with respect to a given ATS.

This means in particular that these proformas should always have the same **status** as the ATS specification (e.g. I-ETS if the ATS specification is an I-ETS, ETS if the ATS specification is an ETS).

This also means that, during the maintenance process, these proformas should always be aligned with the ATS, and a new version of the proformas issued when a new version of the ATS is issued.

Keeping the proformas in the same document as the ATS secures and eases the alignment of the proformas with the ATS.

ISO/IEC 9646-2 [6], in subclauses 14.1 and 14.1.b) supports the same principle, since it reads: "The ATS specifier shall provide information in the standardized ATS specification {...}. This information shall include {...} the specification of a partial IXIT proforma for each ATS {...}".

10.1.1.2 Conformance TS for a profile

ISO/IEC 9646-6 [11], subclause 10.6, provides guidance on packaging of profile-related standards.

Table 6 defines three components, which shall be independent standards or parts of one or more multi-part standards.

These three components have to be standardized in separate standards or in separate parts of standards. It is precluded to have more than one of these three components in the same stand-alone standard or in the same part of a multi-part standard.

Table 6: Standardization rules for PTS components

Logical component		Rules for packaging
1)	PTS-summary	**Shall form an independent stand-alone standard or part of a multi-part standard.**
2)	Profile-Specific Test Specification (PSTS)	**Shall form an independent stand-alone standard or part of a multi-part standard.**
3)	SCTR proforma tailored to profile	**Shall form an independent stand-alone standard or part of a multi-part standard. In any case, a copyright release clause shall be included in this ETS.**

10.1.2 Need for an overview document

Every time several related components of test specifications are standardized in different standards, or parts of a multi-part standard, it is strongly recommended to build a separate overview document. This overview document can be informative, i.e. an ETSI Technical Report (ETR) or an EWOS Technical Guide (ETG). It can also be normative, depending on a committee decision.

A typical example is the case of a multi-part standard in which each part is related to a given aspect of a complex base specification. An overview document is necessary to understand what is covered by the different parts of the test specification.

10.1.3 Editing rules for TTCN

The ATS shall be produced by a TTCN-dedicated tool. Compare with subclause 7.4.4.

Both TTCN.GR and TTCN.MP shall be standardized (normative) and distributed.

In case of discrepancy between TTCN.GR and TTCN.MP, the TTCN.MP shall take precedence.

The TTCN.GR shall be distributed on paper, if required. It is not necessary to distribute it in electronic form.

It is encouraged to adopt a policy of distribution limited to a summary of ATSs (e.g. including the TTCN test suite overview, and information on how to obtain the full ATS on request). This can apply to the various approval and voting phases.

NOTE 1: In ISO/IEC/JTC1/SC21 proposes such a policy for the ATSs that ISO will standardize. SC21 also proposes "mechanics of electronic distribution", providing rules on format, read-me files, etc. In particular, it is proposed to distribute the TTCN.GR in several electronic formats, e.g. PostScript, ASCII, word processor formats, etc.

The TTCN.MP shall be distributed in electronic form. It is not necessary to distribute it on paper, unless it is needed in the standardization process, to be distributed during the Public Enquiry.

The TTCN.GR shall follow the rules of ISO/IEC 9646-3 [7].

The TTCN.GR need not follow all of the PNE Rules [3] and ETSI rules of document layout. TTCN.GR contains its own editing rules (ISO/IEC 9646-3 [7]) which are sometimes in contradiction with the PNE-Rules [3] (e.g. the PNE-Rules [3] on physical numbering of tables need not be applied, because TTCN provides a complete and consistent logical referencing scheme of components).

However, the following PNE-Rules [3] and ETSI rules of document layout shall be applied, provided they are supported by the TTCN syntactical editor:

- mirror margins, as per PNE-Rules [3];
- page headers, as per PNE-Rules [3];
- continuous page numbering of the TTCN.GR part, as part of a document.

In particular, the TTCN.GR specification shall be standardized and distributed as it is issued by the TTCN syntactical editor, and shall not be submitted to any post-processing (e.g. on a word processor).

NOTE 2: The recommendation to have the ATS in TTCN in a separate part of a TS (preferably an annex) is justified by the fact that:

- it has to be isolated from the part following the PNE-Rules [3]; and

- this part can be semantically substituted with the equivalent electronic version of TTCN.MP.

In practice, the annex will possibly contain an introductory text announcing TTCN and containing the proper references, and then the TTCN.GR itself, as issued by the TTCN tool (see figure 18).

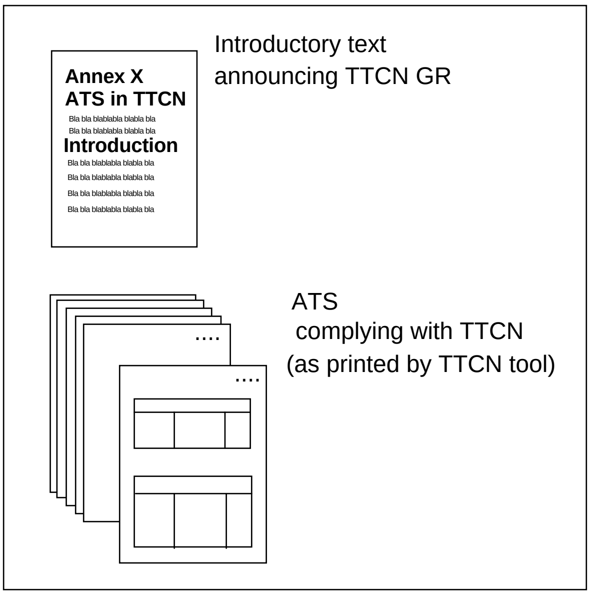


Figure 18: The annex containing the TTCN ATS

10.1.4 Copyright of proformas

ISO/IEC 9646-7 [12] subclause 8.2 provides the requirements for ICS proforma specifications: clauses that shall be contained for copyright release. See subclause 6.6.

In ETSI, in the case of the PICS proforma, the copyright release clause shall be:

Notwithstanding the provisions of the copyright clause related to the text of this ETS, ETSI grants that users of this ETS may freely reproduce the PICS proforma in this clause so that it can be used for its intended purposes and may further publish the completed PICS.

For other proformas the proper name of the proforma shall replace "PICS".

For other documents (e.g. I-ETS) the proper name of the document shall replace "ETS".

All proformas shall contain copyright release clauses: PCTR proforma, SCTR proforma, partial (base specification) IXIT proforma, profile IXIT proforma, TMP implementation statement proforma.

10.1.5 Copyright of TTCN.MP

If the machine processable versions of the ATS are copyrighted, their use in tools (e.g. for editing, or for automatic generation of executable tests) may constitute a violation of copyright.

The policy of European standardization on whether the machine processable form of the TTCN ATS should be copyrighted or not is not stable yet.

In ISO, ISO/IEC 9646-2 [6], subclause 12.7 specifies that a copyright release clause shall be included in the ATS specification.

NOTE 1: This subclause needs to be updated when a decision is made on the subject in the European instances.

NOTE 2: The distribution process of the ATS is out of the scope of this ETS.

10.1.6 Conformance clause

An ATS specification shall contain a conformance clause, indicating the requirements for an MOT, and for a testing laboratory to conform to the ATS specification.

In particular, the conformance clause shall contain:

- the statements of ISO/IEC 9646-2 [6], subclause 12.5;

- the identification of test cases or test groups which shall be realized in a MOT claimed to conform to the ATS specification (see ISO/IEC 9646-2 [6], subclause 14.1, item f).

10.1.7 Case of ATSs having parts in common

It often happens that several ATSs have components in common.

This is the case, for instance, when several test suites cover different aspects of the same technology.

EXAMPLE 1 (OSI): Embedded ATSs for the common stack of upper layer protocols (ROSE, ACSE, Presentation, Session) that support various Application layer protocols (FTAM, MHS, Directory, Virtual Terminal (VT), etc.). The dynamic behaviour of the test cases is the same; the constraints are different according to the application layer under which the IUT is embedded. The technique consists in splitting the test suites into a Common Part, and several Specific Parts (compare with EWOS study quoted thereunder).

EXAMPLE 2 (ISDN): The test suites developed for ISDN D-channel layer 3 (Basic Call Control) have different declarations and constraints according to whether Primary Rate Access or Basic Access are concerned. The test steps and the test cases are the same for both (compare with ETSI STC SPS5, WG3 work).

