WLAN 802.11ay: up to 176 Gbit/s over the air

The new WLAN standard advances into higher frequency ranges and promises significantly higher data rates and larger range. The R&S®FSW85 signal and spectrum analyzer provides the appropriate T&M functionality.

The IEEE 802.11ad WLAN standard introduced a few years ago for high data rate transmissions in the 60 GHz band can no longer provide the required data rates and range for a variety of current applications. That is why the IEEE 802.11ay extension is currently being specified, with the development of chipsets and components already underway.

In place of 2.16 GHz bandwidth offered by 802.11ad, the enhanced 802.11ay standard can deliver 8.64 GHz total bandwidth by combining up to four channels (channel bonding). The available frequency range has been extended to 71 GHz. MIMO with up to eight streams per channel is also possible. With only four streams at 44 Gbit/s, data rates of up to 176 Gbit/s can be achieved. This is additionally supported by higher-order modulation schemes such as 64QAM. The new standard also promises larger transmission range.

The new standard is mainly intended to replace Ethernet and other wired transmission standards, e.g. to transport video content to monitors, to integrate augmented reality (AR) and virtual reality (VR) headsets and glasses, and to exchange large data volumes between computers and mobile devices very quickly over the air, a capability perfect for cloud-based applications. As a result, insiders expect potential applications not only in homes but also in business and industrial environments, e.g. in open-plan offices and production plants. The high bandwidth eliminates the need for complex cable installations, saving costs and allowing a more flexible design of the work environment. The standard also facilitates quick connection of service providers. For example, with 802.11ay, network operators can connect base stations to the core network more easily than by using radio relay setups.

In view of the wealth of new possibilities offered, many manufacturers of WLAN applications have already started development of 802.11ay transmitters and receivers. While the technology is very promising in terms of extremely high data rates, device development is very costly and complicated. Chip and component manufacturers not only need state-of-the-art production technologies, but also the T&M equipment that can handle frequency ranges up to 71 GHz as well as modulation bandwidths of at least 2 GHz.

The R&S®FSW85 signal and spectrum analyzer (Fig. 1) covers the relevant frequency band without any frequency converters and also offers the necessary demodulation bandwidth.

Fig. 1: R&S®FSW85 signal and spectrum analyzer in combination with R&S®RTO2064 oscilloscope for analyzing WLAN 802.11ay signals with high sensitivity at bandwidths up to 4.32 GHz.

Fig. 2: Analysis of a 2 GHz wide WLAN 802.11ay signal. Along with graphical representation of the signal in the time and frequency domain, display of the constellation diagram and other results, users especially appreciate EVM and other numerical results.

With the R&S®FSW-B2001 option, it provides 2 GHz internal bandwidth, turning it into a one-box solution that can analyze, i.e. measure the modulation characteristics of, one channel of an 802.11ay signal. The instrument does this with a sensitivity of –37 dB, corresponding to an error vector magnitude of approximately 1.5 %. A dedicated internal measurement application (R&S®FSW-K97) provides all results of interest at the push of a button. Along with tabular listing of the modulation characteristics, display of the preamble content and the transmitted bits, it visualizes diverse diagrams that enable the user to identify problems and improve transmission quality (Fig. 2). If signals are very weak or need to be measured over the air interface, which is often the case in this frequency band because the antennas are usually integrated on the PCBs, a preamplifier such as the R&S®HA-Z24 can be connected to improve the signal-to-noise ratio. If more than 2 GHz bandwidth is required, e.g. when two channels are bonded, this requirement can be met by combining the R&S®FSW85 with an R&S®RTO2064 oscilloscope to provide 5 GHz analysis bandwidth. The frequency response of the combined signal analyzer and oscilloscope is fully equalized; the data is automatically loaded into the R&S®FSW85 without the user noticing that the oscilloscope is being used instead of the internal R&S®FSW85 A/D converters. The user simply adjusts the bandwidth in the R&S®FSW85 measurement application.

Spectral measurements such as adjacent channel power and spectrum mask can be directly performed on the R&S®FSW85, including preselection up to 85 GHz – unmatched by any other signal and spectrum analyzer on the market. This feature offers substantial benefits, i.e. significantly fewer spurious signals and higher sensitivity for spectral measurements. For OTA measurements, strong interfering signals outside the wanted band can be suppressed to avoid distortion of results.

Of course, it is also possible to use a signal and spectrum analyzer together with an external harmonic mixer, such as the R&S®FSW43 with the R&S®FS-Z90, to achieve up to 5 GHz analysis bandwidth for measuring modulation characteristics. However, these combinations do not offer the advantage of preselection for spectral measurements.

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