

PROCEDURE
for the technical and functional verification
of the subscriber terminals to be used
within the broadband radio access network,
WiMAX IEEE 802.16e-2005, administered
by STS

Chapter 1 Purpose of the procedure

Art. 1 The Special Telecommunications Service identifies and certifies the types of WiMAX subscriber terminals, in terms of services to be provided within the broadband radio access network, based on the WiMAX IEEE 802.16e-2005 technology, administered by STS, between the subscriber terminals and the network infrastructure.

The result of the certification process is the issuance of a conformance certificate provided for the tested subscriber terminal type.

Art. 2 STS makes available for the providers of WiMAX subscriber terminals, a technical and functional verification procedure for this type of equipment, in order to certify their interoperability with the infrastructure of the broadband radio access network, based on WiMAX IEEE 802.16e-2005 technology, administered by STS, in terms of access and management services implementation.

Art. 3 STS guarantees the protection and the confidentiality of the special radiocommunications, which are exempt from the licensing and permits regime, under the current legal regulations in the telecommunications field.

Chapter 2 Applicability domain

Art. 4 The certification procedure is mandatory for all the WiMAX subscriber terminals, proposed for use within the broadband radio access network, based on WiMAX IEEE 802.16e-2005 technology, administered by the STS.

Art. 5 The WiMAX subscriber terminals that have not been subjected to the certification procedure herewith and have not obtained positive results at the PASS/FAIL tests, specified as mandatory in the procedure herewith, cannot be activated within the WiMAX network administered by STS.

Art. 6 After the technical and functional verifications, prior to be published on the STS website, the test results will be presented to the applicant for validation.

Art. 7 The applicant shall within 5 working days validate/invalidate the test results. If the applicant does not meet this deadline in submitting a response, the certificate will be published on the www.sts.ro website, in the "Regulations" section, as resulted after completing the tests.

Art. 8 The original format of the certificates will be kept at STS, while other copies shall be issued only for the legal beneficiaries of the services provided by STS, upon their specific request.

Art. 9 Printed copies of the certificates shall not be released to the applicant, who has the possibility to download the electronic format of the certificate, published on the Internet.

Chapter 3 Definitions and abbreviations

- 1) *WiMAX Network* – the infrastructure of the broadband radio access network, based on WiMAX IEEE 802.16e-2005 technology, administered by the STS. The WiMAX network, as previously defined, mainly consists of the following elements: WiMAX base stations (hereinafter referred to as BS), Access Services Network Gateway (hereinafter referred to as ASN-GW), the AAA system (Authentication, Authorization and Accounting), infrastructure management system (hereinafter referred to as NMS) and subscribers' management system (hereinafter referred to as MS-NMS).
- 2) *Core Network* – entirety of the ASN-GW, AAA, NMS and MS-NMS elements.

- 3) *Conformance assessment* – the activity proving that a WiMAX subscriber terminal meets the conditions specified by the IEEE 802.16e-2005 standard and by the STS requirements.
- 4) *Compliance Certification* - action following the assessment, which confirms that a WiMAX subscriber terminal is compatible with the WiMAX network infrastructure.
- 5) WiMAX subscriber terminal - equipment which can use the WiMAX network services.
- 6) Subscriber terminals class – a category of WiMAX subscriber terminals, which are considered similar, in accordance with the procedure herewith.
- 7) Prejudicial interference – radio interference which endangers the functioning of a service or disrupts or impedes or repeatedly disconnects a service provided by WiMAX network.
- 8) *Technical documentation* - technical specifications completely describing a type of WiMAX subscriber terminal.

Chapter 4 Stages of the procedure

Art. 10 Initiation Stage

- 1) The procedure is initiated through a request for technical and functional verification, submitted in writing to the Director of STS, by a legal person, be it a vendor/provider of WiMAX subscriber terminals, or a legal beneficiary of the communications services provided by STS.
- 2) The director of STS analyzes the request's eligibility within 3 working days after receiving it. The applicant shall be notified in writing, within 2 working days after a decision is made.
- 3) If the request is approved, the applicant is required to deliver, within 3 working days, the technical documentation, the hardware and the software necessary for the configuration and diagnose of the WiMAX subscriber terminals to be tested.

Art. 11 The applicant must make available for STS the full technical specifications of the WiMAX subscriber terminals, which the applicant intend to activate or provide for use within the WiMAX network administered by STS. The technical specifications must include all the details that allow the functional verification of the subscriber terminals, for all the services provided by the WiMAX network administered by STS.

Art. 12 The applicant must provide administration credentials to the STS specialists, that will allow them to configure/setup the terminals with all the working parameters specified in the procedure herewith.

Art. 13 Conformity verification stage

- (1) The applicants must provide at least the following equipment and tools for carrying out the tests:
 - a) The terminals to be tested (UUT – unit under test):
 - i) Two WiMAX subscriber terminals, including all the accessories for the installation at the customer's location (except for the antenna support, which will be provided by STS);
 - ii) A WiMAX subscriber terminal adapted for radio compliance testing, with external antenna connector.
 - b) The necessary cables, the attenuators, the power dividers, the adapters between the terminal connectors and N-type connectors, as well as other devices necessary for running radio compliance testing.
- (2) The applicants must ensure at the STS headquarters and in the radio locations indicated and provided by STS, all the necessary technically qualified personnel,

able to install and configure the testing equipment and to carry out the tests, in the presence and with the technical support of STS staff.

- (3) The equipment and the hardware/software accessories provided by the applicants to carry out the tests will be returned to them within 10 days after the evaluation is completed. One WiMAX subscriber terminal will remain at STS for the duration of certificate's validity.