However, the methodology does not allow, today, to design modular test suites. The referencing scheme of the TTCN makes a test suite atomic.

NOTE: The problem of partial or modular test suites is threefold:

a) TTCN test components are not independent modules in a TTCN test suite, and the components belonging to the four parts of the suite: Overview, Declarations, Constraints, Behaviour have cross-connections between each other. It has been proposed that TTCN be enhanced to support "extraction" of components;

b) a precise referencing scheme, analogue to the PTS-Summary, would be needed to express that a test suite is composed of several (common or specific) components, specified in several standards;

c) maintenance of test suites has to be aligned with a modular approach. As a matter of fact, the modification of a component may affect several test suites.

The following rule shall be applied:

When different test suites have some components in common (test cases, test steps, constraints, etc.) the components in question shall be duplicated, and each test suite shall remain complete, self-standing and independent.

Modularity may be used at editing level (see figure 19). The editors responsible for issuing and maintaining the test suites are encouraged to store the components in a modular way, provided that this modularity is not used in the standardized documents issued. By doing so, the editors of the test suites make their own life easier, and also facilitate the future transition to a full modular structure of test suite standards, the day the methodology provides a framework for it.

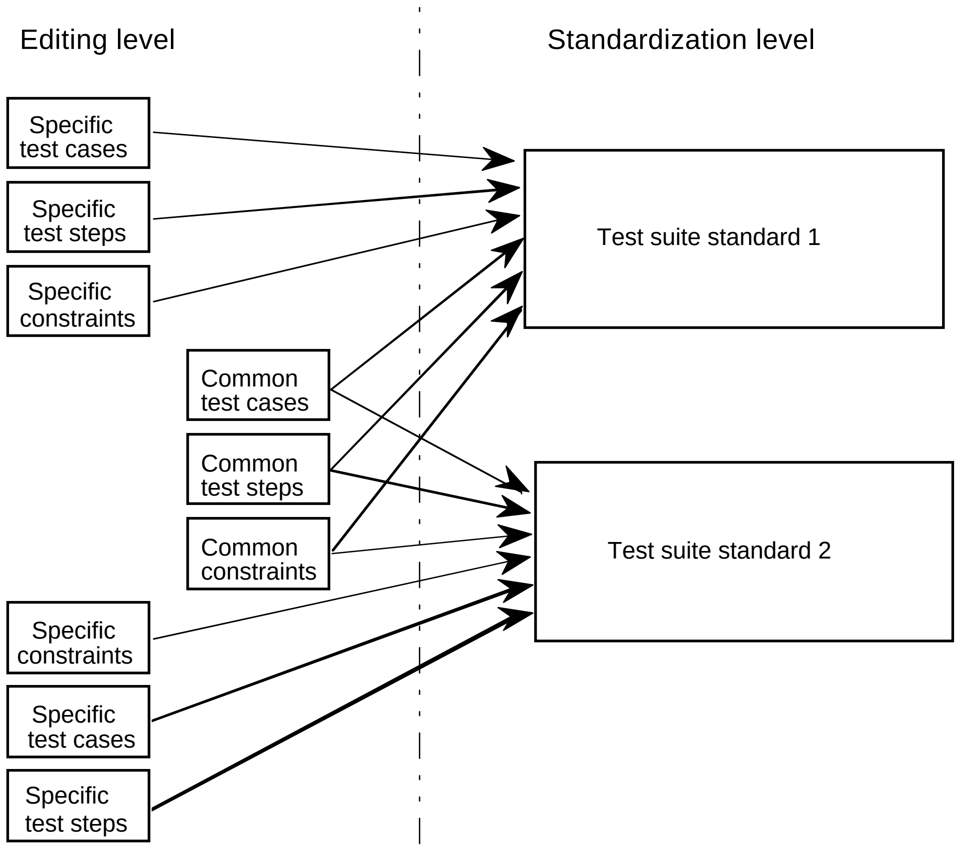


Figure 19: The way to keep a modular approach at the editing level, while test specifications are self-standing

10.2 Minimal quality criteria

This subclause specifies minimal quality criteria that shall be satisfied before a test specification can be standardized.

10.2.1 Reference to the reference specification

Any conformance TS shall contain an unambiguous reference (including date, version number, amendments) to the Reference Specification to which it applies.

10.2.2 Components of a TS

All the components of a TS shall comply with the requirements expressed in clauses 7 and 9 of this ETS.

10.2.3 TTCN notation

As expressed in subclause 7.4.4, an ATS shall use the TTCN notation of ISO/IEC 9646-3 [7].

The version shall be the IS version. The use of the DIS version shall be precluded.

NOTE: This rule is deliberately more stringent than ISO/IEC 9646 (references [5] to [12]), which only recommends the use of the TTCN notation.

10.2.4 Validation

10.2.4.1 Validation of TSS&TP

Before being capable of standardization, a TSS&TP shall have passed the validation of the coverage of the reference specification by the TPs.

Validation of TSS&TP is a pre-requisite to:

- TSS&TP standardization;
- ATS specification validation.

Validation of TSS&TP consists in paper work. In support of this activity, a number of checklists exist, published as Quality Assurance review tables. The use of such relevant review tables is encouraged.

10.2.4.2 Validation of ATS specification

Before being capable of standardization, an ATS specification shall have passed the following validations steps:

1) validation of the TTCN syntax and static semantics (the TTCN tool on which the ATS was produced already performed some validation of syntax and static semantics. However, this may be not sufficient, and additional manual validation on paper may be required, in particular for static semantics);

2) validation of the TTCN semantics in relation with the reference specification, i.e. validation of the coverage of the TPs by the ATS. This validation consists in checking that each TP is actually covered by at least one ATC, except when the ATM makes it impossible.

It should also have passed the following validation:

3) field trial validation: it is recommended that an ATS should be effectively and totally implemented and the resulting ExTS run against an IUT and all the defect reports related to this implementation resolved and fed-back into the ATS.

The ATS specification shall be published as an ETS or an EN.

However, if the field-trial validation 3) has not been passed (the implementation of a standard is not under the responsibility of a standardization institution), it may be necessary to adopt a two-stage approach, and to issue the ATS specification with a temporary status (i.e. ENV or I-ETS). This decision is under the responsibility of the relevant TC, STC, or EG. Whatever status is chosen, it is recommended to make the ATS specification publicly available as soon as possible, without awaiting full validation.

NOTE 1: The validation steps mandated or recommended here concern the ATS specification. The TSS&TP needs only a review of the coverage (equivalent to validation 2)) in order to be capable of standardization. In particular, the TSS&TP should not await the validation of the ATS to be standardized.

NOTE 2: Recommending field trial validation as a prerequisite to standardization may lead to the question: why is it necessary in the case of an ATS, and not for all standards? The answer is that most of the standards may be validated by paper work or simulation on dedicated software. An example is the validation of a communication model specified with a formal description technique. In the case of an ATS, the complexity of the specification, and the fact that it contains many data values, exposes it to errors to a larger extent. A non-validated ATS would contain as many errors as a software written without having ever been compiled or executed. This different order of magnitude in the risk of finding errors explains that field-trial validation is necessary in the case of an ATS, while it may be optional in the case of other standard specifications.

NOTE 3: In ETSI, if an I-ETS status is chosen for the ATS specification, this prevents the ATS specification to be a part of a multi-part standard when the other parts have an ETS status. The ATS specification should then be standardized separately.

11 Conformance clause

11.1 Conformance with this ETS

A conformance testing specification conforming to this ETS is required to comply, as a minimum, with the requirements and criteria stated in:

- subclause 4.1.2;
- clause 6, subclauses 6.5, 6.5.1, 6.5.2;
- clause 7, subclauses 7.3, 7.4.1, 7.4.1.1.1, 7.4.1.1.4, 7.4.1.2, 7.4.1.3.2, 7.4.2, 7.4.4, 7.4.5, 7.4.6, 7.4.7, 7.4.8, 7.4.9;
- clause 8, subclauses 8.2, 8.2.1, 8.2.2, 8.3;
- clause 9, subclauses 9.2, 9.4, 9.5.1, 9.5.2, 9.5.2.1, 9.5.2.2, 9.5.2.3, 9.5.2.4, 9.5.2.5, 9.5.2.6, 9.5.2.7, 9.5.3, 9.5.4;
- clause 10, subclauses 10.1.3, 10.1.4, 10.1.5, 10.1.6, 10.2.1, 10.2.2, 10.2.3, 10.2.4;
- annex A, clauses A.1, A.2, A.3, A.4, A.5.

