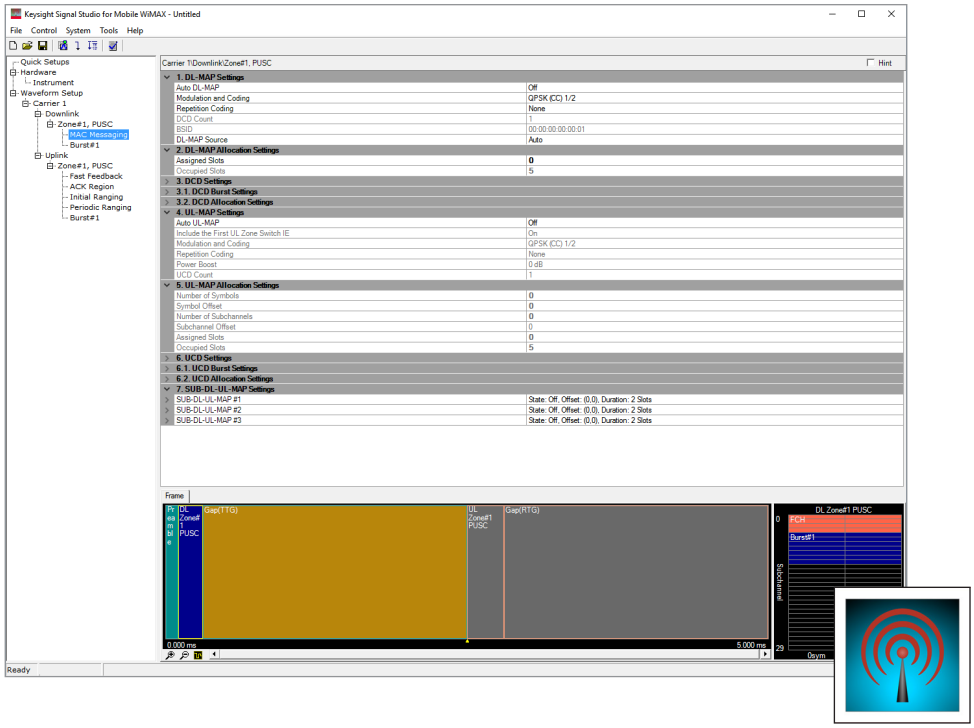
Keysight Technologies
Signal Studio for Mobile WiMAX™ N7615C

Technical Overview



- Create Keysight validated and performance optimized Mobile WiMAX and WiBro reference signals compliant with the IEEE 802.16 Wireless MAN-OFDMA PHY standards
- Test components with single- and multi-carrier signals
- Configure downlink and uplink channel parameters for testing space-time coding (STC) and MIMO features, as well as new features in the IEEE 802.16-2009 (formerly 802.16 Rev2) standard such as cyclic delay diversity (CDD) and FDD/H-FDD frames
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

KEYSIGHT TECHNOLOGIES

Simplify Mobile WiMAX Signal Creation

Keysight Signal Studio software is a flexible suite of signal-creation tools that will reduce the time you spend on signal simulation. For Mobile WiMAX, Signal Studio's performance-optimized reference signals—validated by Keysight—enhance the characterization and verification of your devices. Through its application-specific user-interface you'll create standards-based and custom test signals for component, transmitter, and receiver test.

Component and transmitter test

Signal Studio's basic capabilities use waveform playback mode to create and customize waveform files needed to test components and transmitters. Its user-friendly interface lets you configure signal parameters, calculate the resulting waveforms and download files for playback. The applications for these partially coded, statistically correct signals include:

- Parametric test of components, such as amplifiers and filters
- Performance characterization and verification of RF sub-systems

Receiver test

Signal Studio's advanced capabilities enable you to create fully channel-coded signals for receiver bit-error-rate (BER), block-error-rate (BLER), packet-error-rate (PER), or frame error rate (FER) analysis. Applications include:

- Performance verification and functional test of receivers, during RF/baseband integration and system verification
- Coding verification of baseband subsystems, including FPGAs, ASICs, and DSPs

Apply your signals in real-world testing

Once you have setup your signals in Signal Studio, you can download them to a variety of Keysight instruments and software platforms. Signal Studio software complements these platforms by providing a cost-effective way to tailor them to your test needs in design, development and production test.

