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Technical Specification

Broadband Radio Access Networks (BRAN);
HiperMAN;
Conformance Testing for WiMAX/HiperMAN 1.3.1;
Part 3: Abstract Test Suite (ATS)

Reference
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Broadband Radio Access Networks (BRAN).

The present document was developed on the basis of the Abstract Test Suite (ATS) specification for HiperMAN systems that was in the advanced stage of development when the work was reoriented to produce joint HiperMAN/WiMAX specifications.

The present document is part 3 of a multi-part deliverable covering Broadband Radio Access Networks (BRAN); HiperMAN; Conformance Testing for WiMAX/HiperMAN 1.3.1, as identified below:

Part 1: "Protocol Implementation Conformance Statement (PICS) proforma";

Part 2: "Test Suite Structure and Test Purposes (TSS&TP)";

Part 3: "Abstract Test Suite (ATS)".

1 Scope

The present document contains the Abstract Test Suite (ATS) to test BRAN HiperMAN1.3.1/WiMAX systems for conformance.

The objective of the present document is to provide a basis for conformance tests for BRAN HiperMAN/WiMAX equipment giving a high probability of air interface inter-operability between different manufacturer's BRAN HiperMAN/WiMAX equipment.

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [5] and ISO/IEC 9646-2 [6]) as well as the ETSI rules for conformance testing (ETS 300 406 [4]) are used as a basis for the test methodology.

Annex A provides the code written in Testing and Test Control Notation version 3 (TTCN-3) that is considered integral part of the ATS.

Annex B provides the Partial Protocol Implementation eXtra Information for Testing (PIXIT) Proforma of the BS side.

Annex C provides the Partial Protocol Implementation eXtra Information for Testing (PIXIT) Proforma of the MS side.

Annex D provides the Protocol Conformance Test Report (PCTR) Proforma of the BS side.

Annex E provides the Protocol Conformance Test Report (PCTR) Proforma of the MS side.

Annex F provides the HTML documentation that is considered integral part of the present document.

Annex G provide the bibliography.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI TS 102 178 (V1.2.1): "Broadband Radio Access Networks (BRAN); HiperMAN; Data Link Control (DLC) layer".

[2] IEEE 802.16-2004: "IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems".

[3] IEEE 802.16e-2005: "IEEE Standard for Local and metropolitan area networks - Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems. Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1".

[4] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

[5] ISO/IEC 9646-1/ITU-T Recommendation X.290: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".

[6] ISO/IEC 9646-2/ITU-T Recommendation X.291: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 2: Abstract Test Suite specification".

[7] ISO/IEC 9646-6: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 6: Protocol profile test specification".

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

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

[10] IEEE P802.16-2004/Cor1/D3: "Corrigendum to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems".

[11] ISO/IEC 9646 (All parts): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ISO/IEC 9646-7 [8], TS 102 178 [1], IEEE 802.16-2004 [2] and IEEE 802.16e-2005 [3] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TS 102 178 [1], ISO/IEC 9646-1 [5], ISO/IEC 9646-6 [7], ISO/IEC 9646-7 [8], IEEE 802.16-2004 [2], IEEE 802.16e-2005 [3] and the following apply:

ATS Abstract Test Suite
BS Base Station
BW BandWidth
CID Connection IDentifier
CS Convergence Sublayer
FDD Frequency Division Duplexing
HO HandOver
IUT Implementation Under Test
MAC Medium Access Control Layer

MS	Mobile Station
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PHY	PHYsical layer
PIXIT	Partial Protocol Implementation eXtra Information for Testing
PMP	Point-to-MultiPoint
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
REQ	REQuest
RNG	RaNGing
RSP	ReSPonse
RTG	Receive/Transmit Transition Gap
SS	Subscriber Station
SUT	System Under Test
TC	Test Case
TLV	Type, Length, Value
TP	Test Purposes
TTCN	Test and Test Control Notation
TTG	Transmit/Receive Transition Gap

4 Abstract Test Method (ATM)

This clause describes the ATM used to test the HiperMAN DLC layer at the BS side and at the SS side.