Art. 14 Conditions for access in the STS premises

- (1) The access of the applicant's technical staff in the STS premises is based on a request for access addressed to the Director of STS, a list of the staff concerned being attached and including all the required identification data (surname/first name, Identity Card series and number, Personal Identification Number, home address, a copy of the passport for foreigners, the employing company).
- (2) The request for access shall be submitted by the applicant immediately receiving from STS the notification concerning the eligibility of its application for the technical verification of WiMAX subscriber terminals and shall be valid for the entire period needed to run the tests (see paragraph 16 below).

Art.15 Necessary conditions for obtaining the certificate

- (1) In order to be certified, each type of WiMAX subscriber terminal must comply with the following regulations:
 - a) Government Decision no. 457/2003 on ensuring safety of low voltage electrical equipment users, republished, with subsequent amendments, but without applying any voltage limits;
 - b) Government Decision no. 982/2007 on electromagnetic compatibility;
 - c) Directive 1999/5/EC of the European Parliament and Council amended and supplemented.
- (2) The WiMAX subscriber terminal has to be built so that it effectively uses the spectrum allocated to the WiMAX technology and it avoids prejudicial interferences.

Art. 16 Certification stage

- (1) The terminal type under evaluation receives certification for use within the WiMAX network only if it meets the requirements and the provisions of the technical tests developed by STS.
- (2) In case of the WiMAX subscriber terminals admitted upon verification, STS issues a certificate of conformity related to the functioning on optimal interoperability terms within the WiMAX network administered by STS. The list of these terminals shall be presented on STS website.
- (3) The result of each of the tests described in the procedure herewith can be: positive (PASS), negative (FAIL) or not tested (N/A).
- (4) ONLY the WiMAX subscriber terminals that were subjected to the test procedure herewith and that obtained positive results (PASS) in the tests specified as mandatory can be activated in the WiMAX network administered by STS.
- (5) The results/ conclusions following the technical verification shall be communicated to the applicant within maximum 30 calendar days since receiving the terminals and the technical documentation.
- (6) In exceptional circumstances, the results of the technical verification can be communicated to the applicant within 5 working days since receiving the terminals, together with their technical documentation (according to the detailed description in Articles 11-13), and with a specific request for urgent technical

verification, addressed to STS. Such request can be addressed to STS only if the following conditions are simultaneously met:

- a. The applicant must prove that he is involved as a bidder in a public acquisition procedure, whose object also includes the delivery of WiMAX subscriber stations that are going to be used within the *WiMAX Network* and the Contracting Authority requires STS certification for the WiMAX subscriber stations. The proof that the applicant is involved in a public acquisition procedure can be made by attaching to the request for urgent technical verification, the relevant documents certifying the offer's submission to the Contracting Authority (e.g. a copy of the offer forwarding letter, submitted to the Contracting Authority).
- b. The request for the urgent technical verification will be accepted by STS if it is submitted within maximum 2 working days since the offer has been submitted to the Contracting Authority. Exceeding the mentioned time limit determines the loss of the urgency character of the technical verification request.
- c. The WiMAX subscriber terminals that are going to be subjected to the technical and functional verifications, as well as their technical documentation (according to the detailed description in Articles 11-13) will be provided at the STS HQ starting with the moment of submitting the urgent technical verification request.
- d. The applicant will permanently ensure, for the entire 5 days period, at least one empowered representative to take part into the WiMAX terminals' technical and functional verifications activities, in order to rapidly solve all the problems that might be identified by the STS specialists during the testing procedure.

Chapter 5 Claims

Art. 17 If the applicant does not accept the result announced by STS, he may lodge a claim to the Director of STS, within 5 calendar days since he received the results.

Art. 18 The claim will be solved amicably between the parties, within 30 days after submitting it.

Chapter 6 Final dispositions

Art. 19 STS reserves its right to modify the procedure herewith, whenever considers it necessary. New versions become applicable from the moment they are posted on the STS Internet website www.sts.ro, in the "Regulations" section, with the exception of the terminals subject to ongoing testing procedures, to which the procedure version in force at the moment of initiating the tests will be applied.

Art. 20 If the amendment procedure involves changing the PASS/FAIL conditions for the mandatory tests, or the addition of mandatory tests, the testing procedure will resume for all the subscriber terminals for which a certificate of conformity has been issued.

Art. 21 STS ensures the electronic archiving of the information concerning the technical specifications of the WiMAX subscriber terminals under evaluation.

Art. 22 The certificate of conformity is posted on the STS website, after the applicant accepts the results. If within 5 calendar days the applicant does not formulate a response regarding the test results, the certificate will be published in its initial form.

Art. 23 The certificate shall enter into force after publication on the STS website and shall be available to third parties as presented on the site.

Art. 24 Only the public authorities, as beneficiaries of the WiMAX network administered by STS, can request a copy of the conformity certificate's formal version, bearing the signature and seal of the issuer.

Art. 25 The tests register is classified as Restricted. Data in the tests register can be accessed in accordance with the legislation on the classified information protection.

Art. 26 In cases when the tests show inconsistencies with the provisions of the Government Decision no. 88/2003 on radio equipment and telecommunications terminal equipment and mutual recognition of their conformity, republished, STS will request remedial actions.

Art. 27 STS will not charge any fees for its material and human resources allocated for running the technical and functional verification tests. Applicants will bear the costs of material and human resources that they will involve in the technical and functional verification tests.

Art. 28 On behalf of STS, the procedure is performed by specialized personnel belonging to its radio communications central unit.