NOTE: In this ETS, the rules and the strong recommendations are highlighted by the use of bold text.

11.2 Conformance with ISO/IEC 9646

The underlying assumption is that, by conforming to this ETS for drafting test specifications, one also conforms to ISO/IEC 9646:1994 (references [5] to [12]). Conformance to ITU-T Recommendation X.290 is only required when it does not conflict with ISO/IEC 9646 (references [5] to [12]). Full alignment is expected when the new series of X.290 (1994) Recommendations is issued by ITU-T Study Group 7.

However, conformance to ISO/IEC 9646 (references [5] to [12]), strictly speaking, requires that a SUT is built of OSI protocols from layer 1 to its top layer.

NOTE: The exact meaning of what an OSI protocol is has never been defined. A pragmatic definition follows.

In the upper layers, OSI session and presentation belong to OSI. In layer 7, all protocols making an explicit statement that they require the existence of OSI session and presentation as supporting layers, and are consistent with ISO 7498 (X.200), are deemed to be OSI.

At layer 4, all OSI transport classes, operating on a layer 3 providing the OSI network service, are unambiguously defined. In layers 1 to 3, all those protocols which are referenced by the T/ profiles of ISO Technical Report 10000-2 taxonomy, and provide a conformant OSI network service, are deemed to belong to OSI.

In summary, an OSI SUT has at least a network service and a transport layer implemented according to OSI standards (JTC1/SC6). If upper layers exist, session and presentation standards (SC21) will be implemented.

This leaves some freedom in the lower layers, and allows to accept ISDN within the OSI scope if the above conditions are met.

However, the experience in European standardization is that ISO/IEC 9646 (references [5] to [12]) is also applicable to most telecommunications protocols and profiles, especially if they belong to a layered architecture, and that the concept of service definition between layers (Abstract Service Primitive (ASP)) is used.

When referred to in European standardization, ISO/IEC 9646 (references [5] to [12]) shall be used by:

- either using it in the OSI context;

- or in another context, by replacing the acronym OSI by a reference to another architecture.

Annex A (normative): Normative criteria for the standardization of PICS (ICS) proforma specifications

This annex provides quality criteria that an ICS proforma specification shall satisfy, in addition to ISO/IEC 9646-7 [12] criteria.

NOTE 1: Although it is desirable to constrain the notations defined in ISO/IEC 9646-7 [12], and define a European ICS style, consensus on this topic is not straightforward An independent work item in TC MTS covers the subject and will produce an independent ICS style document (see note 2).

NOTE 2: This annex is not the European ICS style guide; it only provides the **minimal** criteria that needs to be applied.

NOTE 3: **Grey tables** are used in the examples of ICS tables to show **what should not be done**, while clear tables are examples of what should be done.

This annex contains a number of normative requirements. Exceptions can be tolerated to the requirements of clauses A.4 and A.5, only in the case of existing ICS proformas which are imported for the purpose of standardization. The requirements of clauses A.4 and A.5 shall be followed for any ICS proforma developed.

A.1 Static versus dynamic requirements in an ICS proforma

The ICS questions shall be static conformance requirements from the reference standard. Dynamic questions shall not appear in the ICS, except in particular situations.

The situation in which dynamic requirements are tolerated is the case of a profile-specific ICS relating to a profile which adds dynamic behavioural requirements to the base specifications, additions or exclusions. For instance, a profile which makes the presence of a parameter mandatory.

If dynamic requirements appear in an ICS proforma, a clear justification shall be provided.

Dynamic conformance requirements shall never appear in an ICS proforma if they are related to static conformance requirements of the reference specification (see ISO/IEC 9646-7 [12], subclause 8.5.1).

Static requirements can be interpreted as:

- WHAT are the requirements to conform with;
- WHAT capabilities need to be implemented.

Examples of STATIC REQUIREMENTS:
"capabilities", "features" e.g. link set-up
"functional units" e.g. flow control, duplex speech
"protocol elements" e.g. S_Connect_Request
"parameters" e.g. calling_addr, prot_discriminator

Dynamic requirements can be interpreted as:

- HOW is a requirement implemented;
- HOW a capability is achieved, what is the sequence of commands and actions.

Example of DYNAMIC REQUIREMENTS:
"does implementation send a Connect_Response after receipt of a Connect_Request"?

A.2 Level of detail of an ICS proforma

Subclause 8.5 of ISO/IEC 9646-7 [12] specifies a hierarchical structure for ICS proforma items, from general questions to detailed ones. This hierarchical structure is the reference, when, further in this text, **more general** or **more detailed** features are alluded to.

The questions should respectively tackle, for a protocol:

- the roles (initiator or responder, manager or agent, Data Circuit terminating Equipment (DCE) or Data Terminal Equipment (DTE), etc.);
- the major capabilities (functional units, service classes, service elements, protocol classes, etc.);
- the negotiation capabilities;
- the timers;
- the PDUs;
- the PDU parameters;
- protocol error handling, multi-specification dependencies, other conditions, according to the needs of a given protocol.

The desired level of detail of the PICS proforma items should follow the rules hereunder:

All the roles, major capabilities, negotiation capabilities, timers, PDUs shall be subject to an ICS question, whatever their status may be: mandatory, conditional, or optional[19)].

At the level of detail of PDU parameters, it often happens that mandatory or conditional items all directly depend on the support of a more general feature, for instance a PDU. Their support is then an implicit consequence of the support of the more general feature in accordance with the conformance requirements of the standard related to the more general feature[20)].

In this case, the table related to the PDU parameters should either be omitted, or replaced with a single question factoring out the support of parameters: "Are all the parameters of PDU x supported?".

The rule just expressed for PDU parameters may also apply to other features equally, or more detailed.

---

19) One immediate reason for this is that the PICS serves as the basis to the static conformance review.

20) As a matter of fact, "supported" means "implemented in accordance with the standard". The standard may specify that the implementation of a given PDU means the implementation of all its parameters. See subclause 6.4.

However, when in a list of PDU parameters (or other features equally, or more detailed), there is a mix of:

- some items mandatory or conditional directly dependent on the support of a superior feature; and
- some items optional or conditional without being directly dependent on the support of the coarser feature,

the complete list of parameters should be provided, including the optional items.

EXAMPLE 1: If a PDU is mandatory, and all its parameters are mandatory.

The following table appears:

Table A.n: Channel_Open_Request PDU

Item	PDU	Ref.	Status	Support
1	Channel_Open_Request	7.5.2	M	

The following table should be omitted:

Table A.nnn: Channel_Open_Request parameters

Item	Parameter	Ref.	Status	Support
1	Req_Called_Address	7.5.2.1	M	
2	Application_Address	7.5.2.2	M	
3	Application_Selection	7.5.2.3	M	

The following table may appear:

Table A.n: Channel_Open_Request PDU parameters

Item	Parameter	Ref.	Status	Support
1	All parameters	7.5.2	M	

EXAMPLE 2: If a PDU is optional, and all its parameters shall be implemented as soon as the PDU itself is implemented.

The following table appears:

Table A.n Channel_Open_Request PDU

Item	PDU	Ref.	Status	Support
1	Channel_Open_Request	7.5.2	O	

the following table should be omitted:

Table A.nnn Channel_Open_Request parameters

Item	Parameter	Ref.	Status	Support
1	Req_Called_Address	7.5.2.1	c8	
2	Application_Address	7.5.2.2	c8	
3	Application_Selection	7.5.2.3	c8	

c8 = if A3.1 -- i.e. if the Channel_Open_Request PDU is supported
then m -- the concerned parameters have to be supported
else n/a

The following table may appear:

Table A.n: Channel_Open_Request PDU parameters

Item	Parameter	Ref.	Status	Support
1	All parameters	7.5.2	c8	

c8 = if A3.1 -- i.e. if the Channel_Open_Request PDU is supported
then m -- the parameters have to be supported
else n/a

EXAMPLE 3: If a PDU is mandatory, and some of its parameters are optional.

The following table appears:

Table A.n: Channel_Open_Request PDU

Item	PDU	Ref.	Status	Support
1	Channel_Open_Request	7.5.2	M	

The following table should also be present, and contain all the parameters:

Table A.nnn: Channel_Open_Request parameters

Item	Parameter	Ref.	Status	Support
1	Req_Called_Address	7.5.2.1	M	
2	Application_Address	7.5.2.2	O	
3	Application_Selection	7.5.2.3	M	

EXAMPLE 4: If a PDU is mandatory, and some of its parameters depend on conditions not related to the PDU itself.