4.1 Test architecture

4.1.1 Test method

The test method chosen is the remote test method with notional upper tester. Remote test method means that the test tool (the test machine + the executable test suite) shall behave as a BS when the IUT is an SS and shall behave as an SS when the IUT is a BS. Notional upper tester means that it is possible to trigger and to force the IUT to execute predefined actions.

EXAMPLE: Adding a new service flow with defined parameters, sending data over a known service flow, etc.

This could be done by a specific and proprietary application layer inside the IUT or by other procedures clearly described by the IUT's manufacturer (PIXIT question). As the exchange between the test system and the IUT is the air interface, the PHY layer of the test machine shall be totally conformant with the corresponding PHY layer specification to use the remote test method.

4.1.1.1 What is notional upper tester?

Usually the IUT is not only a plane containing Convergence, MAC and PHY layers, but a real product to be marketed after testing, and therefore the IUT contains also application software to accomplish the purpose of the final product. In that case, the application inside the IUT could be commanded to generate events in direction of the transmission sub layers that shall be used by the testing software as expected IUT's actions. The application layer is the Upper tester as defined in ISO 9646 [11]. It is also a notional upper tester, because the test designer cannot determine all of the possible applications that are only market driven.

Considering the explanation of the former paragraph, in terms of source code writing, requesting a notional upper tester action is the combination of the call of an external function and a PIXIT parameter. The external function asks the test laboratory operator to execute the procedure described in the PIXIT parameter. If the action is possible to obtain the external function succeeds, otherwise the test execution becomes inconclusive. The PIXIT parameter is a "how to" question, for which the product manufacturer has to explain the procedure to be used in the IUT to obtain the required action.

Figures 1 to 4 show some examples of possible notional upper tester.