Art. 29 The beneficiary of the conformity certificate shall request the re-testing of the subscriber terminals models already tested, in cases when the tested software and hardware versions have been modified, before releasing such new versions on the Romanian market.

**Detailed description
of tests for the certification of conformity to use WiMAX subscriber
terminals within the WiMAX network
administered by STS**

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Chapter 1: Introduction

Section 1. Test procedures methodology

Art. 1 The procedure herewith presents the WiMAX network architecture administered by STS, lists and describes the services provided by this infrastructure, each of the provided services being tested by means of a work procedure, consisting of the following operations:

- 1. THE SETUP PROCEDURE:** the settings applied to the equipment used in the testing process. The setup requirements for the system infrastructure or for the set of equipment that emulate the infrastructure will be specified only if they differ from the standard settings.
- 2. THE TEST PROCEDURE:** the internal work procedure, including the testing operations flow for each service subject to verification. The test procedures require extensive knowledge in the field of the WiMAX 802.16e technology, and *the exit conditions* will be defined if, once the test ends, changes must be made to reset the equipment to its initial state.

Art. 2 The test results are mentioned in a data sheet of the tested equipment type, attached to the certificate of conformity which shall contain the following data:

1. Data concerning the performed tests and their results;
2. Observations concerning the tested services, these being added as comments next to the test in question;
3. The results of the laboratory measurements performed on the emission and reception radio parameters, according to technical specifications of the ETSI EN 302 623 standard "Broadband Wireless Access Systems (BWA) in the 3400 MHz to 3800 MHz frequency band; Mobile Terminal Stations; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive ".

Section 2. Overview of the WiMAX network administered by STS

Art. 3 STS administers and operates a broadband radio access network, based on WiMAX IEEE 802.16e-2005 technology, operating in the 3.7 GHz frequency band (3 channels of 5 MHz, in the 3685-3700 MHz sub-band, TDD use) – referred to as the WiMAX network according to the definitions in the procedure herewith. The architecture of the WiMAX network administered by STS is presented in the Figure 1 below.

(2) The mobile access services are transported through GRE tunnels on the R6 interface between BS WiMAX and ASN-GW, and respectively switched to the mobile traffic interface of the ASN GW (trunk 802.1q, VLAN ID configurable for each mobile user domain).

(3) The WiMAX subscriber terminals designed for nomadic or mobile use must also allow IP CS service flows configuration and provisioning.

Art. 8 The operating modes described in art. 6 and art. 7 above (ETH CS / IP CS) will not be used simultaneously by the same subscriber terminal.

Art. 9 (1) The maximum operating distance, between the subscriber terminal and the base station is not less than 20 km, although the standard maximum operating distance, for the 5 MHz channel bandwidth is 8.4 km.

(2) To reach the 20 km distance, the PHY (physical layer) implementation allocated a symbol of the downlink subframe to the TTG (Transmit Transition Gap), six symbols are used for the IR (Initial Ranging) area, four of them being used for the IR code. Due to these features, the WiMAX subscriber terminals must support these parameter changes in the PHY implementation.

Art. 10 The WiMAX base stations that are functional within the STS WiMAX network are equipped with a multiple antenna system (2 Tx antennas and 4 Rx antennas) and thus implement the following features:

- 1) Receive MRC (fourth and second order MRC)
- 2) MIMO Matrix A (STC)
- 3) MIMO Matrix B
- 4) Transmit Cyclic Delay Diversity
- 5) Adaptive MIMO

Art. 11 To fully use the features of the multiple antenna system the STS WiMAX network infrastructure is provided with, the WiMAX subscriber terminals must be able to implement MIMO Matrix B on downlink, 1 Tx antenna and 2 Rx antennas being the minimum requirements to be met by the terminal's multiple antenna system.

Art. 12 To ensure the retransmission of erroneous packets, the data service flows are configured with the H-ARQ, both in the downlink and uplink directions, and the WiMAX subscriber terminals certified for interoperability with the WiMAX network infrastructure, must ensure the proper functioning of H-ARQ mechanisms together with the MIMO mechanisms, irrespective of the MIMO setup dynamically selected by the system. These technical features (MIMO and HARQ) will not be directly tested, but the band tests results will highlight the proper functioning and the stability of these mechanisms.

Chapter 2 Operating modes for the WiMAX subscriber terminals

Section 1 Bridge – ETH CS operating mode

Art. 13 This operating mode should only be used for fixed access services. The fixed WiMAX subscriber terminals are installed within the customers' premises and provide an Ethernet interface for the connection of customer's LAN equipment, configured in the trunk mode IEEE 802.1q, thus being able to provide several data services with different QoS parameters, on a single physical interface, each data service being assigned to a distinct pair of ETH CS service flows (downlink - uplink).

Art. 14 The Ethernet interface of the WiMAX subscriber terminal can also be configured in access mode if a single data access service is needed at the customer's premises, this service being also assigned to a pair of ETH CS service flows. In this case, the BS WiMAX is performing the VLAN tagging.

Art. 15 The authentication credentials for the STS WiMAX network are configured in the WiMAX subscriber terminal as part of the commissioning process.

Art. 16 The authentication mode is EAP-TTLS/MS-CHAP v2, and the credentials consist of user name, password and user domain. Based on these credentials, the AAA server from CSN (Connectivity Service Network) recognizes the terminal as being with fixed use (bridge ETH CS operating mode) and downloads into the WiMAX subscriber terminal only the basic and primary service flows.

