802.11ac Simulation, Design and Test with LXI Instruments

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The number of wireless devices available on the market is exploding and in consequence, so is the number of users, with many people carrying multiple wireless devices such as a cellphone, laptop or tablet. In fact, Cisco's visual network index (VNI) forecast[1] predicts that by the end of 2013, the number of mobile-connected devices will exceed the number of people on earth!

Consumers are using their wireless devices to do much more than make phone calls including surfing the Internet, sharing photos, watching live streaming video and playing 3D games. These, plus countless other media-rich applications, are pushing current bandwidth availability to its limits and driving the need for the rapid deployment of new wireless technologies such as 802.11ac.

While most people have probably heard of 802.11a/b/g/n, all of which are protocols for the 802.11 wireless networking standard, 802.11ac is still in its infancy and promises many performance advantages 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)
- Multiuser multiple-input, multiple-output (MU-MIMO) (2 to 8)
- Faster data rates up to 6.93 Gbps (160 MHz, 8 Tx)

While 802.11ac will add significant 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.

With approximately 500 million 802.11ac devices expected to reach the market by 2015[2], device manufacturers require a cost-effective and efficient solution for wideband testing of multichannel applications with accurate EVM analysis. Extending previous 2-channel test solutions to support 802.11ac requirements for 160 MHz bandwidth testing can be complex. Therefore, a multichannel test solution capable of creating and analyzing MIMO signals is an essential requirement of an 802.11ac test solution.

Agilent Technologies provides a complete, end-to-end, solution with an LXI (LAN eXtensions for Instrumentations) interface for multichannel measurements of 802.11ac baseband IQ (BBIQ) simulation, design and test. Figure 1 illustrates Agilent's test simulation setup for 4 BBIQ channels with 4 N5182B MXG RF vector signal generators and a M9703A digitizer.

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[1] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017
[2] Wireless LAN Market Estimates and Forecast by Device and by Technology 2009-2015, In-Stat

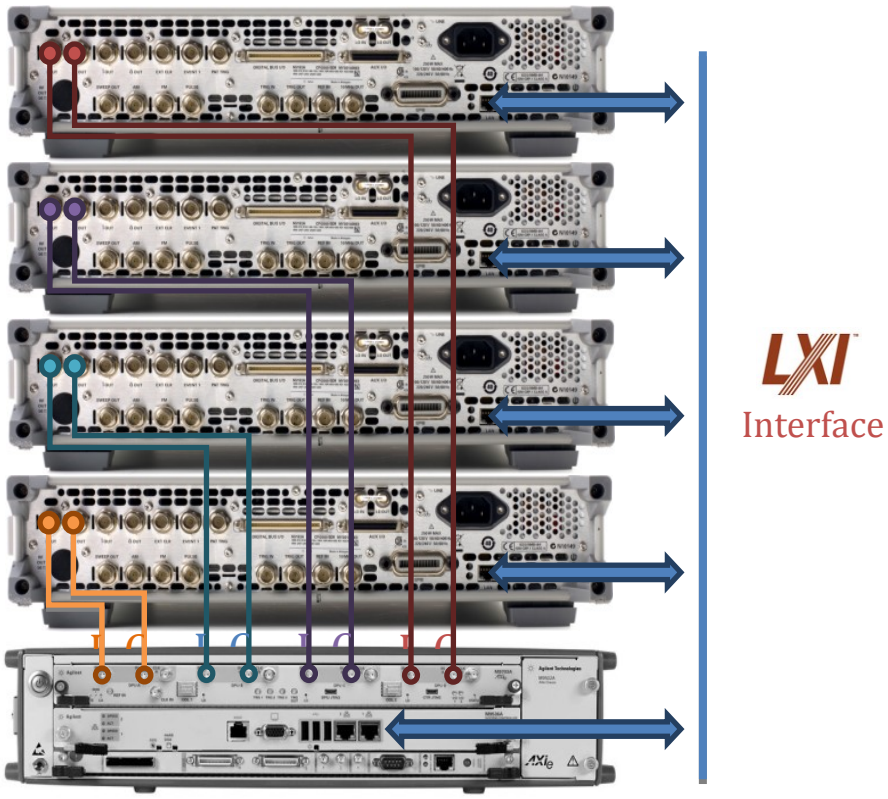

Figure 1. Agilent's simulation setup for 4xBBIQ channels

LXI provides a fast and efficient interface for communicating with instruments. Currently, LXI instruments are available with Ethernet speeds of 100 Mb/s and 1 Gb/s. However, the present Ethernet infrastructure enables speeds up to 10 Gb/s and will be even faster in the future. Thanks to backward compatibility requirements of the LXI Standard, present day LXI instruments such as those from Agilent will continue to operate in the future as network speeds continue to increase.