- Vector signal generators
  - X-Series: MXG and EXG
  - PSG
  - ESG
  - First-generation MXG
  - M9381A PXIe VSG
- E6640A EXM wireless test set

Typical Measurements

Test components with basic capabilities:

- ACLR
- CCDF
- EVM
- Modulation accuracy
- Channel power
- Occupied bandwidth

Verify receivers with advanced capabilities:

- Sensitivity
- Maximum input level
- Selectivity
- Blocking
- Intermodulation
- Demodulation
- Power control
- Packet error rate

Component and Transmitter Test

Figure 1. Typical component test configuration using Signal Studio's basic capabilities with a Keysight X-Series signal generator and an X-Series signal analyzer

Signal Studio's basic capabilities enable you to create and customize Mobile WiMAX waveforms to characterize the power and modulation performance of your transmitter or receiver components. Easy manipulation of a variety of signal parameters, including channel bandwidth, FFT size, frame duration, guard period, and modulation type, simplifies signal creation.

- Create spectrally-correct signals for ACLR, channel power, spectral mask, and spurious testing
- Configure TDD or FDD downlink or uplink frames
- Configure single or multi-carrier waveforms, with each carrier having its own settings for bandwidth, frequency offsets, power, and preamble index/cell ID
- Set parameters such as channel power, number of symbols of data, and modulation type (QPSK, 16QAM, 64QAM) for modulation verification and analysis, such as EVM tests
- View CCDF, spectrum, power envelope, and time domain graphs to investigate the effects of various settings on these parameters

Receiver Test

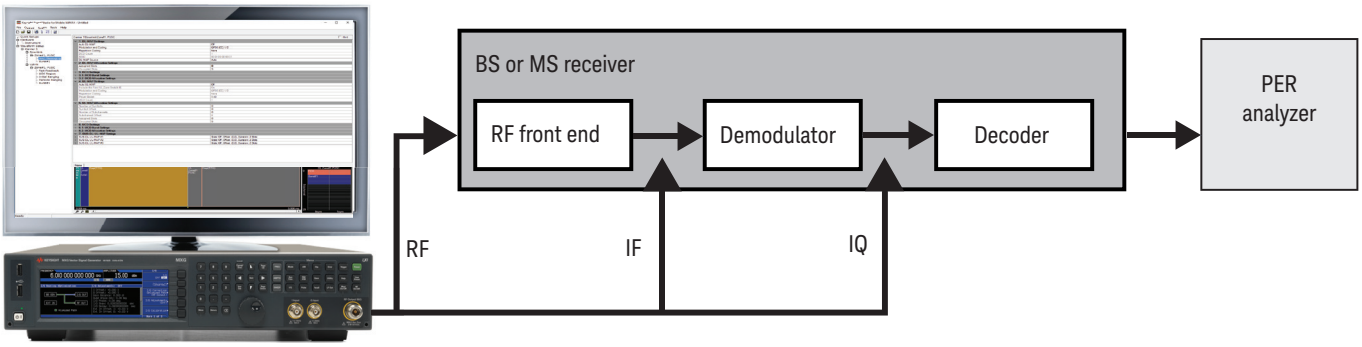


Figure 2. Generate fully channel-coded signals to evaluate the PER of your receiver with Keysight X-Series signal generators and Signal Studio's advanced capabilities

Signal Studio's advanced capabilities provide additional features to help you create 802.16e OFDMA standard-compliant frame structures for testing receiver designs in all stages of development. Set the output mode to build frames that are TDD, FDD, or FDD/H-FDD for downlink or uplink only. Create multiple bursts and MAC PDUs and configure the PDUs individually using standard data patterns or user-defined data. The MAC PDU parameters include MAC PDU mode (with or without header and CRC), CID, data type, and data length. Each data burst can be fully coded with convolutional coding (CC) or convolutional turbo coding (CTC), randomization, and interleaving. You also have the flexibility to configure individual burst parameters, such as modulation type and rate, repetition coding, and power boosting.

For easy burst configuration, the software includes an auto-allocation feature which automatically selects a valid combination of symbol and subchannel settings. You can choose regular data bursts or HARQ bursts.

