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Technical Specification

Broadband Radio Access Networks (BRAN); HiperMAN; Conformance Testing for the Network layer of HiperMAN/WiMAX terminal devices; Part 3: Abstract Test Suite (ATS)



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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 Network layer of the WiMAX/HiperMAN terminal devices, 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 HiperMAN/WiMAX terminal devices for conformance across WiMAX networks.

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

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [40] and ISO/IEC 9646-2 [41]) as well as the ETSI rules for conformance testing (ETS 300 406 [36]) are used as a basis for the test methodology.

Annex A provides the Tree and Tabular Combined Notation (TTCN) part of the ATS.

Annex B provides the Partial Protocol Implementation Extra Information for Testing (PIXIT) Proforma of the SS side ATS.

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

2 References

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

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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] WiMAX Forum (V1.2.2): "WiMAX Forum Network Architecture; Stage 1: Architecture Tenets, Reference Model and Reference Points, Part 1".
- [2] WiMAX Forum (V1.2.2): "WiMAX Forum Network Architecture, Stage 2: Architecture Tenets, Reference Model and Reference Points, Part 2".
- [3] WiMAX Forum (V1.2.2): "WiMAX Forum Network Architecture, Stage 3: Detailed Protocols and Procedures".
- [4] Void.
- [5] ETSI TS 102 624-2: "Broadband Radio Access Networks (BRAN); HiperMAN; Conformance Testing for the Network layer of the HiperMAN/WiMAX terminal devices; Part 2: Test Suite Structure and Test Purposes (TSS&TP)".

- [6] ETSI TS 102 545-3: "Broadband Radio Access Networks (BRAN); HiperMAN; Conformance Testing for WiMAX/HiperMAN 1.3.1; Part 3: Abstract Test Suite (ATS)".
- [7] 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".
- [8] IEEE 802.16g-2007: "IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems - Amendment 3: Management Plane Procedures and Services".

NOTE: Available at <http://standards.ieee.org/getieee802/802.16.html>.

- [9] IETF RFC 768 (August 1980): "User Datagram Protocol".
- [10] IETF RFC 791 (September 1981): "Internet Protocol specification".
- [11] IETF RFC 792 (September 1981): "Internet Control Message Protocol".
- [12] Void.
- [13] IETF RFC 1112 (August 1989): "Host Extensions for IP Multicasting".
- [14] IETF RFC 1256 (September 1991): "ICMP Router Discovery Messages".
- [15] IETF RFC 2131 (March 1997): "Dynamic Host Configuration Protocol".
- [16] IETF RFC 2132 (March 1997): "DHCP Options and BOOTP Vendor Extensions".
- [17] IETF RFC 2460 (December 1998): "Internet Protocol, Version 6 (IPv6) Specification".
- [18] IETF RFC 2794 (March 2000): "Mobile IP Network Access Identifier Extension for IPv4".
- [19] IETF RFC 3315 (July 2003): "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)".
- [20] IETF RFC 3344 (August 2002): "IP Mobility Support for IPv4".
- [21] IETF RFC 3543 (August 2003): "Registration Revocation in Mobile IPv4".
- [22] IETF RFC 3748 (June 2004): "Extensible Authentication Protocol (EAP)".
- [23] IETF RFC 3775 (June 2004): "Mobility Support in IPv6".
- [24] IETF RFC 3846 (June 2004): "Mobile IPv4 Extension for Carrying Network Access Identifiers".
- [25] IETF RFC 4187 (January 2006): "Extensible Authentication Protocol Method for 3rd Generation Authentication and Key Agreement (EAP-AKA)".
- [26] IETF RFC 4283 (November 2005): "Mobile Node Identifier Option for Mobile IPv6 (MIPv6)".
- [27] IETF RFC 4285 (January 2006): "Authentication Protocol for Mobile IPv6".
- [28] IETF RFC 4433 (March 2006): "Mobile IPv4 Dynamic Home Agent (HA) Assignment".
- [29] Void.
- [30] IETF RFC 4861: "Neighbor Discovery for IP version 6 (IPv6)".
- [31] IETF RFC 4862: "IPv6 Stateless Address Autoconfiguration".
- [32] IETF RFC 5216: "The EAP-TLS Authentication Protocol".
- [33] IETF RFC 5246: "The Transport Layer Security (TLS) Protocol Version 1.2".
- [34] IETF RFC 5281 (August 2008): "Extensible Authentication Protocol Tunnelled Transport Layer Security Authenticated Protocol Version 0 (EAP-TTLSv0)".

