Agilent E6651A
Mobile WiMAX Test Set

Preliminary Technical Overview

Accelerate time-to-market for your IEEE802.16e subscriber station designs

The E6651A represents a significant breakthrough in Mobile WiMAX testing. It incorporates flexible base station emulation and RF parametric tests into one integrated unit and extends Agilent's unmatched portfolio of WiMAX test solutions for development, verification, and manufacturing customers.

The E6651A Mobile WiMAX Test Set will allow 802.16e-2005 subscriber station designers and manufacturers to move rapidly from development to volume production, and to improve the integrity and quality of products while reducing cost.

The Agilent E6651A provides RF signal generation and signal analysis capability up to 6 GHz and includes a full suite of high-speed, precision-accuracy RF measurements for characterization, calibration, and verification purposes. Certification profiles 1A and 3A are currently supported. Further profiles will be added as the WiMAX standards are formalized.

The Mobile WiMAX test set can be extended to enable protocol interoperability and application testing. With realistic base station emulation, the test set offers a controlled environment, with flexibility to configure a wide range of network parameters in which you may test, stress, and debug the protocol and data handling capabilities of your design.

With this exciting new product, Agilent helps you get your designs to market faster and more efficiently, and continues to provide comprehensive tools for all stages of your product lifecycle. So, as you move WiMAX forward, Agilent clears the way.

E6651A Features

- IEEE802.16e OFDMA Mobile WiMAX subscriber station tester
- Real-time Mobile WiMAX downlink signal modulation
- Real-time Mobile WiMAX uplink demodulation
- Base station emulation with MAC, protocol stack
- TDD synchronization (auto-switching) of signal generator and signal analyzer
- Ranging code detection
- Various preamble, FCH, DL-MAP, UL-MAP, burst configuration settings
- DL PUSC, DL FUSC, UL PUSC

Mobile WiMAX radio (PHY) measurements
- OFDM constellation and EVM (BPSK, QPSK, 16QAM, 64QAM)
- DL preamble EVM, pilot EVM, data EVM, symbol EVM
- UL data EVM
- Error vector spectrum, error vector versus time
- CCDF (complimentary cumulative distribution function)
- Channel power, occupied bandwidth

Transmitter
- Modulation and coding
- Ranging support
- Power level control
- Synchronization
- Maximum output signal
- Frequency accuracy
- Channel bandwidth measurement
- Spectral flatness
- Relative constellation error (EVM)

Receiver
- Maximum tolerable signal
- Maximum input signal
- Sensitivity
- Cyclic prefix
- Preambles
- Frame duration timing
- RSSI
- BER, PER, FER
- BER versus CINR

Mobile WiMAX MAC test items
- Response time for MAC management request message
- Initial ranging procedure verification under exceptional RF conditions
- Dynamic service flow status for given conditions
- SS MAC layer verification and performance test

E6655A WiMAX Lab Application

Features of emerging mobile devices are increasing the complexity and software content. Only by testing these features in a realistic network environment can you ensure the quality of your subscriber equipment. The WiMAX lab application provides convergence service network emulation to allow you to do this – supporting real-time, end-to-end functional test of your WiMAX design.

- Controlled network environment – no need to run tests on a live network
- Verify correct operation, stress test your WiMAX device by running multiple applications
- Configure key elements of MAC operation

Note that network emulation requires a customer-supplied PC dedicated to act as a gateway between the application server and E6651A.

N6421A WiMAX Protocol Logging and Analysis

Quickly collect and interpret wireless protocol messaging, verify functionality, and isolate and resolve protocol problems when developing subscriber stations and applications.

- Real-time logging and decodes of PHY and MAC layer protocol
- Post-capture analysis of protocol log files
- Log filtering makes it easy to sort through the huge volume of messaging to and from the WiMAX device

N6422C WiMAX Wireless Test Manager

Agilent's test manager software provides ready-to-use tests, test plans, test sequencing, and menu-selectable hardware support for quick and easy automation of device calibration and test processes. An integrated test development wizard simplifies making software modifications and adding user-defined tests. The test manager runs on a Windows® PC and supports Agilent test system hardware.

- Ready-to-use tests, test plans, and test sequencing
- Customize test steps and test parameters by using Wizards to reduce time on coding
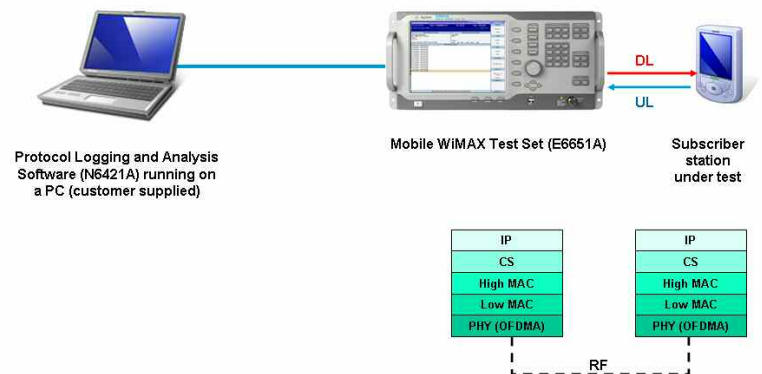- Results can be logged, compared, and post processed

