

Testing WiMedia-based receivers and transmitters

Testing throughout the implementation stages provides a predictable path to conformance to the WiMedia specification.

By Mark Lombardi

During the design through certification phases of radios that implement WiMedia-based MB-OFDM UWB technology, testing plays a key role in understanding how the design conforms to the specification. Testing through these phases can help designers understand their device's raw performance with respect to the specification and the margin that is available in the design.

Testing of the physical WiMedia-based radio or PHY can be broken down into two main components: receiver testing and transmitter testing. Much of the testing is focused on the performance of the design with respect to the specification. Other tests explore margins by stressing the design to its absolute limits. This is done as a means of understanding whether the design has headroom that could potentially be used as a differentiator in the marketplace. In particular, this article explores the primary measurements used to confirm the design is performing as required by the WiMedia specification.

The WiMedia specification calls out multiple parameters intended to insure radios produced by various silicon providers will interoperate. Initially, this testing is "conducted," or wired directly to the test equipment, to eliminate the antenna as a variable. In later development stages, when the radios are integrated into products, many of these same tests, along with additional tests, can be performed with a "radiated" setup, which necessitates using an antenna on the test equipment.

The specification outlines multiple transmitter parameters that can be categorized as timing, frequency and modulation requirements. The requirements generally considered the most critical indicators of performance and ultimately interoperability include the following:

- **Time domain measurements.** These measurements can be made by capturing the RF signal with a real-time oscilloscope. Measurements such as zero-padded suffix duration and symbol interval may be read directly from the time capture. Many of the specification requirements are interdependent; therefore, a case could be made to skip many time domain tests. For example, a problem with the timing of a standard preamble's burst length (the requirement is 30 symbols) would likely be detected in error vector magnitude (EVM) testing, which would not decode the preamble properly if it was malformed. However, it is important to realize that the ultimate goal of conformance testing is interoperability of multiple vendors' radios. There are cases where interoperability problems may not be detected due to extra margin in a transmitter or receiver. In this case, the margin may potentially hide a problem in one or the other; thereby reinforcing the value of thorough testing.

- **Frequency domain testing.** One of the first and most obvious tests is verifying that the radio is broadcasting on the specified bands and is within the specified power limits.

Note that this discussion will not cover the regulatory testing that is required for radio operation in various regions of the world. Regulatory testing uses a different set of tools—mainly narrowband spectrum analyzers—which enable the very low-noise measurements needed to verify the low-power-level restrictions imposed on UWB technologies. These tools do not allow for modulation domain testing of WiMedia-based technologies. And, because they are swept measurement tools, they cannot measure the individual band performance of these signals as they hop. WiMedia-based frequency and modulation domain measurements are performed by using a high bandwidth, real-time oscilloscope as the digitizer and vector signal analyzer software for the measurements.

The key frequency domain tests required to verify that a radio is designed to the WiMedia specification are frequency tolerance, power spectral density (PSD) testing, adjacent-channel power ratio (ACPR) and transmit power control (TPC). These tests are performed on the transmitter and are strong indicators of (what kind of neighbor the radio will be when) operating in the presence of other radios. Frequency tolerance tests help ensure the radio is transmitting within the frequency offset capabilities of the receiver. PSD and ACPR tests help insure that radios operating in the same band group do not have artifacts that would cause

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