Art. 17 The ETH CS service flows for data traffic are provisioned from NMS, and are associated with the MAC address of the WiMAX subscriber terminal. The VLAN ID classification ensures the L2 traffic mapping, between each VLAN ID and the corresponding pair of ETH CS service flows, thus ensuring the quality of services (QoS) in accordance with the types of traffic requested by the customer. The types of QoS that can be defined are those specified by IEEE 802.16e-2005 standard (UGS, RT-VR, NRT-VR, ERT-VR and BE). The VLAN ID marking of the data traffic is ensured by the L2 (VLAN aware switches) or L3 (routers with 802.1q (sub) interfaces) devices, connected downstream the WiMAX subscriber terminal.

Art. 18 (1) The management of the WiMAX subscriber terminals configured in bridge ETH CS mode is ensured by provisioning a distinct management VLAN ID mapped to a distinct pair of ETH CS service flows, assigned for the management traffic of the subscriber terminal.

(2) The WiMAX subscriber terminal's local management software application must allow the configuration of static IP parameters for the terminal management (IP, mask, default gateway) as well as the configuration of management VLAN ID (on the uplink direction, the marking of the traffic management with VLAN ID is ensured by the subscriber terminal).

(3) From the BS WiMAX point of view, the ETH CS service flows assigned for the subscriber terminals management are processed similarly with the service flows assigned for data traffic, the traffic on the management VLAN ID of the subscriber terminals being switched at Layer 2 on the WiMAX BS traffic interface.

Art. 19 The initial setup (commissioning) of the fixed WiMAX subscriber terminal must include the setting of the following parameters:

- 1) Operating mode: ETH CS
- 2) The working frequencies of the STS WiMAX network – the channels (frequencies) that the subscriber terminal scans during the process of network entry will be explicitly set.
- 3) The channel bandwidth: mandatory, the terminal must allow the 5 and 10 MHz bandwidths, and optionally the 7 MHz bandwidth.
- 4) The authentication credentials in AAA: username, password and domain.
- 5) The authentication mode in AAA: EAP-TTLS/ MS-CHAP v2. Also, the terminal must allow the configuration of X.509 certificates, so that it accepts the X.509v3 server certificate provided by the infrastructure.
- 6) The remote management parameters (WAN WiMAX interface): IP, subnet mask, default gateway, management VLAN ID.

Section 2 NAT – IP CS operating mode

Art. 20 (1) The WiMAX subscriber terminals must be able to provide mobile or nomadic access services that allow their ad hoc connection to any BS WiMAX from the STS WiMAX network. In terms of the initial setup, the parameters are similar to those presented in art. 19.

(2) Based on the authentication credentials, the AAA server recognizes the subscriber terminal as being mobile and provides the data service flows that ensure the access to the mobile services gateway.

(3) The operation of the WiMAX subscriber terminal in IP CS mode involves the possibility of setting up the WAN interface for the WiMAX terminal as DHCP client (in this operating mode the connections are established at Layer 3, the parameters received from the DHCP server are: IP address, netmask, default gateway and, as appropriate, the IP address of the DNS server), and the LAN interface (toward the user's equipment) may be setup as DHCP server.

(4) For other constructive versions of WiMAX subscriber terminals (e.g. USB terminals), the LAN interface is not available, the terminal acting as a network interface, the NAT function not being applicable.

Chapter 3 Test plan description

Section 1 Radio conformity test

Art. 21 Initial conditions:

1. All the tests will be conducted under laboratory conditions.
2. Required equipment:
 - a. BS WiMAX – Airspan MacroMAXe
 - b. TS UUT - WiMAX subscriber terminal adapted for radio conformity tests, with external antenna connector
 - c. Agilent E3238S Spectrum Analyzer, with the software module Agilent 89600 Vector Signal Analysis
 - d. Directional coupler
 - e. Variable attenuator
 - f. Coaxial cables, connectors, connector adapters

Note: For the WiMAX terminals that do not allow the installation of an external antenna connector (some types of USB terminals), all the laboratory tests will be performed using real (internal) antenna of TS UUT, respectively installing an antenna that will replace the cable between the variable attenuator and TS UUT. Under these conditions, the tests will be carried out in a room shielded against electromagnetic radiations.