As a result of the increasing network speeds, LXI instruments have much faster block data transfer rates to the PC than instruments using slower buses such as GPIB. Some LXI instruments also support advanced intra-device synchronization and triggering mechanisms that improve test throughput efficiency.

Agilent'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) and support up to 8 spatial streams for single-user or MU-MIMO testing. In order to simulate 4xBBIQ channels 4 MXGs are required as illustrated in figure 1, however, up to 8 MXGs can be synchronized using Signal Studio for MIMO signal generation.

The Agilent M9703A 12-bit AXIe digitizer provides 8 synchronous channels of signal acquisition and optional, real-time, flexible digital down-conversion (DDC) capable of tuning/zooming, triggering and analyzing the MIMO 802.11ac signals of interest.

The resulting MIMO 802.11ac signals are transferred by the high-speed LXI interface to the PC for further analysis. Agilent's 89600 vector signal analysis (VSA) software provides a flexible display for optimal viewing of MIMO results and supports a variety of hardware configurations to test the performance, bandwidth and number of channels of the 802.11ac test system. The 89600 VSA software also provides accurate EVM performance measurements (better than -32 dB) required to support 802.11ac 256 QAM modulation.

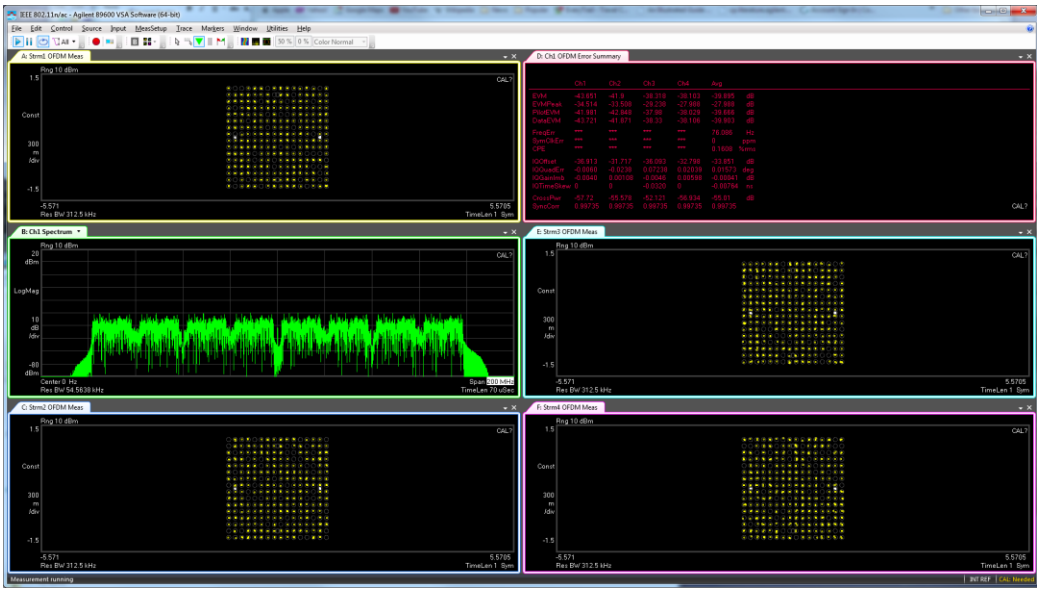

Figure 2. Results on M9703A of BBIQ MIMO analysis with 89600 VSA software

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. The requirement for MIMO implies that test equipment must support up to 8 coherent channels for the capture and generation of signals to and from the 802.11ac device. Agilent Technologies' RF vector signal generator and multichannel digitizer with an ultrafast LXI interface to the PC for further analysis of the 802.11ac signals by Agilent's VSA software, form a complete MIMO 802.11ac BBIQ simulation, design and test system.