The following table appears:

Table A.n: Channel_Open_Request PDU

Item	PDU	Ref.	Status	Support
1	Channel_Open_Request	7.5.2	M	

The following table should also be present, and contain all the parameters:

Table A.nnn: Channel_Open_Request parameters

Item	Parameter	Ref.	Status	Support
1	Req_Called_Address	7.5.2.1	M	
2	Application_Address	7.5.2.2	c9	
3	Application_Selection	7.5.2.3	c9	

c9 = if A1.2 -- i.e. if the Begin_Application functional unit is supported
then m -- the concerned parameters have to be supported
else n/a

A.3 Requirements on numeric values

Numeric features (e.g. protocol numeric parameters, timers, etc.) are generally associated with a set of allowed values (discrete values, or intervals).

The tables specifying allowed values contain two columns for values: allowed values, supported values.

EXAMPLE 1:

Table A.n

Item	Parameter	Ref.	Status	Support	Values	
					Allowed	**Supported**
1	Recovery_time	7.5.2	c.3		1 - 3 600 s	
2	Data_Size	7.5.6	m		128, 256, 512	

In these tables, a "status/support" question cohabits with an "allowed/supported value" question.

The status/support refer to the feature, and not to the allowed values.

The support of the feature is submitted to the status.

The implementation of the allowed values is NOT submitted to the status.

In the example, the support of the Recovery_time parameter is submitted to condition c.3; the respect of the value interval is not submitted to c.3.

When it is necessary to specify that the support of some values, or the respect of some intervals is mandatory, or conditional, an additional table shall be produced. The items of this additional table are Values/Intervals. The status and support columns of this table relate to the values and intervals.

This additional table shall not contain "allowed values" or "supported values" columns.

The following example shows how the Values/Intervals table completes the information of the table related to the features:

EXAMPLE 2: **Table related to features (here, parameters):**

Table A.n Single-keypad implemented

Item	Parameter	Ref.	Status	Support	Values	
					Allowed	**Supported**
1	Identifier for double octet	7.6.1	M		6	
2	2nd-ID of single-keypad of fixed length	7.6.1	M		9	
3	Keypad information	7.6.6	M		23,2A,30-39, 61-64, 00, 14, 16 (Hex)	

Additional table, related to values/intervals:

Table A.n   Keypad information values

Item	Values/intervals	Ref.	Status	Support
1	Keypad information values 23,2A,30-39 (Hex)	7.6.6	M	
2	Keypad information value interval 61-64 (Hex)	7.6.6	C241	
3	Keypad information values 00, 14, 16 (Hex)	7.6.6	C242	

C241: IF digits_a-d THEN M ELSE O
digits_a-d = Q.9/8
C242: IF go_dtmf THEN M ELSE X
go_dtmf = Q.9/12

(end of example)

When no additional Value/Intervals table is provided, the support of any value in the "allowed values" column of the table related to the features is by default optional.

A.4 References to ICS items

Each item in the ICS shall have a unique identification, composed of the unique reference to the table and the unique item reference inside the table.

Two approaches are possible:

- **numbers:** flat or structured numbers for the tables, item numbers (1, 2, 3, etc.) inside a table. This method makes it easy to find ICS questions;

- **mnemonics:** meaningful references to ICS questions. Mnemonics are useful for protocol experts; use of mnemonics **alone** makes it quasi impossible to find an ICS table referred to.

Numbers shall always be used in ETSI ICSs.

Mnemonics may be used as a complement.

Mnemonics alone shall not be used.

The following method is recommended, in order to associate mnemonics to ICS questions: an additional column of comment containing the mnemonic.

EXAMPLE:

avoid:

Table FU_ZXL_FT3

Item	PDU type	Ref.	Status	Support
ZXL_G	Channel_Close_Request	7.5.2	o	
ZXL_F	Channel_Close_Response	7.5.3	x	

prefer:

Table A.n: FU_ZXL_FT3

Item	PDU type	Ref.	Status	Support	comment associated mnemonic
1	Channel_Close_Request	7.5.2	o		**ZXL_G**
2	Channel_Close_Response	7.5.3	x		**ZXL_F**

Any reference to an item in this table should include the number (3.6/2). Optionally, it may also remind the mnemonics.

A.5 Scope of qualified optionals

Qualified optionals allow to define mutually exclusive, or selectable options among a set. The notation consists in placing an integer after the 'o' in the status column. This is documented in ISO/IEC 9646-7 [12], subclause 9.2.1.

NOTE 1: The rule expressed hereunder is in fact already in ISO/IEC 9646-7 [12]. However, a frequent misunderstanding makes a more accurate formulation necessary.

The integer "i" shall identify the group of related optional items to which the "o.i" applies.

A new "i" shall be chosen every time a new set is addressed, even if it follows the same logic.

The integer "i" shall not be used to identify the nature of the option defined by the "o.i".

EXAMPLE:

What shall be done:

Table xxx

Item	PDU type	Ref.	Status	Support
1	Channel_Close_Request	7.5.2	o.1	
2	Channel_Close_Response	7.5.3	o.1	

o.1: all supported or none supported.

Table yyy

Item	PDU type	Ref.	Status	Support
1	Start_Appli_Request	8.3.2.6	o.2	
2	Start_Appli_Response	8.3.2.8	o.2	

o.2: all supported or none supported.

What shall not be done:

Table xxx

Item	PDU type	Ref.	Status	Support
1	Channel_Close_Request	7.5.2	o.1	
2	Channel_Close_Response	7.5.3	o.1	

Table yyy

Item	PDU type	Ref.	Status	Support
1	Start_Appli_Request	8.3.2.6	o.1	
2	Start_Appli_Response	8.3.2.8	o.1	

o.1: all supported or none supported.

NOTE 2: In this forbidden example, "i" identifies a **logic**. It is ambiguous because the scope of the "o.i" is implicit: a semantic is deduced from the fact that the items are in the same table. On the example above, it **seems** that items xxx/1 and xxx/2 should follow an "all or none supported" law, independent of the support of the yyy/1 and yyy/2. Another interpretation could be that all four items xxx/1, xxx/2, yyy/1, yyy/2, follow an "all or none supported" law.

Annex B (informative): Components of a TS for a base specification when several ATSs are produced

B.1 Why a single ATM has been chosen

Subclause 7.1 has encouraged the specification of a single ATS for each protocol - or subset of a protocol.

This requires additional explanation:

This ETS fully supports the use of ISO/IEC 9646 (references [5] to [12]) as a reference in terms of conformance testing specifications. ISO/IEC 9646-2 [6], subclause 11.6, indicates explicitly that one or more ATMs shall be supported. It is up to the main conformance TS associated with a protocol to define a sort of global conformance of the testing services for that protocol, and to indicate how many ATSs, each supporting an ATM, shall be provided and implemented in MOTs (to allow for a comprehensive testing service).

The underlying principle of ISO/IEC 9646 (references [5] to [12]) is that it is up to the testing service to adapt to the SUT/IUT, not the reverse. The SUT/IUT, at least, shall support the Remote method - whatever it means. If a conformance TS does not provide an ATS for the remote method, it shall "apologize" (penultimate paragraph of 11.6.2 in ISO/IEC 9646-2 [6]).

That is theory. In spite of the huge efforts of the Europeans to build CTS programmes and testing services, in spite of all Project Teams, everybody knows that it is almost hopeless to develop a collection of ATSs for each ATM, for each protocol. Fact of life is that it is already a success if ONE test suite is available, of good reputation and world-wide or region wide harmonized. **The choice of the SINGLE supported ATM is made according to the best marketing judgement available, and is usually both sensible and meeting the need of a majority of products.**

That is why this ETS prefers to recommend - frankly - to concentrate on one ATS initially, and maybe forever.

This advice is also a means of hiding some real difficulties. If two or more ATSs exist, they shall be consistent together, and comply with the same TSS&TP, and that may be difficult to verify (as mentioned above). In addition, the certifiers are puzzled when they have to appreciate the respective merits of two tests made with two different test suites.

The position of this ETS is pragmatic, though. Theory remains licit. If some manufacturers happened to make products requiring an unusual ATM, and would ask for an MOT based on an ATS which does not exist yet, they should be invited to contribute to such a test suite, consistent with the existing ones in terms of TSS&TP compliance. ETSI or EWOS Committees could not refuse to deal with it if quality is acceptable.

Such an occurrence is likely to be very rare.