3. The test general scheme

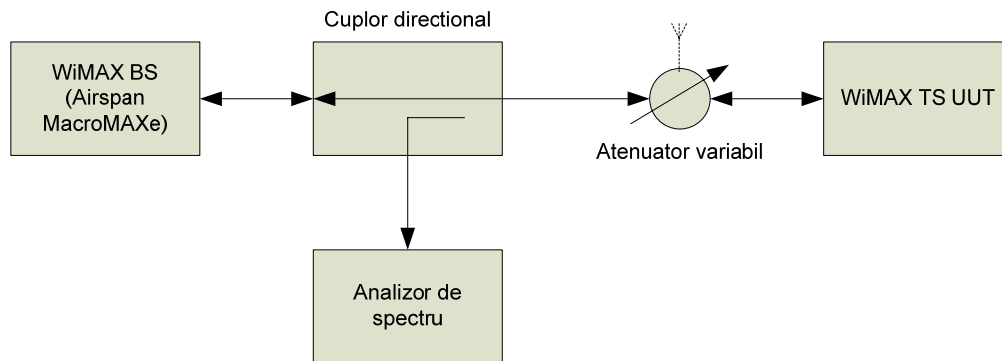


Fig. 2 – The test scheme for the radio conformity tests

Paragraph 1 Test procedure

Art 22 Determination of the TS UUT spectral emission mask

- 1) The test will run on the following central working frequencies:
 - a) 5 MHz TDD channel: 3602.5 MHz, 3697.5 MHz - **MANDATORY PASS/FAIL TEST**
 - 7 MHz TDD channel: 3603.5 MHz, 3696.5 MHz – **OPTIONAL PASS/FAIL TEST**
 - 10 MHz TDD channel: 3605.0 MHz, 3695.0 MHz – **MANDATORY PASS/FAIL TEST**
 - b) The test equipment will be connected in compliance with the scheme from Fig. 2.
 - c) BS WiMAX and TS UUT will be successively set on the channels and the working frequencies mentioned above. The output power of the BS WiMAX will be set so that the adjusting range of the variable attenuator allows TS UUT to increase the output power by the ATPC mechanism, up to around its maxim value.
 - d) BS WiMAX will be connected to Core Network, and TS UUT will be provided within the AAA server with authentication credentials for the IP CS operating mode. After the TS UUT affiliation to the network, UDP traffic will be generated in the uplink direction, using computers connected downstream the TS UUT, respectively upstream the ASN-GW, on the mobile traffic interface. The *Iperf* application will be used with datagrams of 1500 bytes.
 - e) Using the spectrum analyzer, the output power will be measured on the uplink subframe and the essential transmit parameters will be analyzed, with respect to the specifications of ETSI EN 302 623 standard.
- 2) Possible results:
 - a) PASS - if all the following conditions are simultaneously met:
 - TS UUT performs network entry on both working frequencies specified for each of the channel bandwidths mentioned in paragraph a) above.
 - The out of band emissions comply with the limits specified in the relevant clauses of section 4.2 of ETSI EN 302 623 standard.
 - b) FAIL - if any of the above conditions is not met.
 - c) N/A - if the test was not performed

Art. 23 (1) Control and monitoring function verification consists of the following operations:

- a) Checking that the WiMAX subscriber terminal does not transmit in the absence of a valid network.

- b) The working frequency of the subscriber terminal will be setup to 3795 MHz, 10 MHz TDD channel – MANDATORY PASS/FAIL TEST
- c) The test configuration is identical to that shown in fig. 2. The spectrum analyzer will be used to determine if the TS UUT transmits in the 3790-3800 MHz band, with a greater power than the upper limit specified in clause 4.2.9.2 of the ETSI EN 302 623 standard.

(2) Possible results:

- a) PASS - if all the following conditions are simultaneously met:
 - TS UUT can be set to operate on 3795 MHz, 10 MHz channel bandwidth.
 - Transmit power of TS UUT in 3790-3800 MHz bandwidth is lower than the upper limit specified in clause 4.2.9.2 of the ETSI EN 302 623 standard.
- b) FAIL - if any of the above conditions are not met.

Section 2 Initial configuration of WiMAX subscriber terminal, network entry, and terminal control from WiMAX core network (ASN-GW, NMS)

Art. 24 Initial conditions:

1. All the tests will be conducted under laboratory conditions.
2. Required equipment:
 - a. BS WiMAX – Airspan MacroMAXe
 - b. TS UUT - WiMAX subscriber terminal adapted for radio conformity tests, with external antenna connector
 - c. Agilent E3238S Spectrum Analyzer, with the software module Agilent 89600 Vector Signal Analysis
 - d. Directional coupler
 - e. Variable attenuator
 - f. Coaxial cables, connectors, connector adapters
3. General test scheme: see Fig. 2

Paragraph 1 Test procedure

Art. 25 The test operations are performed as follows:

- 1) The WiMAX subscriber terminal initial setup and network entry in Bridge Mode ETH-CS - OPTIONAL PASS / FAIL TEST
 - a) BS WiMAX will be setup on 3607.5 MHz, 5 MHz channel bandwidth/ TDD Split (DL / UL): 28/18/ FFT Size: 512/ Frame Period: 5ms
 - b) The BS transmit power and the attenuators will be adjusted to ensure CINR> 35 dB downlink
 - c) TS UUT initial configuration:
 - i) Scanning set: 3602.5 MHz, 3607.5 MHz, 3612.5 MHz, channel bandwidth 5 MHz / FFT Size: 512
 - ii) Authentication credentials (username, password and domain, X509v3 server certificate configuration, if needed)
 - iii) Authentication methods: EAP-TTLS with MS - CHAPv2
 - iv) Operating mode: Bridge Ethernet CS
 - d) IP settings:
 - i) Static IP Parameters for management (IP, Subnet Mask, Default Gateway)

- ii) The WAN interface of the WiMAX terminal is set in trunk (tagged) mode and a VLAN ID is assigned for the WiMAX subscriber terminal management
 - iii) Settings for integrating with MS-NMS management server (TR069 protocol)
- e) Possible results:
- i) PASS - if all the following conditions are met:
 - Authentication and successful network entry followed by terminal identification in NMS Netspan (MAC address of the terminal). Signaling and authentication messages will be captured and checked on the R6 interface (in ASN-GW).
 - WiMAX subscriber terminal control from the core network:
 - (a) Forced network exit through specific commands in ASN-GW, followed by automatic network re-entry.
 - (b) Forced network exit through specific commands in NMS followed by automatic network re-entry.
 - ii) FAIL - if any of the above specified conditions (i) are not met
 - iii) N/A - if the test was not performed

2) The WiMAX subscriber terminal initial setup and network entry in NAT Mode IP-CS - MANDATORY PASS / FAIL TEST