Note that the test manager requires customer-supplied Microsoft® Visual Studio® .NET software.
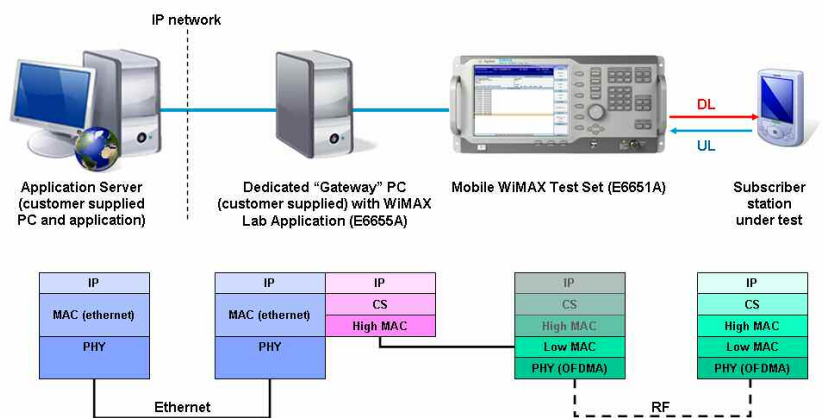
Example Configurations

RF Test Configuration

Optional

WiMAX Wireless Test Manager
software (N6422C) running on
a PC (customer supplied)

Mobile WiMAX Test Set
(E6651A)

DL
UL

Subscriber
station
under test

Protocol Test Configuration

Protocol Logging and Analysis
Software (N6421A) running on
a PC (customer supplied)

Mobile WiMAX Test Set (E6651A)

DL
UL

Subscriber
station
under test

| IP |
| CS |
| High MAC |
| Low MAC |
| PHY (OFDMA) |

| IP |
| CS |
| High MAC |
| Low MAC |
| PHY (OFDMA) |

RF

Application & Functional Test Configuration

IP network

Application Server
(customer supplied
PC and application)

Dedicated "Gateway" PC
(customer supplied) with WiMAX
Lab Application (E6655A)

Mobile WiMAX Test Set (E6651A)

DL
UL

Subscriber
station
under test

| IP |
| MAC (ethernet) |
| PHY |

| IP |
| MAC (ethernet) |
| PHY |

| IP |
| CS |
| High MAC |

| IP |
| CS |
| High MAC |
| Low MAC |
| PHY (OFDMA) |

| IP |
| CS |
| High MAC |
| Low MAC |
| PHY (OFDMA) |

Ethernet

RF

E6651A WiMAX Test Case Coverage

The E6651A can be used as part of a pre-conformance test system and supports the performance of the following wave 1 RF measurements, as referenced in the Mobile WiMAX MRCT v1.0

Test case reference	Test case name	Measurement Supported
MS-01.1	MS receiver maximum tolerable signal	Yes++
MS-02.1	MS receiver preamble	Yes+
MS-03.1	MS receiver cyclic prefix	Merged with MS-01.1
MS-04.1	MS receiver RSSI measurements	Yes+
MS-05.1	MS receiver physical CINR measurements	Yes++##
MS-07.1	MS receiver adjacent and non-adjacent channel selectivity	Yes+
MS-08.1	MS receiver maximum input signal	Yes
MS-09.1	MS receiver sensitivity	Yes#
MS-10.1	MS transmit and receive HARQ	Yes*
MS-10a.1	MS transmit HARQ	Yes*
MS-10b.1	MS receive HARQ	Yes*
MS-11.1	MS receiver PHY support for handover	Yes*++
MS-12.1	MS transmitter modulation and coding, cyclic prefix, and frame duration timing	Yes
MS-13.1	MS transmit ranging support	Yes
MS-14.1	MS transmitter modulation and coding	Merged with MS-12.1
MS-15.1	MS transmit power dynamic range and relative step accuracy	Yes
MS-16.1	MS transmit closed and open loop power control	Yes
MS-17.1	MS transmitter spectral flatness	Yes
MS-18.1	MS transmitter relative constellation error	Yes**
MS-19.1	MS transmit synchronization	Yes
MS-20.1	MS transmit/receive switching gap	Yes

PER is measured by ping method, rather than ACK/NACK method.

+ Additional RF source(s) required for part of the test.

++ Additional RF source(s) required for all of the test.

Fader required.

Fader required and instantaneous fading channel gains must be known.

* Verification required for specific chipsets.

** Active subcarriers only. Unused subcarrier RCE is not measured

Wave 2 RF measurements are in process, but at the time of printing this document the WiMAX MRCT test case definition has not been finalized.

E6651A Specification

The test set will meet its warranted performance after one hour within the stated environmental operating range plus one hour after turn on. Unless otherwise stated all specifications are valid over the operating temperature range. Supplemental characteristics are intended to provide additional information, useful in applying the instrument by giving typical (expected), but not warranted, performance parameters at room temperature (20 to 30°C). These characteristics are shown in italics or labeled as nominal.