- [35] IETF draft-ietf-mip6-hiopt-07.txt: "DHCP Option for Home Information Discovery in MIPv6".
- [36] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [37] 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".
- [38] Void.
- [39] ETSI ES 201 873-6: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 6: TTCN-3 Control Interface (TCI)".
- [40] ISO/IEC 9646-1 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts". (See also ITU-T Recommendation X.290 (1991).
- [41] ISO/IEC 9646-2 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 2: Abstract Test Suite specification". (See also ITU-T Recommendation X.291 (1991).
- [42] ISO/IEC 9646-6 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 6: Protocol profile test specification".
- [43] ISO/IEC 9646-7 (1995): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statement".
- [44] IETF RFC 761: "DoD standard Transmission Control Protocol".
- [45] IETF RFC 3486: "Compressing the Session Initiation Protocol (SIP)".
- [46] IETF RFC 3957: "Authentication, Authorization, and Accounting (AAA) Registration Keys for Mobile IPv4".
- [47] IETF RFC 2461: "Neighbor Discovery for IP Version 6 (IPv6)".
- [48] IETF RFC 2462: "IPv6 Stateless Address Autoconfiguration".
- [49] IETF RFC 2246: "The TLS Protocol Version 1.0".
- [50] IETF RFC 2716: "PPP EAP TLS Authentication Protocol".
- [51] IETF RFC 4286: "Multicast Router Discovery".
- [52] IETF RFC 4721: "Mobile IPv4 Challenge/Response Extensions (Revised)".
- [53] IETF RFC 4857: "Mobile IPv4 Regional Registration".
- [54] IETF RFC 4988: "Mobile IPv4 Fast Handovers".

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 [43], TS 102 545-3 [6], IEEE 802.16e-2005 [7] and IEEE 802.16g-2007 [8], [1], [2] and [3] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TS 102 545-3 [6], ISO/IEC 9646-1 [40], ISO/IEC 9646-6 [42], ISO/IEC 9646-7 [43], IEEE 802.16e-2005 [7], IEEE 802.16g-2007 [8], [1], [2], [3] and the following apply:

AKA	Authentication and Key Agreement
ATS	Abstract Test Suite
AVP	Attribute Value Pair
BS	Base Station
CID	Connection IDentifier
CMAC	Cipher-based MAC
CS	Convergence Sublayer
DHCP	Dynamic Host Configuration Protocol
DIUC	Downlink Interval Usage Code
DLC	Data Link Control
EAP	Extensible Authentication Protocol
ICMP	Internet Control Message Protocol
IGMP	Internet Group Membership Protocol
IP	Internet Protocol
IUT	Implementation Under Test
MIP	Mobile IP
NAP	Network Access Provider
NCT	Network Conformance Tests
NSP	Network Service Provider
NWE	Network Entry
OFDM	Orthogonal Frequency Division Multiplexing
OSI	Open Systems Interconnection
PA	Platform Adapter
PCO	Point of Control and Observation
PCT	Protocol Conformance Tests
PCTR	Protocol Conformance Test Report
PHY	Physical layer
PIXIT	Partial Protocol Implementation Extra Information for Testing
REQ	REQuest
RSP	ReSPonse
SA	SUT Adapter
SS	Subscriber Station
SUT	System Under Test
TA	Test Adapter
TC	Test Case
TLS	Transport Layer Security
TLV	Type, Length, Value
TP	Test Purposes
TTCN	Test and Test Control Notation
TTLS	Tunnelled TLS
UIUC	Uplink Interval Usage Code

4 Abstract Test Method (ATM)

This clause describes the ATM used to test the Network layer of the HiperMAN/WiMAX terminal devices.