- a) BS WiMAX will be setup on 3607.5 MHz, 5 MHz channel bandwidth/ TDD Split (DL / UL): 28/18/ FFT Size: 512/ Frame Period: 5ms
- b) The BS transmit power and the attenuators will be adjusted to ensure CINR> 35 dB downlink
- c) TS UUT initial configuration:
 - i) Scanning set: 3602.5 MHz, 3607.5 MHz, 3612.5 MHz, channel bandwidth 5 MHz / FFT Size: 512
 - ii) Authentication credentials (username, password and domain, X509v3 server certificate configuration, if needed)
 - iii) Authentication methods: EAP-TTLS with MS - CHAPv2
 - iv) Operating mode: NAT IP CS
- d) IP settings:
 - i) DHCP client on WAN interface of the WiMAX terminal
 - ii) DHCP server on LAN interface (to the subscriber equipment) – only for ETH interface terminals, not applicable to USB terminals
- e) Possible results:
 - i) PASS - if all the following conditions are met:
 - Authentication and successful network entry followed by terminal identification in NMS Netspan (MAC address of the terminal). Signaling and authentication messages will be captured and checked on the R6 interface (in ASN-GW).
 - WiMAX subscriber terminal control from the core network:
 - (a) Forced network exit through specific commands in ASN-GW, followed by automatic network re-entry.
 - (b) Forced network exit through specific commands in NMS followed by automatic network re-entry.

- ii) FAIL - if any of the above specified conditions (i) are not met

Section 3 Service provisioning in Ethernet CS (bridge) mode

Art. 26 Initial conditions:

1. All the tests will be conducted under laboratory conditions.
2. Required equipment:
 - a. BS WiMAX – Airspan MacroMAXe
 - b. TS UUT - WiMAX subscriber terminal adapted for radio conformity tests, with external antenna connector
 - c. Agilent E3238S Spectrum Analyzer, with the software module Agilent 89600 Vector Signal Analysis
 - d. Directional coupler
 - e. Variable attenuator
 - f. Coaxial cables, connectors, connector adapters
3. General test scheme: see Fig. 2

Paragraph 1 Test procedure

Art. 27 The testing operations are performed as follows:

- 1) Services provisioning in Ethernet CS mode (bridge) - OPTIONAL PASS/ FAIL TEST
 - a) BS WiMAX will be setup on 3607.5 MHz, 5 MHz channel bandwidth/ TDD Split (DL / UL): 28/18/ FFT Size: 512/ Frame Period: 5ms
 - b) The BS transmit power and the attenuators will be adjusted to ensure CINR> 35 dB downlink
 - c) TS UUT initial configuration:
 - i) Scanning set: 3602.5 MHz, 3607.5 MHz, 3612.5 MHz, channel bandwidth 5 MHz / FFT Size: 512
 - ii) Authentication credentials (username, password and domain, X509v3 server certificate configuration, if needed)
 - iii) Authentication methods: EAP-TTLS with MS - CHAPv2
 - iv) Operating mode: Bridge Ethernet CS
 - d) IP settings:
 - i) Static IP Parameters for management (IP, Subnet Mask, Default Gateway)
 - ii) The WAN interface of the WiMAX terminal is set in trunk (tagged) mode and a VLAN ID is assigned for the WiMAX subscriber terminal management
 - iii) Settings for integrating with MS-NMS management server (TR069 protocol)
- 2) Management services provisioning:
 - i) One pair of service flows will be provisioned in Netspan NMS for management, on a VLAN ID identical to the one previously according to art. 25 1) d) ii) above. The service flows will be assigned to the WiMAX terminal MAC address already identified in Netspan NMS.
 - ii) The followings aspects will also be checked:
 - Successful provisioning of the service flows in WiMAX subscriber terminal (by viewing their IDs in the WiMAX subscriber terminal status menu - if this feature is enabled by its local management interface)

- IP connectivity/ management over WiMAX radio connection through 'ping' command, by accessing the WiMAX subscriber terminal via telnet/ ssh/ web/ proprietary application, by checking and taking over the WiMAX subscriber terminal into MS-NMS server, over TR069 protocol.
- 3) Provisioning a single L2 access service
- i) A pair of service flows will be provisioned for traffic in NMS Netspan (associated to MAC address of the WiMAX terminal), in addition to the management ones, with a distinct VLAN ID, in order to simulate a situation where the customer is using a single L2 access service. The Ethernet interface of the WiMAX subscriber terminal will be configured in access mode and a laptop will be connected downstream the subscriber terminal.
 - ii) The provisioned service will be tested through the ICMP protocol ('ping' command) between hosts downstream the WiMAX subscriber terminal and upstream the base station.
- 4) Provisioning multiple L2 access services
- i) 4 pairs of service flows will be provisioned for traffic in NMS Netspan (associated to MAC address of the WiMAX terminal) each having a distinct type of scheduling, respectively BE, NRTPS, RTPS, eRTPS; the total provisioned bandwidth for UL / DL data transfer will not exceed the maximum capacity of a single user UL / DL
 - ii) 2 VLAN IDs are assigned to each pair of service flows, resulting in 8 L2 data connections (a total of 8 VLAN IDs)
 - iii) The provisioned services will be tested through the ICMP protocol ('ping' command) between hosts downstream the WiMAX subscriber terminal and upstream the base station, for each VLAN-ID.
- 5) Possible results:
- i) PASS- if the following conditions are simultaneously met:
 - Correct functioning of the management terminal service.
 - Correct functioning when provisioning a single L2 access service with terminal's traffic interface in access mode.
 - Correct functioning when provisioning multiple L2 access services with terminal's traffic interface in trunk mode. In this case the terminal will have to support five pairs of service flows with different scheduling types (one pair for management traffic and 4 pairs for data traffic) and respectively the assignment of two VLAN-IDs for each data service.
 - ii) FAIL - if any of the above conditions was not met.
 - iii) N / A - if the test was not performed

