Keysight Technologies
Measurement Solutions for Multichannel Applications

Application Note

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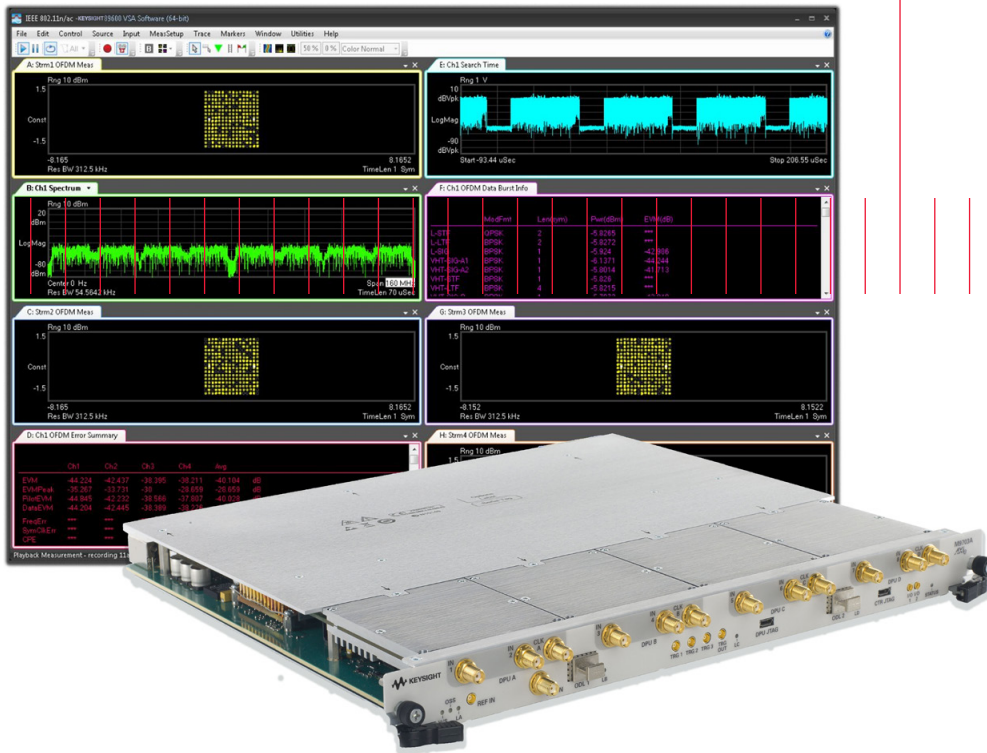
Abstract

The ever-increasing demand for consumer devices that support wireless LAN (WLAN), including cell phones, tablets, and game consoles, is driving the need for the rapid deployment of new wireless technologies such as 802.11ac.

While 802.11ac will add signifi cant value to customers and end-users, it brings with it new design and test challenges for systems engineers such as much wider bandwidth signals of 160 MHz, as well as the need for better error vector magnitude (EVM) performance to support 256 QAM.

Accelerate system simulation, design, and test for 802.11ac with Keysight Technologies, Inc. RF vector signal generator, multichannel digitizer, and vector signal analysis (VSA) software that provide a complete BBIQ solution for multiuser, multiple-input, multiple-output (MU-MIMO) analysis.

With approximately 500 million 802.11ac devices expected to reach the market by 2015, device manufacturers require a cost-effective and effi cient solution for wideband testing of multichannel applications with accurate EVM analysis.

Introduction

802.11ac is backwards compatible with 802.11n digital communication techniques, while providing several new key advances over prior Wi-Fi technology. Major feature enhancements of 802.11ac include:

– Wider channels (80+80 / 160 MHz)

– Higher-order modulation (256 QAM)

– More spatial streams and antennas (up to 8)

– MU-MIMO (2 to 8)

– Faster data rates up to 6.93 Gbps (160 MHz, 8 Tx)

The challenging combination of wider bandwidths, higher-order modulation, and MU-MIMO introduced by 802.11ac brings new simulation, design and test challenges for the system engineer.

Figure 1   : M9703A multichannel AXIe digitizer module.

Application Overview

New requirements for multichannel applications require a wideband test solution capable of analyzing at least 3 to 4 BBIQ channels with highly accurate EVM performance. Extending previous 2-channel test solutions to support 802.11ac requirements for 160 MHz bandwidth testing can be complex; therefore, the ability to create and analyze MIMO signals during the research and development (R&D) test phase is an essential component of an 802.11ac test solution. As higher-order modulation of 256 QAM necessitates the demand for better EVM performance (-32 dB), a test solution must also be capable of providing accurate EVM performance results. The requirement for MIMO implies that test equipment must support up to 8 channels for the capture and generation of signals to and from the 802.11ac device. To test the optional beamforming functions in the standard, the channels also need to be phase-coherent. As we look towards the future, test systems must be flexible enough to evolve with WLAN test standards which may require support for bandwidths up to 500 MHz.

Solution

Keysight Technologies provides a complete, end-to-end solution for multichannel measurements of 802.11ac BBIQ simulation, design, and test.