NOTE: In the present document the normative terms SUT Adapter (SA), Platform Adapter (PA) and CODECS as defined by TTCN-3 standards [37] are used. The non-normative term Test Adaptor (TA) is also used for backward compatibility with TS 102 545-3 [6] and embodies SA, PA and CODECS concepts.

4.1 Test architecture

4.1.1 Points of Observation and Control

Testing BRAN HiperMAN/WiMAX terminal devices for conformance across WiMAX networks involves the participation of many procedures and protocols. In order to delimit the scope of NCT, the identification of Points of Observation and Control (i.e. PCO as defined in ISO/IEC 9646-1 [40]) become of utmost importance.

After an exhaustive analysis of the NWG base standards WiMAX Forum Network Architecture; Stage 2 [2], WiMAX Forum Network Architecture; Stage 3 [3] and TS 102 624-2 [5], the PCO for "Conformance Testing for the Network layer of the HiperMAN/WiMAX terminal devices" are identified.

PCO are depicted in figure 1 on an OSI model representation of the WiMAX terminal device in all the scenarios considered in the present document.

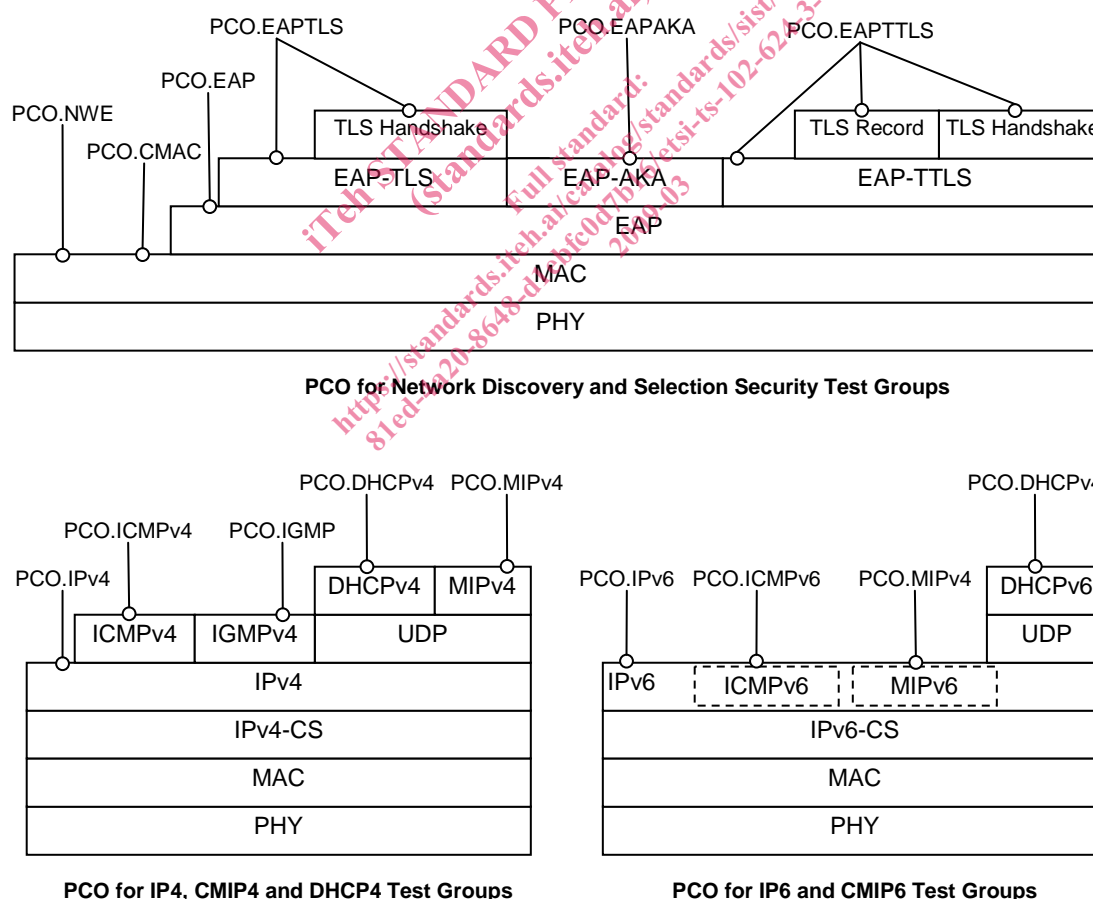


Figure 1: Points of Observation and Control

Each PCO identified above is specified in IETF standards (with the exception of PCO.NWE and PCO.CMAC).

Since protocols usually have extensions and options, several standards may be needed to specify one single protocol in its completeness. However, the scope of the present document is limited to the IETF standards applicable in NWG base standards. The list of standards which specifies the protocols involved in the network functionalities to be tested in accordance with TS 102 624-2 [5] is given in table 1.

Table 1: IEEE and IETF standards for NCT PCOs

PCO	Standards
PCO.NWE	IEEE P802.16g/ D9, April 2007 [8]
PCO.CMAC	IEEE 802.16e-2005 [7]