Section 4 Services Provisioning in IP CS (NAT) mode

Art. 28 Initial conditions:

1. All the tests will be conducted under laboratory conditions.
2. Required equipment:
 - a. BS WiMAX – Airspan MacroMAXe
 - b. TS UUT - WiMAX subscriber terminal adapted for radio conformity tests, with external antenna connector
 - c. Agilent E3238S Spectrum Analyzer, with the software module Agilent 89600 Vector Signal Analysis

Unclassified

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Unofficial translation

- d. Directional coupler
- e. Variable attenuator
- f. Coaxial cables, connectors, connector adapters

3. General test scheme: see Fig. 2

Paragraph 1 Test procedure

Art. 29 The test operations will be performed as follows:

- 1) Services provisioning in IP CS mode (NAT) - MANDATORY PASS/ FAIL TEST
 - a) BS WiMAX will be setup on 3607.5 MHz, 5 MHz channel bandwidth/ TDD Split (DL / UL): 28/18/ FFT Size: 512/ Frame Period: 5ms
 - b) The BS transmit power and the attenuators will be adjusted to ensure CINR> 35 dB downlink
 - c) TS UUT initial configuration:
 - i) Scanning set: 3602.5 MHz, 3607.5 MHz, 3612.5 MHz, channel bandwidth 5 MHz / FFT Size: 512
 - ii) Authentication credentials (username, password and domain, X509v3 server certificate configuration, if needed)
 - iii) Authentication methods: EAP-TTLS with MS - CHAPv2
 - iv) Operating mode: NAT IP CS
- 2) IP settings:
 - a) DHCP client on WAN interface of the WiMAX terminal
 - b) DHCP server on LAN interface (to the subscriber equipment) - only for terminals having ETH interface, it does not apply to USB terminals
- 3) Provisioning of L3 access service
 - a) A pair of traffic service flows will be provisioned from the AAA server, successively, with two types of scheduling:
 - BE, configured to the UL / DL maximum rate performed on a BS sector, for a single user
 - RTPS for video services (512 kbps UL / DL)
 - b) It is intended to achieve a correct allocation of the terminal IP parameters through DHCP client from its WAN interface (IP address, netmask, default gateway, DNS)
 - c) It is intended to successfully provision the service flows in the WiMAX subscriber terminal (by viewing their IDs in the status menu of the WiMAX subscriber terminal - if this feature is enabled by its local management interface)
 - d) The services provisioned will be tested with ICMP protocol between hosts downstream the WiMAX terminal and upstream the ASN GW
 - e) WiMAX subscriber terminals must be accessible from the ASN-GW with ping, telnet/ssh, or from a computer connected to the gateway for mobile data services, with web or proprietary application.
- 4) Possible results:
 - a) PASS - if the following conditions are simultaneously met:
 - Successful provisioning of service flows in WiMAX subscriber terminal
 - Correct allocation of IP parameters to the terminal, through the DHCP client from its WAN interface
 - Continuity of the provisioned L3 services, tested through the ICMP protocol.
 - b) FAIL - if any of the above conditions are not met.

Section 5 Transfer rate for a single subscriber terminal, registered on a dedicated WiMAX base station

Art. 30 Initial conditions:

1. These tests will be carried out under real conditions, with a single WiMAX terminal registered on a dedicated sector of a WiMAX base station.
2. WiMAX terminal will be installed at a distance of approx. 1 km from the base station (for mobile or nomadic terminals), or at a distance of approx. 15 km (for fixed outdoor terminals with directive antenna). In both cases there will be direct visibility between the WiMAX terminal and the base station
3. Necessary equipment:
 - a. BS -WiMAX Airspan MacroMAXe
 - b. TS UUT - WiMAX subscriber terminal

Paragraph 1 Test procedure

Art. 31 The test operations will be performed as follows:

- 1) Transfer rate for a single subscriber terminal, registered on a dedicated WiMAX base station - MANDATORY TEST
- 2) BS WiMAX will be set up to one of the WiMAX network operating frequencies, in the 3685-3700 MHz band, 5 MHz channel bandwidth / TDD Split (DL/ UL): 28/ 18/ FFT Size: 512/ Frame Period: 5ms
- 3) Initial configuration of TS UUT:
 - a) Scanning set : 3687.5 MHz, 3692.5 MHz, 3697.5 MHz, 5 MHz channel / FFT Size: 512
 - b) Authentication credentials (username, password and domain, server certificates load X509v3, if necessary)
 - c) Authentication method: EAP-TTLS with MS - CHAPv2
 - d) Operating Mode: NAT IP CS
- 4) IP settings:
 - a) DHCP client on WAN interface of the WiMAX terminal
 - b) DHCP server on LAN interface (to the subscriber equipment) - ETH interface terminals only, does not apply to USB terminals
- 5) Provisioning L3 access services
 - a) A pair of traffic service flows will be provisioned from AAA server, scheduling BE, being configured to the maximum UL / DL rate feasible for a single user on sector
- 6) Transfer rate will be tested with iperf application in UDP modes (datagrams of 1500 bytes) and TCP. For TCP tests it is possible to configure multiple data streams.
- 7) Possible results:
 - a) The test result is not qualified as PASS/ FAIL.
 - b) Transfer rates obtained will be recorded as follows:
 - (1) Throughput UDP Downlink [kbps]
 - (2) Throughput UDP Uplink [kbps]
 - (3) Throughput TCP Downlink [kbps]
 - (4) Throughput TCP Uplink [kbps]