Mobile station receiver testing

- Add downlink PUSC, FUSC, or AMC zones
- Automatically generate FCH, DL-MAP, UL-MAP, DCD, and UCD for downlink frame
- Choose normal or compressed MAP, or sub-DL-UL-MAPs in the first DL-PUSC zone
- Automatic or manual setting of DIUC and UIUC values
- Test MIMO using Matrix A (space-time coding) or Matrix B (2x2 MIMO)

Base station receiver testing

- Configure uplink PUSC, OPUSC, AMC, or sounding zones
- Add an initial or periodic ranging region, or a fast feedback region to transmit user-defined data bits, with automatic data wrapping around these special regions
- Test MIMO using uplink collaborative spatial multiplexing (1x2 MIMO)

MIMO Test

Signal Studio software can generate STC/MIMO waveforms for unfaded signals at transmit antennas. The software also allows you to incorporate SISO or MIMO fading effects in the waveform for receiver testing. Various channel fading models are provided in the Signal Studio software, including ITU Pedestrian A and B, Vehicular A and B, Vehicular A with long channel, and the correlated MIMO channel models used for the Mobile WiMAX Radio Conformance Tests. Static multipath fading with up to 20 paths can also be applied. Long waveform files containing multiple frames with embedded fading provide a simple solution for testing STC/MIMO receivers without the added expense of channel emulation hardware.

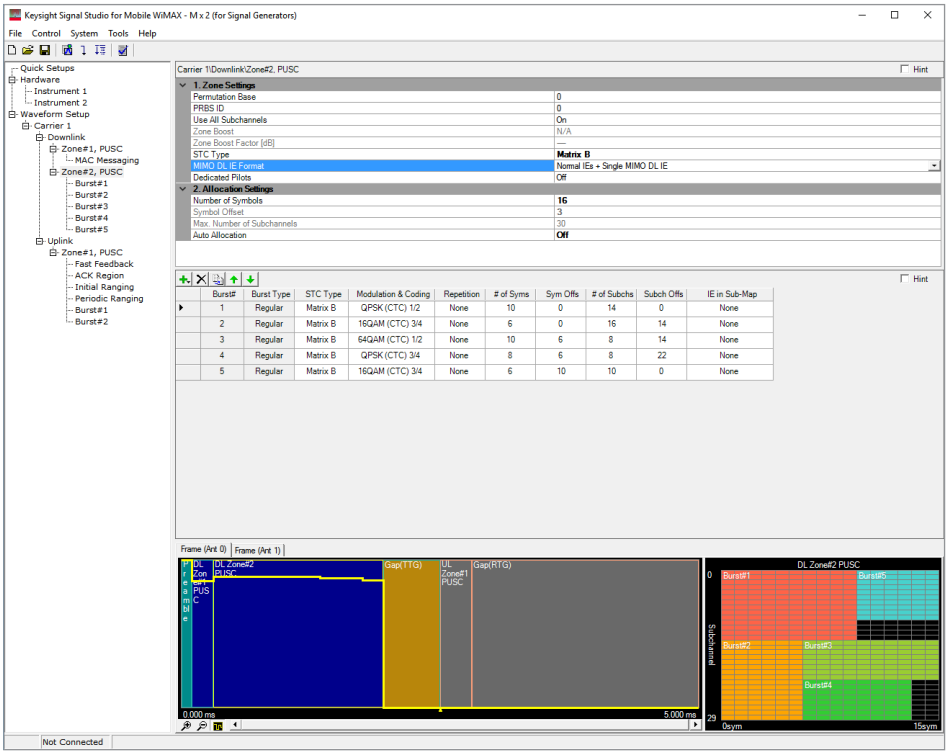


Figure 3. Navigate through the frame elements using the software's tree view in the left panel to quickly customize OFDMA waveforms with multiple zones and data bursts.