PCO.MIPv4	RFC 3344 [20], RFC 3543 [21], RFC 3846 [24] and RFC 4433 [28]
PCO.MIPv6	RFC 3775 [23], RFC 4283 [26] and RFC 4285 [27]
PCO.IPv6	RFC 2460 [17]
PCO.DHCPv4	RFC 2131 [15] and RFC 2132 [16]
PCO.DHCPv6	RFC 3315 [19] and IETF draft draft_ietf_mip6_hiop17.txt [35].
PCO.ICMPv4	RFC 792 [11] and RFC 1256 [14].
PCO.ICMPv6	RFC 2461 [30] and RFC 2462 [31]
PCO.IGMP	RFC 1112 [13]
PCO.EAP	RFC 3748 [22]
PCO.EAPTLS	RFC 2246 [33] and RFC 2716 [32]
PCO.EAPTTLS	RFC 5281 [34]
PCO.AKA	RFC 4187 [25]

New PCO may be identified as new network functionalities become target of NCT testing in future releases of TS 102 624-2 [5]. Likewise, new IETF standards may become within the scope of NCT testing.

The present document also deals with the processing of protocols, messages and fields which currently remains outside the scope of NCT testing. See details in clauses 6.1.3 and 6.1.4.

4.1.2 Architectural Requirements

Based on the PCO identification, and considering compatibility with existing standards a desirable system property, the following list of architectural requirements is proposed. These requirements are to be accomplished in the definition of the Abstract Test Method.

4.1.2.1 Reuse of DLC-TTCN

Table 2: TTCN-3 Test Suite Requirements

ID	Description
REQ-1-ATS	NCT TTCN-3 test suite shall use the existing DLC-TTCN (TS 102 545-3 [6]) in order to operate the DLC layer when required by NCT test cases (e.g. test preambles).
REQ-2-ATS	NCT TTCN-3 test suite shall rely on TA (SA part) for the implementation of the WiMAX PHY layer (according to IEEE 802.16e-2005 [7]).
REQ-3-ATS	NCT TTCN-3 test suite shall rely on TA (PA part) for the implementation of the EAP protocol and the upper security methods. Initial implementation will cover mandatory features and optional features may be developed provided that IUT support is available.