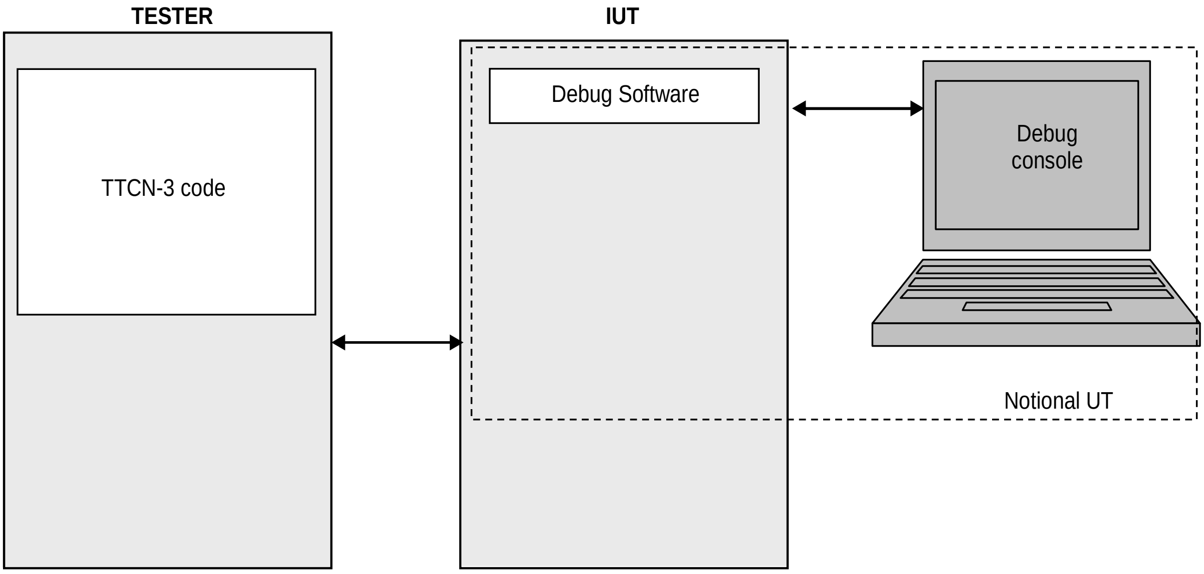

Figure 1: Debug notional upper tester

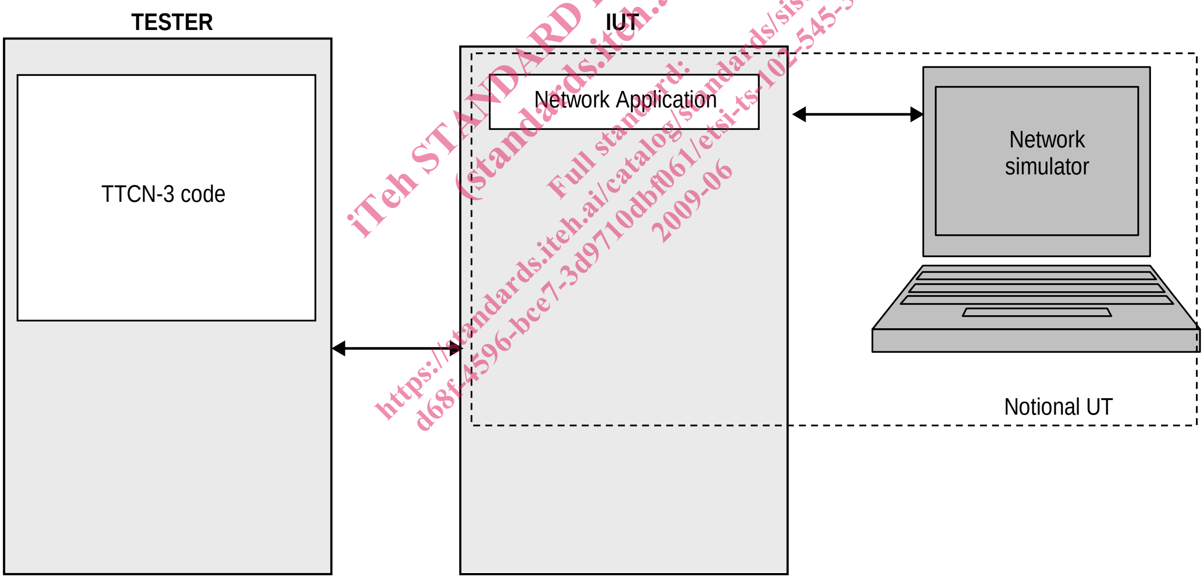

Figure 2: Network driven notional upper tester

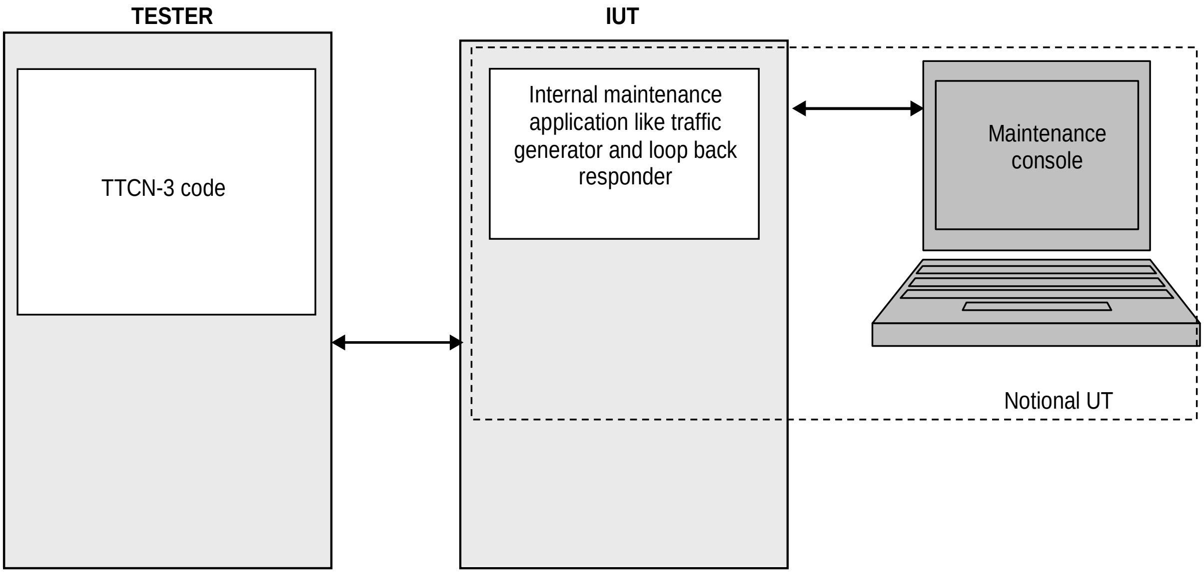

Figure 3: Maintenance application notional upper tester

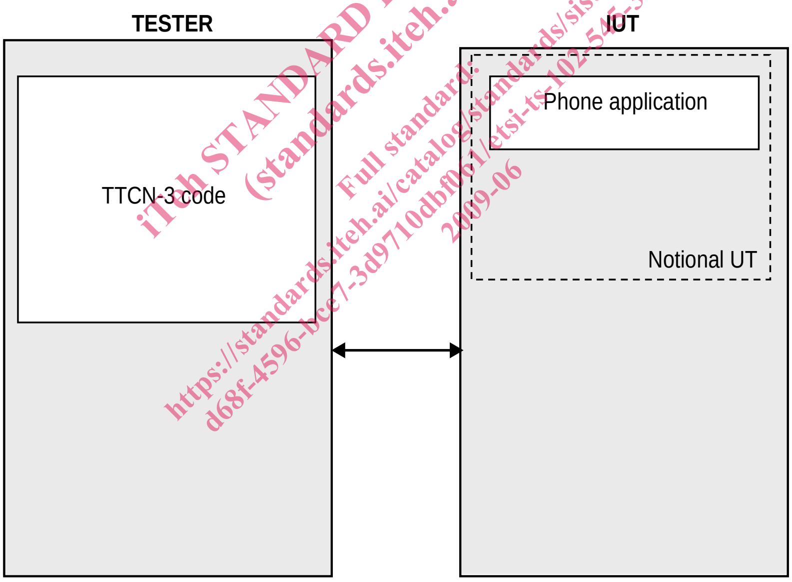

Figure 4: Phone application notional upper tester

4.1.2 Test machine operational parameters

The test machine operational parameters such as frequency, channels, sub channels, power level, etc., could be initialized by static and/or dynamic method.

The static method could be:

1) operational parameters included in the firmware or ROM;
2) operational parameters included in a configuration file executed at power up;
3) other static technique;
4) no default or static operational parameters setting.

The dynamic method could be:

1) before the test cases execution at the beginning of the test campaign and valid for a list of TCs;

2) during the test case execution at the beginning of the test case itself;

3) everywhere during test case execution.

The possibility to acquire and to set all of the operational parameters during the test case execution is a main key to cover all of the requirements to be tested by the TTCN-3 test code.

Considering all of the techniques exposed above, it is possible that the configuration of the operational parameters is done either before the beginning of the TTCN-3 environment or during the initialization of the TTCN-3 environment or during the preamble of a test case. The recommended method is the initialization during preamble of the test case.

Another important problem is the reconfiguration on the fly of some operational parameters. To solve this problem, it is recommended that the test case itself shall be able to start and stop the PHY layer and all of its environments during test case execution.

4.1.3 Test machine configuration

4.1.3.1 Presentation

There are six test machine configurations to allow the complete testing of the required functionalities of the specification.

