Using PXI Solutions to Accelerate Development of Next Generation 802.11ac Wireless LAN Transmitters

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Wireless video and wireless data networking are driving demand for standards enabling higher throughput. Several emerging standards address these new use models, among them 802.11ac, which builds upon the high throughput (HT) capabilities of 802.11n to accommodate these new "Very High Throughput (VHT)" usages. 802.11ac operates in the 5 GHz 802.11a/n bands, and builds upon the high throughput enhancements of 802.11n with key advancements:

- Increased bandwidth (up to 160 MHz)
- Higher-order MIMO (up to 8x8)
- Multi-user MIMO (up to 4 users)
- Higher-order modulation (up to 256 QAM)

Design Validation engineers must ensure their 802.11ac designs will perform well under demanding modulation schemes, including MIMO spatial multiplexing configurations.

To validate MIMO transmitter performance, engineers should have a multi-channel signal analyzer that can be used to demodulate the multi-stream waveforms, measure EVM and other physical layer parameters. The PXI standard enables the development of Wideband multi-channel PXI based signal analyzer solutions that help MIMO 802.11ac R&D and Test engineers validate their designs with a mixture of measurement accuracy, fast speed, flexibility and scalability in a small form factor.

Application Overview

Design and validation of 802.11ac MIMO transmitters requires making EVM measurements of multichannel MIMO spatial-multiplexing signals. A test solution should be able to make these measurements rapidly, and with a high degree of confidence. The higher order modulation formats and wider bandwidths proposed in the 802.11ac standard require better EVM than ever before, and the test solution's residual EVM should be able to exceed these requirements. The test solution should be able to scale with the designs as they evolve, from single and dual-channel 40MHz to 3 and 4 channel 160MHz MIMO designs.

Many test solutions today do not support the wide bandwidths or multichannel capabilities required by 802.11ac designers. Furthermore, they may lack a full featured analysis package that includes hardware control and standards based 802.11ac modulation quality measurements.

Solution

These requirements can be met with the PXI-based, multi-channel signal analyzer solutions. The configuration described in this article, includes up to 4 analysis channels in a single PXI chassis, wide bandwidth per channel, and fast transfer speeds over the PCIe backplane. 802.11ac physical layer measurement can be achieved by leveraging existing Vector Signal Analyzer software which support 802.11ac demodulation and measurements.

This wideband multi-channel PXI signal analyzer configuration offers the capabilities required for 802.11ac MIMO transmitter test design validation in a fast, scalable and flexible platform. Physical layer parametric measurements such as EVM and crosstalk can be measured with VSA software using standards-based 802.11ac capability.

Solution details

802.11ac requires wide-bandwidth measurement capability of up to 160 MHz. With new technology now available in PXI form factor, new PXI downconverters, signal conditioning, and digitizer modules can now be used to build wideband multi-channel PXI signal analyzer solutions with up to 800 MHz instantaneous bandwidth per channel.

To meet 802.11ac standard's -32 dB EVM requirement, the choice of the digitizer is critical. A 12 bits IF digitizer with typical residual EVM of -42 dB for 80 MHz bandwidth signals, exceeds the 802.11ac standard's requirement by 10 dB, and can therefore be used for 802.11ac

The next challenge is to ensure proper synchronization between all the channels of the VSA. In the current configuration, the digitizers are synchronized using the external trigger inputs and outputs on the front panel, with both external trigger and video trigger modes supported. Sample clocks are synchronized using a shared 100 MHz clock input into the Ref In front panel connectors, for phase-locked operation. For up to 4 channel configurations, a passive trigger setup can be used, with splitters providing the trigger distribution to the digitizers. With these techniques, timing synchronization of better than +/- 2 samples can be achieved, allowing for unimpaired MIMO EVM measurements.

Downconversion and signal conditioning must be performed with modules supporting multiple signals, covering the 802.11ac frequency bands, and enabling synchronous measurements. This can be achieved with a 4-channel downconverter module and microwave attenuator modules supporting input signals within 802.11ac frequency range.

The VSA software on the host controller will allow control and synchronization of the digitizers, while the remaining hardware can be controller via a macro in the VSA software. Both VSA software and the wideband multi-channel PXI signal analyzer solutions can be controlled programmatically via .NET and IVI/COM interfaces, respectively, for fast automation required in many validation test scenarios.

This wideband multi-channel PXI signal analyzer solution enables scalable deployment, with 1 to 4 channels configurable in a single 18-slot PXI chassis. As additional channels are required, attenuator and digitizer modules can be added to increase capability without the need to switch to a new platform.