Table 3: Test Adaptor Requirements

ID	Description
REQ-1-TA	TA shall use existing DLC-TTCN SA keeping the same TRI interface to serve the DLC-TTCN ports: TA, Phy, MacMsg, MacBcMsg and MacPdu.
REQ-2-TA	TA shall use an upgraded version of the DLC-TTCN Platform Adapter to deal with the EAP protocol and the upper security methods. See REQ-4-TA for upgrade scope.
REQ-3-TA	TA shall use the DLC-TTCN CODECS subsystem for DLC messages in order to code the messages transported by the DLC-TTCN3 ports: TA, Phy, MacMsg, MacBcMsg and MacPdu.

NOTE: In the present document, DLC-TTCN stands for the ATS to test BRAN HiperMAN/WiMAX systems for conformance in accordance with TS 102 545-3 [6]. Likewise, DLC-TTCN SA, PA and CODECS stands for the SA, PA and CODECS implementation respectively of a test machine in compliance with TS 102 545-3 [6].

4.1.2.2 Security test group

Table 4: TTCN-3 Test Suite Requirements

ID	Description
REQ-5-ATS	EAP protocol shall be TTCN-3 typed to handle incoming EAP packets from Test Adaptor in order to set test verdict.
REQ-6-ATS	EAP-TLS protocol shall be TTCN-3 typed to handle incoming EAP packets from Test Adaptor in order to set test verdict.
REQ-7-ATS	EAP-TTLS protocol shall be TTCN-3 typed to handle incoming EAP packets from Test Adaptor in order to set test verdict.
REQ-8-ATS	EAP-AKA protocol shall be TTCN-3 typed to handle incoming EAP packets from Test Adaptor in order to set test verdict.

Table 5: Test Adaptor Requirements

ID	Description
REQ-4-TA	EAP simulator in TA (PA part) shall support the following authentication methods: EAP-TLS, EAP-TTLS and EAP-AKA (according to RFC 3748 [22], RFC 2716 [32], RFC 2246 [33], RFC 4187 [25] and RFC 5281 [34]).
REQ-5-TA	TA shall implement CODECS subsystem for EAP protocol and authentication methods (EAP-TLS, EAP-AKA, EAP-TTLS/MSCHAPv2).
REQ-6-TA	In the case of EAP-TTLS, Test Adaptor (SA part) shall decrypt and encrypt the AVP (Attribute Value Pairs) throughout the inner security method transported in TLS-Record. Therefore, AVP shall be clear coded at the ATS level.

4.1.2.3 IPv4 test groups

Table 6: TTCN-3 Test Suite Requirements

ID	Description
REQ-9-ATS	DHCPv4 protocol shall be fully TTCN-3 typed according to the RFC 2131 [15] and RFC 2132 [16].
REQ-10-ATS	TTCN-3 test code shall act as the network side of the DHCPv4 protocol.
REQ-11-ATS	MIPv4 protocol shall be TTCN-3 typed according to the RFC 3344 [20], RFC 3543 [21], RFC 3846 [24] and RFC 4433 [28].
REQ-12-ATS	TTCN-3 test code shall emulate the network side of the MIPv4 protocol.
REQ-13-ATS	ICMPv4 protocol shall be TTCN-3 typed according to the RFC 792 [11] and RFC 1256 [14].
REQ-14-ATS	TTCN-3 test code shall emulate the network side of the ICMPv4 protocol.
REQ-15-ATS	IGMP protocol shall be TTCN-3 typed according to the RFC 1112 [13].
REQ-16-ATS	TTCN-3 test code shall emulate the network side of the IGMP protocol.
REQ-17-ATS	IPv4 protocol shall be partially TTCN-3 typed, as per NCT test case needs, according to the RFC 791 [10].

Table 7: Test Adaptor Requirements

ID	Description
REQ-7-TA	TA shall provide CODECS subsystems for DHCPv4, MIPv4, ICMPv4 and IGMP.