The test machine configurations are:

1) test machine simulates a BS with OFDM PHY (IUT is a SS with OFDM PHY);

2) test machine simulates a BS with OFDMA PHY (IUT is a SS with OFDMA PHY);

3) test machine simulates a SS with OFDM PHY (IUT is a BS with OFDM PHY);

4) test machine simulates a SS with OFDMA PHY (IUT is a BS with OFDMA PHY);

5) test machine simulates two BS, each of them with OFDM PHY (IUT is an MS with OFDM PHY). This configuration is used for handover and mobility testing;

6) test machine simulates two BS, each of them with OFDMA PHY (IUT is an MS with OFDMA PHY). This configuration is used for handover and mobility testing;

7) test machine simulates one SS and one BS, each of them with OFDM PHY (IUT is a BS with OFDM PHY);

8) test machine simulates one SS and one BS, each of them with OFDMA PHY (IUT is a BS with OFDMA PHY).

NOTE: For a very small number of specification requirements, it may be useful to have a configuration with three simulated BS. This increases the number of test machine configuration by two (one for OFDM and one for OFDMA). Considering the effort of hardware and software development and the corresponding costs, implementation of these configurations should be investigated very carefully, and interoperability testing may be more suitable than conformance testing.

The configurations 1, 2, 3 and 4 can be covered by a single testing approach. The configurations 5, 6, 7 and 8 shall be covered by a concurrent testing approach (it is necessary to monitor and synchronize the two simulated BS test code to obtain a consistent behaviour and a consistent test verdict). The use of the distributed testing possibilities of TTCN-3 is recommended for the physical architecture of the test machine for the test configurations 5 and 6.

The number of physical test machines to cover the eight test configurations could comprise between one and eight depending of the level of flexibility and parameterization of the hardware design made by the test tool manufacturer. A physical test machine could also be constituted by a number greater than one of real hardware machine.

EXAMPLE: Intelligent PHY plane connected to one or more PC executing the TTCN-3 code.

For similar reasons the number of test suites could comprise between 1 and 8 depending of the level of parameterization, by use of PICS and PIXIT items, used to design the TTCN-3 code. The conditional compilation may be used to have only one source code and many generated test suite. In terms of performance, it is preferable to have static conditional code generation to shorten the length of the test suite and improve the time execution rather than to have dynamic conditional alternatives controlled by PICS or PIXIT items. In terms of readability and maintenance of the test code it is preferable to have a one to one mapping between the test code and the test machine configuration. The use of libraries, packages and other recent technique of source code management are recommended.

4.1.3.2 Test suite TTCN-3 development concept

The possible Test suite TTCN-3 development concepts are shown in figures 5, 6 and 7.