Signal analyzer specifications

Frequency

Frequency range	450 MHz to 2.7 GHz (E6651A-503)
	450 MHz to 5.99 GHz (E6651A-506)
Frequency resolution	1 Hz (< 3 GHz), 2 Hz (≥ 3 GHz)
Frequency accuracy	Same as frequency reference
Modulation analysis bandwidth	10 MHz

Amplitude

Measurement range[1]	+27 to –50 dBm
Absolute measurement accuracy[2]	±0.5 dB (attenuator 0 to 31 dB)
	±1 dB (E6651A-506 attenuator 32 to 62 dB, or 32 to 59 dB for E6651A-503)
Residual response	–85 dBm at 10 kHz RBW
Spurious responses[3]	–55 dBc (excluding IF image)
	–45 dBc (including IF image)

Performance

Quantization	14-bit ADC
Residual (EVM)[4]	≤ 0.5% (preamble), ≤ 1.5% (pilot)
ACLR[5]	≤–43 dBc
Pass-band ripple	±0.5 dB (over 16 MHz bandwidth)
Triggering	Automatic

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[1] Verified using a typical WiMAX signal of 8.75 MHz bandwidth
[2] Verified using CW measurements
[3] At 2345 MHz, span 16 MHz
[4] Error Vector Magnitude measured at input frequency 2345 MHz, level –20dBm
[5] Input frequency 2345 MHz, level –15dBm

Signal generator specifications

Frequency
    Frequency range
        450 MHz to 2.7 GHz (E6651A-503)
        450 MHz to 5.99 GHz (E6651A-506)
    Frequency resolution   1 Hz (< 3 GHz), 2 Hz (≥ 3 GHz)
    Frequency accuracy   Same as frequency reference

Amplitude
    WiMAX preamble power range[6]   –22 to –102 dBm (< 3 GHz)
        –27 to –102 dBm (≥3 GHz)
    CW power range   –7 to –127 dBm (< 3 GHz)
        –12 to –127 dBm (≥3 GHz)
    CW power accuracy   Frequencies < 3GHz
        ± 0.6 dB (–7 to –78 dBm)
        ± 0.75 dB (≤ –78 to –93 dBm)
        ± 1.0 dB (≤–93 to –113 dBm)
        Frequencies 3Ghz to 5.99 GHz
        ±1.0 dB (–12 to –100 dBm)
    Resolution   0.01 dB

Performance
    Phase noise at 3GHz   –102 dBc/Hz @ 10 kHz offset
    Residual (EVM)[7]   ≤ 0.5% (preamble), ≤ 1.5% (pilot)
    ACLR[8]   ≤ –50 dBc (±4.77 MHz offset)
        ≤ –56 dBc (±9.27 MHz offset)
    Harmonics   ≤ –30 dBc (1GHz CW, –7dBm)
    Subharmonics   ≤ –30 dBc (6GHz CW, –12dBm)
    Non-harmonic spurious[9]
        ≤ –60 dBc, offsets > 10kHz (E6651A-503)
        ≤ –70 dBc, offsets > 10kHz (E6651A-506)

General Specifications

RF input/output impedance   50 Ω (nominal)
RF input /output VSWR   < 1.5:1 (<3 GHz)
        < 2.0:1 (3 to 6 GHz)
Maximum safe input level   +27 dBm
Interfaces   USB, LAN, trigger in/out
RF reference input/output   10 MHz, 4 dBm ±2 dB
Frequency reference stability   ±1E-8
Frequency reference aging rate   1E-9/day, 1E-7/year
Power requirement   90 to 250 Vac, 50/60 Hz, 590W
Size (w x d x h)   444 mm x 647 mm x 222 mm
Weight   25.8 kg
Operating temperature   0 to 50°C
Operating humidity   5 to 85% non-condensing
Storage temperature   –40 to 71°C
Storage humidity   0 to 90% at 65°C
Operating altitude   Up to 2000 m

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[6] Verified using a typical WiMAX signal of 8.75 MHz bandwidth
[7] Error Vector Magnitude measured at output frequency 2345 MHz
[8] Output power –20 dBm, measured with 300 kHz RBW, 300 Hz VBW at 2345 MHz
[9] CW measurement, output –12 dBm, 2345 MHz

Remove all doubt

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Further information on the E6651A and associated products is available at:
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www.agilent.com/find/contactus

Phone or Fax

United States:
(tel) 800 829 4444
(fax) 800 829 4433
Canada:
(tel) 877 894 4414
(fax) 800 746 4866
China:
(tel) 800 810 0189
(fax) 800 820 2816
Europe:
(tel) (31 20) 547 2111
(fax) (31 20) 547 2390
Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (080) 769 0800
(fax) (080) 769 0900
Latin America:
(tel) (305) 269 7500
Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331
Other Asia Pacific Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com
Contacts revised: 1/17/05

Agilent Technologies