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Boonton's Wi-Fi 6 Solutions: Video Bandwidth

Wi-Fi 6 (also known as 802.11ax) is the latest generation of the Wi-Fi standard, anticipated to provide greater network efficiency, increased battery life, and improved operation in dense or congested environments. Among its projected improvements from previous generations is Wi-Fi 6's ability to utilize channel bandwidths up to 160 MHz. Although widening channel width increases the speed of data throughput, it also increases the video bandwidth (VBW) demands on test equipment.

Wi-Fi 6 Channel Bandwidths

Wi-Fi 6 devices work over the previously allocated 2.4 GHz and 5 GHz frequency bands and the newly allocated 6 GHz band of unlicensed spectrum. A particular Wi-Fi band is segmented into different Wi-Fi channels to send data, and these channels come in various MHz-sized chunks, referred to as a channel's bandwidth. Wi-Fi channel bandwidths start at 20 MHz and throughout the years have increased to 40 MHz, 80 MHz, and 160 MHz. More and more data can be passed through a Wi-Fi channel as the bandwidth increases, translating to faster connections and data transfer speeds. In the 5 GHz band, Wi-Fi 6 can utilize an 80 MHz channel, 80+80 MHz channel (combining two non-continuous 80 MHz channels into one), as well as a continuous 160 MHz channel (see Figure 1).

Generation / IEEE Standard	Max Linkrate	Adopted	Frequency	Channel Bandwidth
Wi-Fi 6 (802.11ax)	600–9608 Mbit/s	2019	2.4/5 GHz 1 – 6 GHz	20/40/**80/160** MHz
Wi-Fi 5 (802.11ac)	433-6933 Mbit/s	2014	5 GHz	20/40/**80/160** MHz
Wi-Fi 4 (802.11n)	72-600 Mbit/s	2009	2.4/5 GHz	20/40 MHz
Wi-Fi 3 (802.11g)	3-54 Mbit/s	2003	2.4 GHz	20 MHz
Wi-Fi 2 (802.11a)	1.5-54 Mbit/s	1999	5 GHz	20 MHz
Wi-Fi 1 (802.11b)	1-11 Mbit/s	1999	2.4 GHz	20 MHz
(Wi-Fi 1, Wi-Fi 2, and Wi-Fi are unbranded)				

Figure 1: Wi-Fi generations and their corresponding channel bandwidth.

Wi-Fi 6's 160 MHz channel utilization capability is one of its key features to meet current and emerging needs of high-speed gadgets. At the same time, this challenges the test and measurement industry to deliver dependable, error-free power measurements for these advanced chipsets and devices.

Video Bandwidth Requirements

With channel widths up to 160 MHz, a test instrument's VBW must be wide enough to maintain the accuracy of power measurements. VBW describes the ability of a sensor to follow signal variations of envelope power measurements. Envelope power is a continuous function that depicts a signal's amplitude change over time, which occurs because of the pulsed natured of the signal, modulation, or distortion. If a sensor is slower than the signal's varying amplitude, then the waveform will not be accurately tracked and measurement errors will occur for envelope power, peak envelope power (the maximum single value of envelope power), and average power.

A modulated signal with quick amplitude variations is being tracked by two sensors in Figure 2 below. Sensor one (blue) has adequate VBW and effectively tracks the envelope power of the pulse. Sensor two (green), on the other hand, lacks the necessary VBW capabilities, which manifests itself as a measurement error.

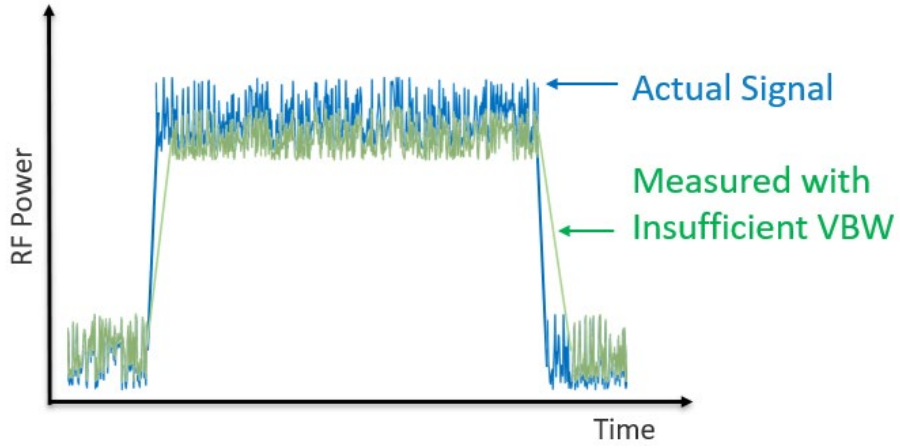

Figure 2: Sufficient versus insufficient VBW and its resultant effects on measurement accuracy.

Most test equipment falls short in VBW capabilities, meaning the peak power of Wi-Fi 6 signals cannot be accurately captured. As a result, engineers are forced to make testing compromises, one of which is to replace peak power for average power measurements. However, as with any compromise this approach has its downfalls, such as hiding signal peak compression and its subsequent distortion. Engineers may also resort to purchasing highly expensive test equipment that not only skyrockets cost but increases testing and instrument complexity.

Test Solutions: Boonton RTP5000 Series

Boonton is the only company that offers RF power measurement instrumentation with sufficient VBW to effectively capture the peak power of Wi-Fi 6 signals. Boonton's RTP5000 series of real-time USB peak power sensors provide the widest VBW up to 195 MHz, while the RTP5008 sensor in particular is uniquely equipped for Wi-Fi 6 chipset and device characterization and compliance testing in the newly allocated 6 GHz band (5.925 to 7.125 GHz) with 165 MHz of VBW.

Along with satisfying VBW needs, Boonton also addresses additional testing requirements for appropriate Wi-Fi 6 characterization, including crest factor and statistical analysis (CCDF),

packet time gating, long data stream capture with Real-Time Power Processing (RTPP) technology and Measurement Buffer Mode software, and time alignment measurements of packets across multiple channels with Synchronized Independent Gate Mode.

The next evolution of the wireless standard pushes the boundaries of its predecessors, such as utilizing channel widths up to 160 MHz. Meeting the new demands placed on the test and measurement industry, Boonton delivers products with the necessary VBW to facilitate Wi-Fi 6 characterization and compliance test. To learn more about Boonton's Wi-Fi 6 solutions, head over to www.boonton.com.