Section 6 QoS mechanisms implementation

Art. 32 Initial conditions:

1. These tests will be carried out under real conditions, with one WiMAX terminal registered on a base station sector, also used by other active WiMAX terminals in STS WiMAX network
2. The test will be performed only for fixed outdoor terminals with directive antenna, which will operate in the bridge ETH CS mode.
3. WiMAX terminal will be installed at a distance of approx. 15 km from the base station, under direct visibility conditions.
4. Necessary equipment:
 - a. BS WiMAX - Airspan MacroMAXe
 - b. TS UUT - WiMAX subscriber terminal

Paragraph 1 Test procedure

Art. 33 The performed testing operations are as follows:

- 1) QoS mechanisms implementation - OPTIONAL PASS / FAIL TEST
- 2) BS WiMAX will be set up to one of the WiMAX network operating frequencies, in the 3685-3700 MHz band, 5 MHz channel bandwidth / TDD Split (DL/ UL): 28/ 18/ FFT Size: 512/ Frame Period: 5ms
- 3) Initial configuration of TS UUT:
 - a) Scanning set : 3687.5 MHz, 3692.5 MHz, 3697.5 MHz, 5 MHz channel / FFT Size: 512
 - b) Authentication credentials (username, password and domain, server load X509v3 certificates, if necessary)
 - c) Authentication methods: EAP-TTLS with MS - CHAPv2
 - d) Operating mode: bridge Ethernet CS
- 4) IP Settings on TS UUT:
 - a) Static IP Management (IP, Subnet Mask, Default Gateway)
 - b) WAN interface of WiMAX terminal will be set up in trunk (tagged) mode and assigning a VLAN ID for WiMAX subscriber terminal management
 - c) Settings for management in MS-NMS server (protocol TR069)
- 5) Management services provisioning
 - a) One pair of service flows will be provisioned in Netspan NMS for management, on a VLAN ID identical to the one previously according to art. 25 1) d) ii) above. The service flows will be assigned to the WiMAX terminal MAC address already identified in Netspan NMS.
- 6) Provisioning L2 access services
 - a) Three pairs of service flows will be provisioned in NMS Netspan (associated to WiMAX terminal MAC address) as follows:
 - BE for data (maximum transfer rate UL/ DL)
 - RTPS for video (512 kbps UL / DL)
 - ERTPS for voice (512 kbps UL / DL)
 - b) One distinct VLAN will be provisioned on each pair of service flows.
- 7) Testing QoS mechanisms:
 - a) Traffic will be generated with *iperf* in UDP mode UL and DL, in order to fill the bandwidth for each service flow, initially on BE service, then successively on the RTPS and ERTPS services.

b) For QoS mechanisms testing, the tests will also be performed with dedicated equipments for videoconferencing and VoIP.

6) Possible results:

a) PASS - if there is a reduction in the transfer rate on service flows with lower priority (BE), while high priority service flows (RTPS and ERTPS) should reach the allocated bandwidth. The transfer rate reduction on the BE service flows should be around 1024 Kbps, while traffic is passed on the higher priority service flows.

b) FAIL - if the mechanisms described above do not work correctly.

c) N / A - if the test was not performed.

Appendix no. 1

Technical facts sheet**WiMAX subscriber terminal under test:**

- **Manufacturer:**
- **Model:**
- **Hardware version:**
- **Firmware version:**

I. Basic technical and functional characteristics of the tested WiMAX subscriber terminal, according to the equipment's technical documentation

Characteristic description	Value	Remarks
Destination and use*	- Outdoor fixed/nomadic terminal - Indoor fixed terminal - Mobile terminal - Laptop	
Frequency band*	3600-3800 MHz	
Channel bandwidths	5 MHz – YES/NO 7 MHz – YES/NO 10 MHz – YES/NO	
Allowed equipment modulations*	...	
Operating modes allowed by the equipment*	Bridge ETH CS NAT IP CS Bridge IP CS Router IP CS	
User interface*	ETH USB Wi-Fi	
MIMO*	MIMO A/STC... MIMO B DL... MIMO B + HARQ – YES/NO	

I. Test results

Test parameters	Type of the test	Results	Observations
1. Radio conformity tests			
Determination of the spectral emission mask of the tested WiMAX terminal			
Channel 5 MHz TDD	MANDATORY	PASS/FAIL	
Channel 7 MHz TDD	OPTIONAL	PASS/FAIL/NA	
Channel 10 MHz TDD	MANDATORY	PASS/FAIL	
Control and monitoring function verification	MANDATORY	PASS/FAIL	
2. Initial setup of WiMAX subscriber terminal, the network entry, terminal's authentication and control from the core network (ASN-GW, NMS)			
Commissioning and WiMAX subscriber terminal's network entry, in bridge ETH-CS operation mode	OPTIONAL	PASS/FAIL/NA	
Commissioning and WiMAX subscriber terminal's network entry, in NAT IP-CS operation mode	MANDATORY	PASS/FAIL	
3. Services' provision in ETH-CS (bridge) mode	OPTIONAL	PASS/FAIL/NA	

Test parameters	Type of the test	Results	Observations
4. Services' provision in IP-CS (NAT) mode	MANDATORY	PASS/FAIL	
5. Transfer rate for a single subscriber terminal, registered in a dedicated WiMAX base station	MANDATORY	UDP UP [kbps] UDP DOWN [kbps] TCP UP [kbps] TCP DOWN [kbps]	
6. QoS mechanisms implementation	OPTIONAL	PASS/FAIL/NA	

*Note: Examples of filling in the form, registration will be made according to the manufacturer's technical documentation.