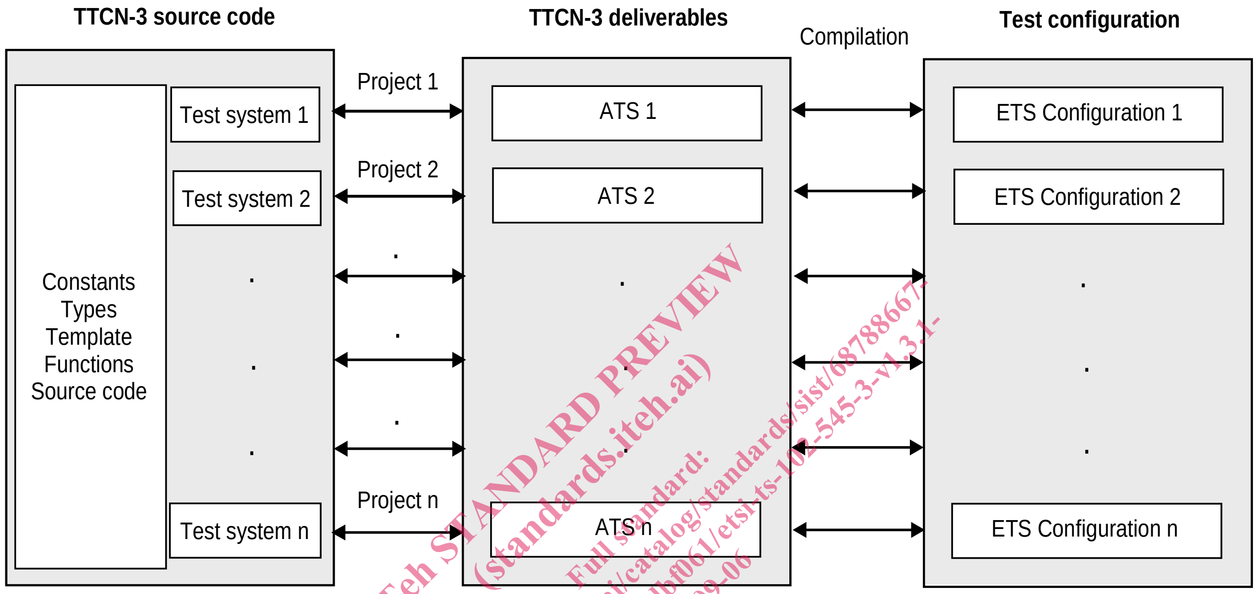

Figure 5: TTCN-3 development concept 1

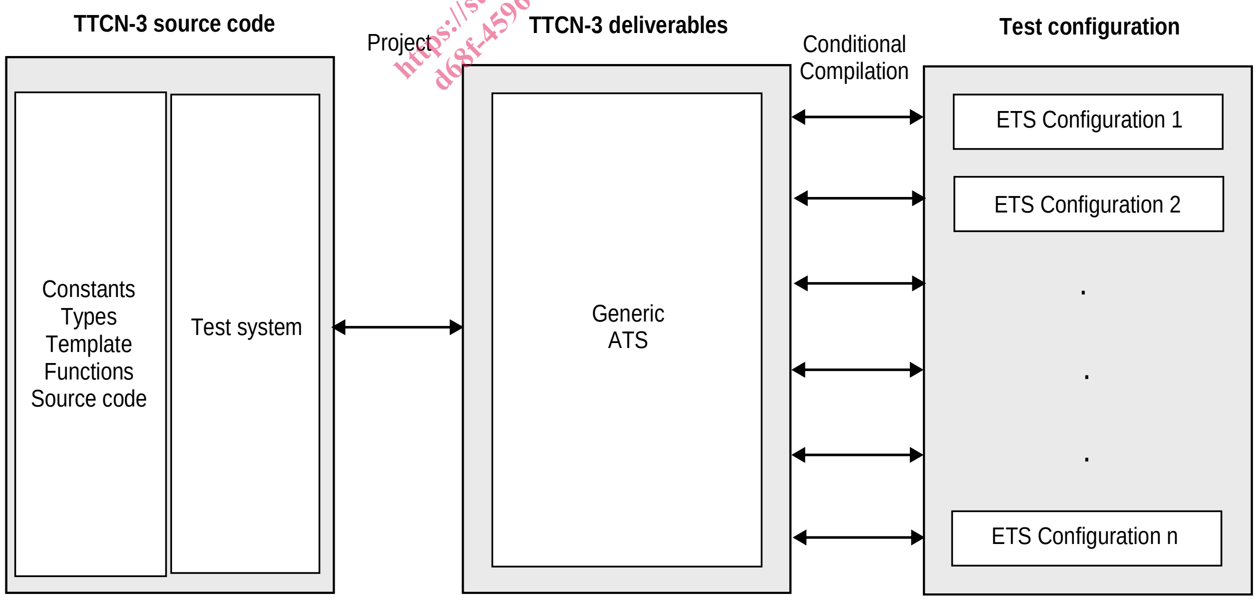

Figure 6: TTCN-3 development concept 2