One of the only examples known hitherto of multiple ATMs for a given protocol is OSI session layer. Mostly for historical reasons, a co-ordinated non-embedded method was defined. Apart from this method, there is a single ATM in the context of a given profile.

B.2 Overview

Theoretically, the addition of a new ATS (for a new ATM) for a given base specification will be based on the existing TSS&TP. However that assumption is based on the fact that the TSS&TP shall be independent of the test method. Practically, when a TSS&TP is specified, its designer has a quite precise idea of the ATM which will be used. Therefore, the TSS&TP is very often influenced by the ATM.

If the ATM initially considered has a large coverage (e.g. co-ordinated Method) the influence of the ATM on the TSS&TP design will not be significant. On the other hand, if the ATM initially considered has a low coverage (e.g. remote method) the extension of the base specification TS to an other ATM may require the extension of the TSS&TP (this generally happens when untestable TPs have been omitted, contrary to the recommendation to produce a TP, whether or not it is testable according to the ATM.). This will be done by producing a TSS&TP amendment.

The following clause shows the components of a TS which have to be re-instanciated for the new ATM.

B.3 Synopsis of the components and their dependencies

Figure B.1 describes the tasks to be achieved and the components to be produced or used by each task when more than one ATM is used. The aim of that description is to highlight the differences between that situation and figure 9 (only one ATM).

From a theoretical viewpoint, the tasks to be achieved may be split into three different categories:

- tasks belonging to base specification (i.e. PICS specification);
- tasks theoretically independent of the ATM (i.e. TSS&TP specification);
- tasks depending on the ATM (i.e. ATS specification).

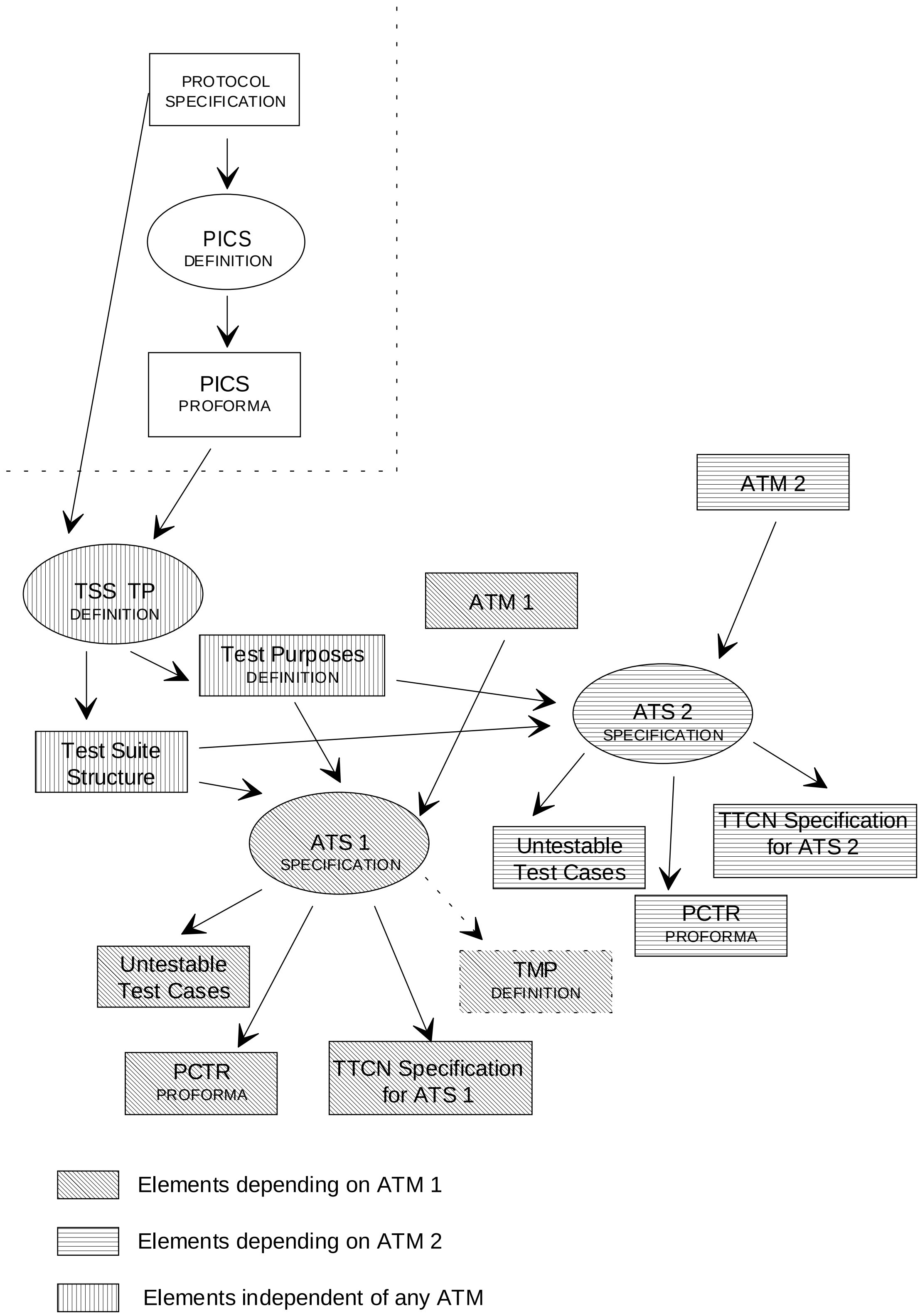


Figure B.1: Case of several ATMs

B.4 Relationships between components

For each ATM, objects to be produced will be those defined in subclause 7.4:

- ATS;
- TMP definition (only if the co-ordinated method is used);
- PCTR proforma;
- partial IXIT proforma;
- untestable TP definition.

B.5 Additional TSS&TP

The notion of additional TSS&TP is treated in subclause 7.5.3.

B.6 Consequences on the pre-existing ATS

Assume the TSS&TP have been initially written for an abstract test method ATM 1, originating the test suite ATS 1; the abstract test method ATM 2 and the specification of ATS 2 are now considered.

When an additional TSS&TP is specified it has incidence on ATSs based on the existing TSS&TP. Two cases have to be considered:

- the new TPs cannot be derived into ATC according to the ATM 1. In that case the "untestable TPs" part of the ATS 1 has to be enhanced in order to cover the new TPs;
- some of the new TPs are derivable according to ATM 1. In that case an additional ATS will be specified as a complement to ATS 1. It will contain the ATCs corresponding to the TPs derivable with ATM 1.

Annex C (informative): Guidance on the combination of TPs

This annex aims at answering the question: When to combine TPs?

No general rule can be provided for combining TPs according to the different aspects of a protocol, according to the conformance requirements, according to a state diagram topology. This is context-dependent.

Generally, the interest of combining TPs will depend on the size of the TSS&TP before combination. When a TSS&TP is considered to be "small enough", it is not opportune to combine TPs, even if, technically, it would be possible.

However, two categories of combinations of TPs can be distinguished:

a) tests having the same morphology;

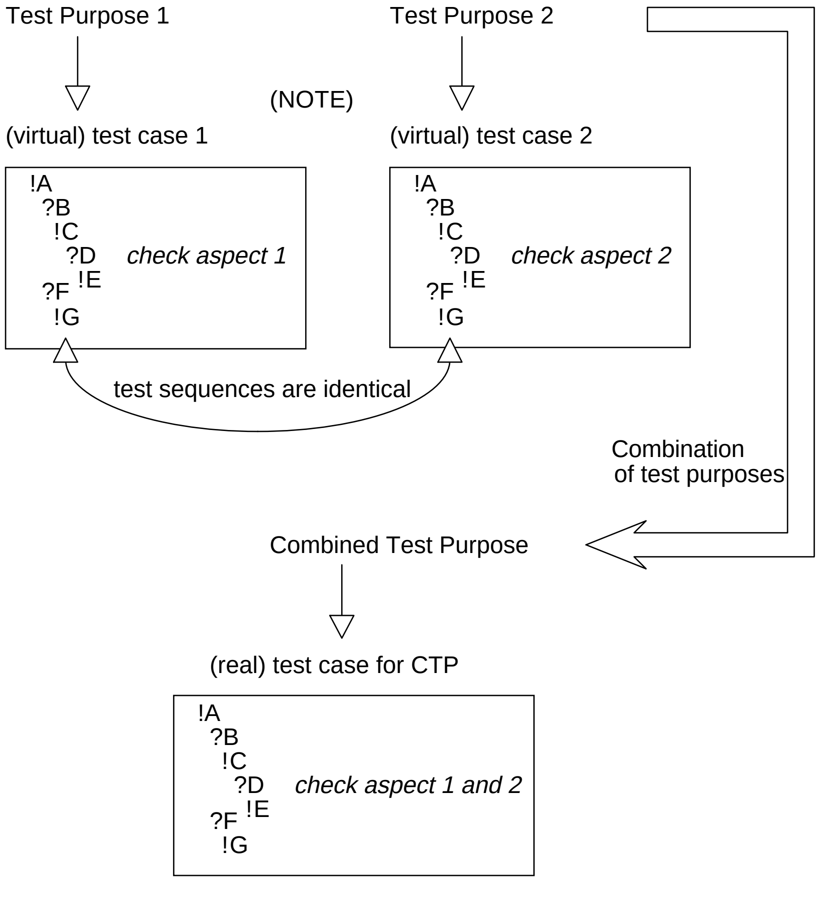
b) tests having the same spirit.