Features Summary

Feature/Parameter	Component & transmitter testing	Receiver testing	
	Basic waveform playback mode	Advanced waveform playback mode	
	802.16 OFDMA	802.16 OFDMA	802.16 Rev2 OFDMA
Waveform properties:			
WiMAX system parameters setup	●	●	●
Marker settings	●	●	●
Baseband quadrature angle and gain balance	●	●	●
Noise setup	●	●	●
Multi-carrier waveform generation	●	●	●
Add one or more zone types	●	●	●
Modulation: QPSK, 16QAM, 64QAM	●	●	●
Data pattern bit offset	●		
Data length based on number of symbols	●		
Data source type: S(QPSK), S(16QAM), S(64QAM), PN9, PN15, user defined	●	●	●
Reference specification:			
802.16-2004/Cor1/D2	●	●	●
802.16-2004/Cor1/D3	●	●	●
802.16Rev2	●	●	●
Carrier settings: MAC CRC order, PRBS method, frame number increment on/off		●	●
RMS power information display	●	●	●
Edit MAC message settings: include DCD/UCD, allow DCD/UCD to be in separate bursts from DL-MAP and UL-MAP		●	●
Choose FEC coding type and rate: raw, CC, CTC		●	●
Configure MAC PDUs for each burst		●	●
Specify MAC PDU data length in bytes		●	●
Configure data bursts in each zone:			
Regular DL and UL data burst		●	●
UL collaborative SM burst		●	●
DL/UL HARQ bursts (Chase combining)		●	●
DL/UL HARQ bursts (incremental redundancy)			●
Fading emulation included in waveform data: static multi-path, mobile SISO and MIMO fading, and dual 1x2 MIMO for UL collaborative SM		●	●
User-defined channel correlation matrix			●
New AMC zone types: 1x6, 3x2, 2x6			●
Downlink			
Group Bitmask	●	●	●
AMC physical bands bitmap	●	●	●
Include FCH, DL-MAP, UL-MAP:			
FCH, normal or compressed DL-MAP and UL-MAP		●	●
Sub-DL-UL-MAP in first DL-PUSC zone		●	●
DL-MAP IE for STC, UL-MAP IE for collaborative multiplexing		●	●
Support STC and MIMO:			
2 antennas STC (Matrix A) in DL-PUSC zone		●	●
2x2 MIMO (Matrix B) in DL-PUSC		●	●
Mixed Matrix A and B bursts in same zone			●
STC/MIMO in AMC zones			●
Dedicated pilots for DL-PUSC and DL-AMC zones		●	●
Cyclic delay diversity (CDD) for 2 antennas			●
FDD/H-FDD output modes			●

Features Summary

Feature/Parameter	Component & transmitter testing	Receiver testing	
	Basic waveform playback mode	Advanced waveform playback mode	
	802.16 OFDMA	802.16 OFDMA	802.16 Rev2 OFDMA
Uplink			
Subchannels and AMC physical bands bitmap	●	●	●
Uplink ranging region		●	●
Initial/handover ranging (2 symbols)		●	●
Periodic ranging/BW request (1 symbol)		●	●
Uplink fast feedback region:			
Fast feedback channel allocation using CQICH allocation IE		●	●
Fast feedback, 4 bits		●	●
Enhanced fast feedback, 6 bits		●	●
MIMO fast feedback, 3 bits		●	●
ACK, 1 bit		●	●
Collaborative spatial multiplexing (SM) in UL-PUSC zone		●	●
Subchannel rotation on/off for UL-PUSC zone		●	●
UL sounding zone and sounding message		●	●

Supported Standards and Test Configurations

IEEE publication	Date
802.16-2004	2004
P802.16-2004/Cor1/D2 and D3	2005
802.16e-2005	2006
802.16Rev2/D6	2008

Performance Characteristics

Definitions

Characteristic value:

Non-warranted value based on testing during development phase of this product.
The majority of instruments tested met this value.

Performance range:

Non-warranted value based on testing during development phase of this product.
All instruments tested performed within this range.

The following performance characteristics table shows the error vector magnitude (EVM) results for each instrument listed. The results are applicable for both non-MIMO configuration and STC/MIMO (Matrix A and Matrix B) configurations. Waveform parameter settings are shown below.

Multiple DL-PUSC waveforms were used with different settings:
- Bandwidths/FFTs = 5 MHz/512, 10 MHz/1024
- Burst length = 30 symbols, 5 ms frame length
- Modulation types = QPSK and 64 QAM
- Symbol rolloff = 2.78% (5 MHz BW), 5.56% (10 MHz BW)
- Power level = –20 dBm (Option 1EA = +8 dBm)