Keysight's N5182B MXG, with Signal Studio software, is capable of generating 802.11ac waveforms with up to 160 MHz bandwidth, to simulate signals sent to the device under test (DUT). Up to 8 MXGs can be synchronized using Signal Studio for MIMO signal generation.

The Keysight M9703A multichannel AXIe digitizer module is an 8-channel, 12-bit digitizer with optional, real-time, flexible digital down-conversion (DDC), capable of capturing MIMO 802.11ac signals of interest.

Keysight's 89600 VSA software provides a flexible display for optimal viewing of MIMO results and supports a variety of hardware configurations to analyze the performance, bandwidth, and number of channels of the 802.11ac test system. The 89600 VSA software also provides accurate EVM performance measurements required to support 802.11ac 256 QAM modulation.

Solution details

System Setup

A 4X4 BBIQ MIMO simulation system setup including 4 N5182B MXG RF vector signal generators, an AXIe chassis with a M9703A multichannel digitizer and embedded PC for system control, is shown in Figure 2. Analysis of the resulting BBIQ signals can then be performed using the 89600 VSA software, shown in Figure 3.

Signal Simulation

To simulate the transmission of 802.11ac wideband signals, the N5182B MXG RF vector signal generator, with N7617B Signal Studio software, is capable of generating 160 MHz signals and supports up to 8 spatial streams for single-user or MU-MIMO testing.

Signal Capture

For BBIQ testing of 4 IQ channels, the M9703A 12-bit AXIe digitizer provides 8 synchronous acquisition channels to capture signals from DC up to 2 GHz at 1.6 GS/s, or up to 3.2 GS/s for 4 channels with interleaving capability. The Keysight M9703A also provides real-time data processing with four Virtex 6 FPGAs. The M9703A FPGAs feature an optional real-time DDC allowing to tune/zoom, trigger, and analyze only the signal of interest.

For example, with a decimation ratio of 8, the effective sampling rate of the M9703A is reduced to 200 MS/s and the analysis bandwidth is 160 MHz, or precisely that of the 802.11ac wideband signal. Since the bandwidth is reduced to match the signal, the amount of captured data and corresponding noise and interference are also reduced. As a result, there is more efficient use of the M9703A's 4 GB of onboard memory, allowing for longer data captures and reducing the workload on post-processing algorithms.

For future WLAN BBIQ signal analysis at 500 MHz bandwidth or higher, the M9703A can provide 1.6 GS/s sampling at full bandwidth of approximately 800 MHz without using the DDC.

Signal Analysis

The 89600 VSA software, with optional BHJ 802.11ac Modulation Analysis, supports all bandwidths and modulation types for flexible display and optimal viewing of MIMO results.

For multiple domain analysis, the 89600 VSA software can be configured to display up to 20 active trace windows of any size with unlimited markers per trace. The 89600 VSA software can also help identify the causes of EVM degradation.

Results

Using the above system setup, resulting EVM performance was measured at -48 dB, much better than the required -32 dB to support the optional 256 QAM modulation of the 802.11ac standard.
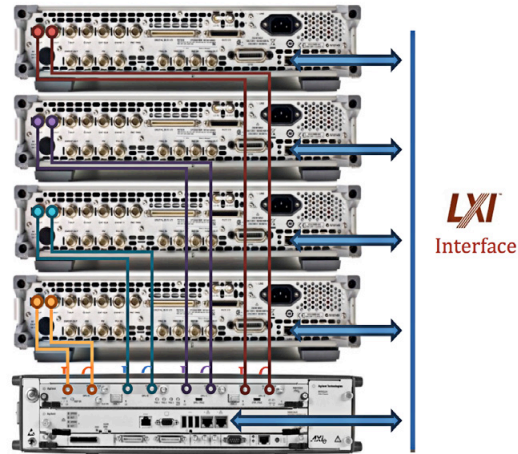

Figure 2 Simulation setup for 4xBBIQ channels with 4 N5182B MXGs and a M9703A digitizer.

Figure 3. Results on M9703A of BBIQ MIMO analysis with 89600 VSA software.

Ordering Information

Model	Description
89601B	89600 VSA software, transportable license
N5182A	MXG RF vector signal generator
M9703A	AXIe 12-bit digitizer
M9703A-SR2	1.6 GS/s sampling rate
M9703A-DDC	Digital down-conversion firmware
M9703A-F05	Input frequency: DC to 650 MHz
M9703A-F10	Input frequency: DC to 2 GHz (not interleaved) DC to 1 GHz (interleaved)
M9703A-M40	4 GB (256 MS/ch) acquisition memory

Related Products	
M9502A	2-slot AXIe chassis
M9505A	5-slot AXIe chassis
M9536A	Embedded AXIe controller
N7617B	Signal Studio for WLAN 802.11a/b/g/n/ac

Software Information

Supported operating systems	Microsoft Windows XP (32-bit) Microsoft Windows 7 (32/64-bit) Microsoft Windows Vista (32/64-bit) Linux
Keysight IO Libraries	Includes: VISA Libraries, Keysight Connection Expert, IO Monitor

Want to Know More

– Product information

www.keysight.com/find/n5182a

www.keysight.com/find/m9703a

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– 802.11ac application information

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