C.1 Tests having the same morphology

This means combining TPs because the test cases are expected to have the same morphology.

The sequences of PDUs exchanged during the tests are the same: **same dynamic behaviour part** (test steps and test cases).

Figure C.1 shows two equivalent test sequences with different checks:



NOTE: Although this figure shows two "virtual" test cases, the combination shall be made at the level of TPs, and NOT at the level of ATCs.

Figure C.1: Illustration of the principle of combination according to morphology

Three examples:

EXAMPLE 1:

TP1: "Check that the IUT sends a valid ERROR PDU when timer X expires." (state transition group).

TP2: "Check that timer X expires after 30 seconds." (timer group).

EXAMPLE 2:

TP1: "Check that the IUT sends a Connect_Response after receipt of a Connect_Request" (capability test group).

TP2: "Check that a Connect_Response PDU sent by the IUT has a valid xxx parameter" (valid behaviour - parameter group).

EXAMPLE 3:

TP1: "Check that a DT PDU sent by the IUT has a valid Segmentation parameter".

TP2: "Check that a DT PDU sent by the IUT has a valid Padding parameter".

In the case of TP combination on morphology, the test sequence is still the same, but several aspects are checked together, though they would be individually checked if TP were not combined.

The simplest case is to check several parameters on a received PDU (compare with EXAMPLE 3). It is the case admitted by ISO/IEC 9646-2 [6]. The constraints in reception will check the aspects related to each TP combined in the CTP (compare with EXAMPLE 3).

However, the different aspects combined will have to be supported according to the same implementation criteria. For instance, the combination in EXAMPLE 3 can only be done if the support of Segmentation parameter and of Padding parameter follow the same criteria (i.e. their status in the PICS proforma responds to the same condition). Otherwise, the combination would break rule 5.

In some cases, TP combination on morphology will not be used: when checks are **deliberately gradual.**

It means that a simple test is just aimed at checking roughly a mechanism, while a second test case with the same morphology deeply checks the PDU and parameter validities. The former would belong to Basic Interconnection group, or Capability, while the second would belong to Valid Behaviour. Combining them would in fact suppress the Basic Interconnection or the Capability test.

Basic Interconnection and Capability tests are essential during a test campaign because they are run in the beginning of a test campaign to validate the overall communication capabilities, and may be the basis of a negotiated exit to the test campaign.

For the reason above, combination should be avoided in EXAMPLE 2.

C.2 Tests having the same spirit

This means combining TPs because the test cases verify aspects which are related to each other, according to the protocol semantics.

The test cases will generally be the **concatenation of two trees,** aimed at testing the two related protocol aspects.

For instance, a "mechanism" consists in two state transitions.

TP 1: semantic protocol action (e.g. transmission of a message) related to first state transition.

TP 2: semantic protocol action (e.g. transmission of an ACK) related to second state transition.

CTP: check the two semantic protocol actions (the message AND the ACK). It means "test the whole mechanism in one shot."

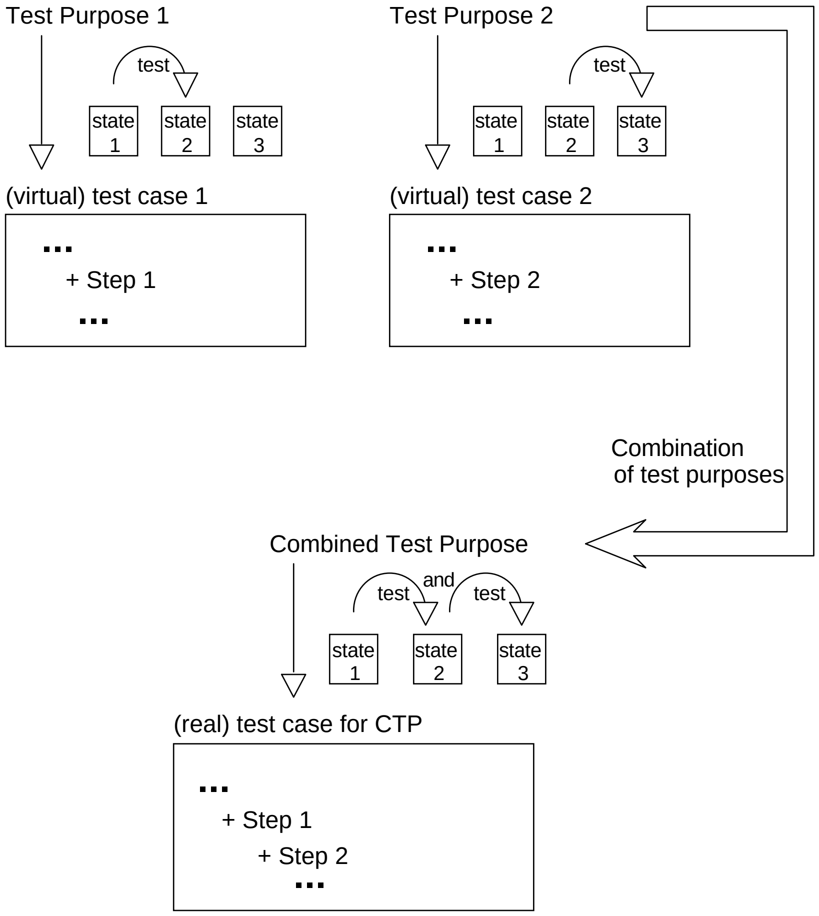


Figure C.2: Illustration of the principle of combination according to "spirit"

Annex D (informative): Guidance on the definition of a test strategy

In this annex, **test strategy** means these technical orientations the conformance testing specification.

Among the main orientations making up the test strategy are the choice of the **test method(s)** and the **volume of tests** required; other orientations concern technical refinements about the test suite itself.

The input to this orientation phase is a good knowledge of the technical domain, a good knowledge of the conformance testing methodology, and also a good understanding of practical considerations on what a conceivable product is. This may lead to consider commercial considerations.

The output of this technical strategy design is important to determine the technical basis of the development, and also the estimated cost of production of the conformance testing specification (number of objects to produce, size of the test suite).

D.1 Test strategy: initial steps

It is recommended to make these initial steps, in order to have decision elements at disposal for the following steps of the test strategy, in particular for the choice of the test method.

Two basic questions are to be examined:

a) why do the protocol/profiles have to be tested?

b) what will an implementation to test look like?

D.1.1 Why do the protocols have to be tested?

The final destination of the test specification to produce is examined here. The idea is to identify the context in which the test service is planned to be operated. For instance:

- certification of terminals (voluntary basis);
- test of network components;
- validation of safety critical systems;
- etc.

It may be difficult to answer all these questions **a priori**. However, they have an impact on the test strategy, for they identify priorities in the coverage.

D.1.2 What will an implementation to test look like?

It is useful to understand what the conceivable products implementing the protocol can be (realistic implementations). This will affect the test strategy, in particular the choice of the appropriate test method.

The following questions may be considered (this list is not exhaustive):

- what types of equipment will implement what functional units? Do the tests have to be focused on one/some particular functional units? It may be justified to choose different test strategies for the different functional units;
- what will be the testing context? e.g. test of an equipment in a laboratory, or test through a network;
- what are the final costs expected for a test campaign? An ATS is not only a nice object to produce (standardization for standardization's sake), but is to be thought in terms of the final test services that will be offered on its basis. The cost of the final test campaign should be kept to reasonable proportions compared to the product value or development cost;

- what are the other technical constraints related to product packaging, to probable implementation strategies, etc. (some of these criteria are analysed in the section devoted to the choice of the test method)?