EVM performance characteristics

Carrier frequency		N5172B EXG/ N5182B MXG (with Option UNV and 1EA)	N5162A/N5182A MXG (with Option UNV)	N5162A/N5182A MXG (with Options UNV and 1EA)	E4438C ESG	E8267D PSG[1]	M9381A
2.5 GHz	Characteristic value[2]	–56.1 dB (0.16% rms)	–48.5 dB (0.4% rms)	–48.0 dB (0.4% rms)	–48.5 dB (0.4% rms)	–48.1 dB (0.4% rms)	–53.5 dB (0.21% rms)
	Performance range[3]	–59.8 to –55.9 dB (0.10 to 0.16% rms)	–51.2 to –48.4 dB (0.27 to 0.38% rms)	–53.6 to –48.4 dB (0.21 to 0.38% rms)	–51.4 to –48.0 dB (0.27 to 0.40% rms)	–52.4 to –47.4 dB (0.24 to 0.43% rms)	–54.8 to –53.3 dB (0.18 to 0.22% rms)
3.5 GHz	Characteristic value[2]	–53.2 dB (–0.22% rms)	–46.0 dB (0.5% rms)	–46.0 dB (0.5% rms)	–46.0 dB (0.5% rms)	–48.9 dB (0.4% rms)	–48.6 dB (0.37% rms)
	Performance range[3]	–57.9 to –53.0 dB (0.13 to 0.22% rms)	–48.6 to –45.7 dB (0.37 to 0.52% rms)	–50.8 to –46.2 dB (0.29 to 0.49% rms)	–50.2 to –44.7 dB (0.31 to 0.58% rms)	–42.7 to –48.3 dB (0.23 to 0.38% rms)	–49.7 to –48.2 dB (0.33 to 0.39% rms)

1. Performance characteristics are based on PSG signal generators with the standard pulse modulation Option E8267D-UNU. EVM performance may degrade with the narrow pulse modulation Option E8267D-UNW, so Option E8267D-UNW is not recommended for use with the N7615C.
2. Non-warranted value based on testing during development phase of this product. The majority of instruments tested met this value.
3. Non-warranted range based on testing during development phase of this product. All instruments tested performed within this range.

Ordering Information

Software licensing and configuration

Signal Studio offers flexible licensing options, including:

- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **Time-based:** License is time limited to a defined period, such as 12-months.

Try Before You Buy!

Free 30-day trials of Signal Studio software provide unrestricted use of the features and functions, including signal generation, with your compatible platform. Redeem a trial license online at

www.keysight.com/find/SignalStudio_trial

N7615C Signal Studio for Mobile WiMAX

Waveform playback licenses (N7615EMBC)

Software	Support Contract	Description
N7615EMBC-1FP	R-Y5B-001-A[2]	Node-locked perpetual license
N7615EMBC-1FL	R-Y4B-001-L[1]	Node-locked 12-month license
N7615EMBC-1TP	R-Y5B-004-D[2]	Transportable perpetual license
N7615EMBC-1TL	R-Y4B-004-L[1]	Transportable 12-month license

Software support subscription for perpetual licenses [3]

Support Contract	Description
R-Y6B-001-L	12-months of support for node-locked licenses
R-Y6B-004-L	12-months of support for transportable licenses
R-Y6B-501	1-month of support for node-locked licenses (extension after 1st year)
R-Y6B-504	1-month of support for transportable licenses (extension after 1st year)

1. All time-based software licenses include a 12-month support contract.
2. Support contracts must be purchased for all perpetual licenses in the first year. All software upgrades and KeysightCare support are provided for software licenses with valid support contracts.
3. After the first year, support contracts for all perpetual licenses may be extended with annual and monthly support extensions.

Hardware configurations

To learn more about compatible hardware and required configurations, please visit: **www.keysight.com/find/SignalStudio_platforms**

PC requirements

A PC is required to run Signal Studio. **www.keysight.com/find/SignalStudio_pc**

Model numbers & options

To learn more about Signal Studio licensing, model numbers and options, please visit: **www.keysight.com/find/signalstudio_model**

Websites

www.keysight.com/find/SignalStudio
www.keysight.com/find/N7615C

Comprehensive Online Documentation

www.keysight.com/find/signalstudio_support

Signal Studio and Signal Creation Software

www.keysight.com/find/signalstudio_software

Signal Generators

www.keysight.com/find/sg

Literature

Signal Studio Software, Brochure, literature number 5989-6448EN

WiMAX Concepts and RF Measurements, Application Note, 5989-2027EN

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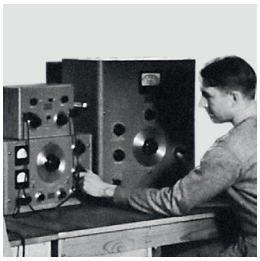

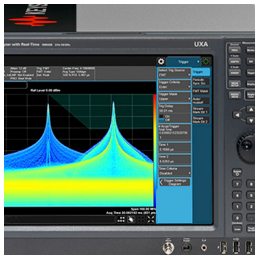

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Published in USA, April 24, 2018
5992-2785EN
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