  NOTE: These questions are very much implementation oriented. It may be difficult to find a response to them within a standardization body.

A typical example is the case of an asymmetrical protocol, devoted to terminal-server communication (access protocol):

- the test of a terminal and the test of a server, which appear as two different functional units (or two different "roles") of the same protocol, have different objectives:

  - the test of a terminal will be needed for both its approval (regulatory sector) and voluntary testing. An important part of the test suite will be TBR-oriented;

  - the test of a server will be used on a voluntary basis (the test of a server might even appear as unnecessary). An important aspect is here to test the robustness of the server if it is accessed from badly behaving terminals. The invalid behaviour test cases will be given a high priority i.e. the ISO/IEC 9646 (references [5] to [12]) concept;

- the test of a terminal may be expected in a laboratory context, although the test of a server may be expected through the network. This is likely to affect the test method;

- the testing cost of a server may be expected to be different from the testing cost of a terminal;

- in a terminal, it may be impossible to incorporate an upper tester for the purpose of testing (product packaging constraint); a server will contain its own application, and may not provide an exposed interface above a communication software stack (implementation strategy).

D.2 Test strategy: choice of test method

Several test methods are proposed by ISO/IEC 9646 (references [5] to [12]). The choice of the test method is a difficult step, do not underestimate it. On one hand, the concepts of the various methods and their implications are not easy to understand thoroughly. On the other hand, there is no straightforward recipe, although criteria can be listed. The choice of the test method remains a matter of experience.

The choice of the test method should always involve conformance testing experts. Do not only rely solely upon the reading of ISO/IEC 9646 (references [5] to [12]) and the guidelines given in this clause.

Annex A of 9646-2 [6] gives a limited set of advice on various protocols.

Discussing the test methods is closely related to the realization of control and observation on the IUT from above. **Discussing the test methods is discussing the nature and the location of the (possibly absent) upper tester.**

Thus, discussing the methods is, inter alia, closely related to discussing the PCOs that will be retained to design the test suite (see ISO/IEC 9646-2 [6]).

The coverage is not the same for all methods, although ISO/IEC 9646 (references [5] to [12]) does not explicitly, and on purpose, mention it (it may be protocol dependent). ISO/IEC 9646-2 [6]

DISCLAIMER: The information provided in this annex concerning the test methodology, and in particular the characteristics of the various test methods do not take into account the Multi-Party Testing methodology (MPyT), as it stands in Edition 2 of ISO/IEC 9646 Parts 1 [5], 2 [6], 4 [9], 5 [10] (mainly Parts 2 [6] and 4 [9]). Although the MPyT is part of ISO/IEC 9646 (references [5] to [12]), this methodology is considered to be too new to report any practical experience.

As a result, all the information provided here should be understood literally in a SPyT context. Some of it, however, might remain valuable in a multi-party testing context; this text will need to be re-considered when real implementations of the MPyT will have brought experience on the subject.

The vocabulary, however, has been adapted, when it was possible, to the new methodology. In particular, the single-layer test methods are called here non-embedded test methods.

D.2.1 One or several test method(s)?

Generally, one only test method will be chosen. The use of several test methods for the same protocol is strongly discouraged. See subclause 7.1.

NOTE 1: The main use of multiple test methods for one protocol that has been made hitherto concerns OSI upper layers (for the justification of this fact, see for instance ISO/IEC 9646-2 [6], annex A, clause A.5: the test of the session layer may require two complementary methods; another case is when different implementation strategies make this or that method inapplicable).

NOTE 2: The notion of "comprehensive test service" that can be offered if a subset of tests can be adapted to several methods (e.g. a subset of an ATS designed for a distributed method can be run in a remote method). This is the least constraining case of multiple test method.

Subclauses D.2.2 to D.2.6 give the different aspects that should be examined in order to choose a test method. For each criterion, examples are given, but no general rule should be induced from them.

D.2.2 Technical criteria intrinsic to standardized area

1) The nature of the protocol to test:

- the **level** in a communication stack (see for instance ISO/IEC 9646-2 [6], annex A);

- the main **objective** of the protocol to test: complex protocol machine (e.g. Transport), or rather syntax-oriented (e.g. Presentation, ROSE);

- the complexity of the **service** provided by the IUT, and its relation with the protocol events (for instance, are the protocol events directly related to service events, or is the protocol machine able to generate most of the protocol elements spontaneously?);

- etc.

2) The other protocols:

- the **interrelation** of the IUT with the other protocols (e.g. OSI presentation layer can only be tested by means of an embedded method);

- the **variety of potential users** of the service provided by the IUT: if the service provided by the IUT is bound to be used always by the same type of layer, an embedded method under this layer can be considered. If the service provided by the IUT is bound to be used by different types of users, a non-embedded (formerly called single-layer) method may be more relevant;

- the **use of the IUT service**, made **by the layer above**. (coverage of service functionalities);

- the **nature of the layer above** (presence of a real protocol machine in the layer above. This is not the case of some "syntax-oriented", pass-through protocols, like Common Management Information Protocol (CMIP) or presentation). In some cases, an extensive control of the IUT service can be realised by automatic transitions of the protocol machine of the layer above. In this case, for instance, a Remote Embedded method may be chosen, where the layer above plays the role of an upper tester (called **notional** upper tester, see ISO/IEC 9646-4 [9], annex A, subclause A.1.3).

3) The coverage required.

Once again, the coverage is not the same for all methods. The coverage mainly depends on the possibility of realizing control and observation of the IUT from above.

The methods can be generally ordered as follows, by decreasing coverage:

- the **coordinated** method offers the best coverage, for it allows the best control and observation of the IUT;

- the **distributed** method;

- the **remote** method, which offers the worst coverage, for the IUT can only be controlled and observed from the protocol side. Many features may not be triggered.

NOTE 1: Caution: this rule should be used carefully. Also:

- the three methods do not apply to all cases, and the coverage shall only be examined after having decided which methods were applicable according to the other criteria. Do not try to enforce the coordinated method under the pretext that it offers a better coverage, if it is not applicable, or hardly applicable, according to the other criteria. An ordering rule is a nonsense if it is not considered amongst the methods applicable to a given situation;

- this rule may be contradicted by particular examples. For instance, a Remote Embedded method using the layer above as a notional upper tester is based upon the same type of testing architecture as a coordinated method, and offers similar coverage.

Once again, whilst the other criteria determine, in general, the **applicability** of a test method, the coverage criterion is a refinement left when several methods appear to be possible.

The coverage criterion should only be examined after having decided which methods were applicable according to the other criteria.

Nothing can be said about the local method. As a matter of fact, its use is restricted to "very" low layers, i.e. essentially the physical layer, and sometimes layer 2 (see clarification and test method characteristics, below).

Other methods exist, which apply to particular situations. For instance, loop-back or transverse methods for testing relays. In these situations, it is generally easy to decide which method to use, since little choice is left among the **applicable** methods.

NOTE 2: The ordering, in terms of coverage, is C > D > R. The presentation of the test methods in ISO/IEC 9646 (references [5] to [12]) may be confusing. As a matter of fact, the test methods are ordered in ISO/IEC 9646 (references [5] to [12]) with respect to the **visibility of the upper PCO**: L > D > C > R. The coordinated method is said in ISO/IEC 9646 (references [5] to [12]) not to provide an explicit PCO above the IUT, because it provides, through the TMP, an **indirect** view of what happens above the IUT. This is in apparent contradiction with the fact that the Coordinated method provides the best control and observation.

D.2.3 Technical criteria related to implementation conditions

Probable implementation strategies should be forecast, for a variety of conceivable products (platforms, applications, etc.). Their impact on the test method appears at two levels:

a) the nature of the **upper interface** of the IUT, and its chance to be **exposed**;

b) the possibility to incorporate a **responder** (this element is closely related to the former on some aspects).

NOTE: The term **responder** is not defined in ISO/IEC 9646 (references [5] to [12]). It is often used, however, in the world of Conformance Testing Methodology. In this paper, **responder** means: "In the context of the Coordinated Test Method, the particular case of implementation of an Upper Tester (defined in ISO/IEC 9646-1 [5]), which consists in a special software incorporated in the SUT for the purpose of testing."

Concerning the upper interface:

- the upper interface, defined in the reference standard as an abstract service interface, is not always implemented as a physical interface between two software modules, and several layers may be built monolithically;

- the nature of the upper interface of the IUT may differ according to its destination:

  - it may be a Programming Interface destined for use by another software, in which case the control and observation may justify the implementation of a responder (Coordinated method). Practically, the availability of a standardized Programming Interface is appreciated if the Coordinated Method is considered, for it reduces the costs of the responder adaptation;

  - it may be (more or less directly) mapped onto a user interface, like in the case of a terminal, in which case the choice is likely to be made between Distributed and Remote methods;

  - it may be directly mapped onto a conceptual system (this is typically the case of OSI application layers, like FTAM responder role, mapped onto the Virtual File Store, like CMIP agent, mapped onto the Management Information Base, like Manufacturing Message Services (MMS) server, mapped onto the Virtual Manufacturing Device, etc.). in this case, the Remote method often appears to be the only one acceptable, depending on the degree of interdependence between the IUT and the conceptual system;

  - etc.;

- the upper interface of the IUT may be more or less exposed in the system. When the top of the IUT is the highest layer of a software bound to be sold as a package, its interface may be expected to be exposed. Note that an exposed interface does not only mean that the interface corresponds to an actual programming interface: it also requires that the software house provide a documented specification of this programmatic interface.

Concerning the possibility to implement a responder:

- it depends on the exposition of the interface (see criteria above);

- it depends on **product packaging** strategies: e.g. enough program memory should be available in the product so as to implement additional software; if the IUT resides in a PROM, implementing extra software may appear impossible, etc.

D.2.4 Other criteria

The testing cost of an IUT depends on the test method: necessity to implement additional software (responder) in the case of a coordinated method; action required from an operator throughout the test campaign execution (distributed method).

D.2.5 Further clarification on test methods characteristics

Coordinated Method: Practically, the Coordinated Method implies the availability of an exposed interface, and the implementation of a software (responder) dedicated to testing. This places a heavy constraint on the test realization, and significantly increases the costs of the preparation of the IUT (the incorporation of a responder requires programming effort, in particular if the interface is not standardized).

Embedded versus non-embedded: Embedded methods have been defined for the test of protocol layers without exposed interface. Therefore, when such interfaces are available, non-embedded methods are recommended, if they are economically viable.

Local method: The use of the local method is restricted to "very" low layers, i.e. essentially the physical layer, and sometimes layer 2 (in practice, Medium Access Control only - See ISO IS 9646-2 [6], annex A, clause A.2 and ISO/IEC 9646 (references [5] to [12]), which reads: "the Local Test method is applicable only if the IUT has a **standardized hardware interface**").

Single Confusion should be avoided between:

- **single layer test method:** synonymous, in the old version of ISO/IEC 9646 (references [5] to [12]), of non-embedded test method. This term is deprecated.

- **single protocol testing:** Testing specified for a single protocol in a single-protocol or multi-protocol IUT. (ISO/IEC 9646-1 [5]).

- **single protocol IUT:** an IUT composed of a single protocol in a single OSI layer; alternatively, a multi-protocol IUT consists in multiple adjacent protocols in one or more OSI layers. This does not make any assumption on the number of other open systems with which the IUT has to communicate.

- **single-party testing:** a testing context in which it is required by the TP that the IUT communicates with only one other open system. This does not make any assumption on the number of protocols comprising the IUT.

D.2.6 Clarification concerning the concept of upper tester

NOTE 1: An upper tester is not necessarily software to be incorporated into the SUT.

NOTE 2: The remote method may involve an upper tester.

The various test methods precisely differ according to the **nature** of the upper tester:

- in the distributed test method, the upper tester has access to an interface which explicitly reflects the ASPs specified for the IUT. (ISO/IEC 9646-2 [6], subclause 11.3.3, d), which reads: "there shall be a mapping between the relevant ASPs and their realization at the upper interface of the IUT".

  The upper tester of a distributed test method may be a piece of software, but also a human operator. The test coordination procedures are defined;

- in the remote test method, there may be no upper tester.

  In case there is an upper tester:

  - the **mapping** between the interface accessed by the upper tester and the ASPs of the IUT is not defined, and not always ensured. The test coordination procedures are not defined;

  - (consequently) there is no possibility of **observation** above the IUT, but only possibility of **control**, in terms of "**do whatever is necessary within the SUT in order to provoke the required behaviour**" (ISO/IEC 9646-2 [6], subclause 11.3.5). This justifies the use of the TTCN "implicit send" statement.

    Hence, when the upper tester is conspicuously a human operator (e.g. test of a terminal with a user interface), the choice between distributed and remote is determined by the relation between the IUT abstract interface and the user interface in question. If the user interface is not standardized and is widely implementation-dependent, the method will be remote. If the user interface is expected to be close to the reference IUT standard (e.g. keys of a terminal when they are precisely standardized, or the different "commands", like in the case of FTAM initiator), the distributed method is better suited.

  - In some cases, the upper tester of a remote method is the layer above the IUT. This kind of upper tester is called a **notional** upper tester, see ISO/IEC 9646-4 [9], annex A, subclause A.1.3, which reads: "notional upper tester: (...) the upper layers of the SUT are used to realize the functions of the upper tester, without any additional mechanism being installed.".

D.3 Test strategy: coverage and costs

There is, apparently, a trade-off between the coverage expected from a test suite and the costs associated with it:

- the more (pertinent) tests there are, the higher is the coverage;

- the more tests there are, the higher are the costs:

  - of production of the test suite;

  - of maintenance of the test suite;

  - of implementation of the test suite (realization of the MOT);

  - of the test campaigns.

It is always possible to specify as many tests as one wants; the number of tests should be kept "reasonable" according to the trade-off above.

The main issue is that no rigorous criterion can define the word "reasonable".

NOTE 1: A test suite should never exceed a few hundreds of tests (e.g. 400 tests) no matter how complex the protocol is. This approach to the word "reasonable" may sound rough, unjustified and arbitrary, but is often verified. The scheme proposed by TTCN practically limits the volume of tests contained in a test suite, if this test suite is to remain manageable. If more tests are needed, several test suites are advised. In this case, the reference "protocol" may often be divided into several protocols.

Going from conformance requirements to TPs is an empirical job today.

No metrics exist to assess the coverage of a test specification. See ISO/IEC 9646-2 [6], subclause 10.4.

NOTE 2: The only attempts to define coverage metrics are related to the use of formal description techniques. From a formal description of the different aspects of a protocol it is theoretically possible to determine a number of tests covering the totality of the protocol aspects. From this number, a coverage ratio may be computed for a given test suite. In practice, this ratio is totally meaningless, because it does not take into account the fact that all the tests are not equally relevant. And precisely, the formal and automatic derivation of tests generally leads to a huge number of tests without interest.

Therefore, the only guideline that can be given is limited to the following messages:

- the testing effort needed to reach a given coverage is related to the complexity of the base protocol. Here again, there is no objective complexity indicator;

- a minimum coverage could be defined by:

  - the testing of all basic capabilities (Basic interconnection tests and capability tests);
  - the coverage of the optional items in the PICS;
  - the parameter variations tests should exercise minimum and maximum values;

- the coverage reached by a test suite depends on one hand on the number of tests, on the other hand on the quality and pertinence of the tests. Few pertinent tests have better value than many irrelevant tests (for example, endlessly testing all the theoretically possible transitions of a state table, although many them are practically impossible). The main effort of the conformance testing specification team should be aimed at increasing the pertinence of the tests by choosing them carefully, instead of at increasing the number of tests produced;

- as the design of a test specification can hardly be estimated with respect to an intended coverage, the design of a test specification is generally thought in terms of design-to-cost.

D.4 Test strategy: technical refinements

Further technical refinements may be analysed, as part of the test strategy.

They mainly concern the branches of the future test suite hierarchical structure on which most effort will have to be put. These refinements may be recommendations to the ICS writers, such as: "insist on invalid behaviour tests, on parameter variation tests" (arbitrary example).

Annex E (informative): Bibliography

1) ETSI/EWOS/PT005 Technical Report (1990): "OSI conformance testing methodology and procedures in Europe".

2) European Directive 91/263/EEC: "Council Directive of 29 April 1991 on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity".

NOTE 1: The Directive above is often referred to as the "Terminal Directive".

3) DTR/MTS-00004: "Methods for Testing and Specification (MTS); Implementation Conformance Statement (ICS) style guide and technical criteria".

NOTE 2: This Technical Committe Reference Technical Report (TCR-TR) is expected to be published at the end of 1995.

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