The Wi-Fi 6E Challenge in Regulatory Test

What Is Wireless Regulatory Compliance Test?

The industrial, scientific, and medical (ISM) bands do not require individual end-user licenses. However, this does not mean that there are no rules for use of these radio frequencies. The devices require testing to demonstrate compliance with regulatory standards and ensure efficient use of the wireless spectrum. Regulatory agencies, including the Federal Communications Commission (FCC) in the US, the European Telecommunications Standards Institute (ETSI), and Japan’s Ministry of Internal Affairs and Communications, govern the regulatory standards.

Increased spectrum use adds to test complexity

In the past, regulatory requirements included basic tests such as frequency stability, power limits, and purity of emissions. Regulatory test requirements have become more complex in recent years because of the heavy use of the spectrum, which results in interference. It is difficult for devices using various on-air protocols to cooperate. ETSI in Europe defined new test methods requiring devices to sense several forms of radio-frequency (RF) energy and avoid transmission while those signals are active. After the signals have ceased, wireless devices must follow semi-random delays so that the devices can take turns transmitting. ETSI named this channel-sharing mechanism channel access engine, also known as the adaptivity test.

Congestion on ISM bands, including the 5 GHz band, has caused regulatory agencies to increase spectrum allocation to unlicensed devices. Radar services that operate at the 5 GHz range might experience interference when the ISM bands expand to allow operation in these radar frequencies. The regulatory agencies defined new tests to protect these incumbent services.
Because of the nature of the interference with radar, the test requirements for dynamic frequency selection (DFS) features are extensive and time-consuming. DFS test needs to consider the various types of radar, radar signals, and possible operating frequencies of both the radar and unlicensed wireless devices. The test is repetitive because of the combination of signals and operating frequencies between the radar and unlicensed wireless devices to establish a statistical assurance of the performance.

The Wi-Fi 6E Challenge

The Wi-Fi 6E spectrum is not vacant. Incumbent users include satellite and terrestrial microwave links. These incumbent services need some protection from interference, just like the radar services in the 5 GHz band. In its Wi-Fi 6E announcement, the FCC revealed new test requirements for devices that plan to use the new band. Some of the new requirements are different, like antenna pattern limitations. However, one new test is very much like ETSI’s adaptivity test.

The FCC defined seven device classes for indoor and outdoor installation. Although the agency has not set all the test requirements, indoor devices will have a channel-sharing requirement. This requirement expects devices to use a contention-based protocol (CBP), which is a listen-before-talk protocol, just like the ETSI channel access engine.

The FCC Office of Engineering and Technology publication 987594 D02 defines the test procedure for CBP. Just like the adaptivity test, it simulates incumbent device signals, but in this case with a 10-MHz-wide additive white Gaussian noise signal. In terms of energy, this resembles other signals with which the device must not interfere. The test does not require demodulation of those signals, only sensing of the RF energy.

A new Wi-Fi 6E device may occupy a wider spectrum than the 10 MHz simulated signal, so the test must include all cases where device transmission overlaps the spectrum the incumbent signal uses. It requires multiple test executions with different frequency configurations. In each case, the signal must be detectable with at least a 90% probability if the interferer has a signal strength of -62 dBm or greater. Altogether, the CBP test needs many test repetitions to meet the regulation’s requirements.

Other Interesting Wi-Fi 6E Test Requirements

Although CBP may be the most time-consuming test, there are other more common test requirements, such as frequency stability, power control, bandwidth, and unwanted emissions, for a new Wi-Fi 6E device. Most of these will be familiar to test engineers, with a few exceptions.

Because incumbent users include satellite and terrestrial services, the Wi-Fi 6E equipment must not radiate signals at elevations above 30 degrees from the horizon. This radiated test will vary depending on whether the antennas have fixed radiation patterns or are steerable.
Wi-Fi 6E has different power limits for different classes of equipment. Hence, a device that can connect to both low-power and full-power access points (APs) must adjust its power level to match the limitations imposed by the type of AP to which it attaches. FCC KDB 987594 D02 details the test procedure to confirm proper operation under both conditions.

The Keysight IOT0047A Regulatory Test Solution

Figure 1. Keysight’s IOT0047A regulatory test solution

Keysight’s IOT0047A regulatory test solution includes the test equipment and software needed to perform regulatory tests required by the ETSI and the FCC regulations. The solution is configurable to perform some or all of the tests regulatory agencies require. Labs may set up limited test capabilities at a given test station or have some complete solutions and several smaller stations dedicated to certain tests.

The IoT regulatory test software is purpose-built to help simplify and accelerate the tests required by regulatory agencies, including the new Wi-Fi 6E tests.

The software helps establish connections to the test instruments, define characteristics of the test device, and enable entry of test parameters, such as sample rates, durations, and amplitudes. It also handles interferer setup, offers the flexibility to execute select tests, and simplifies automated tests. The software allows the test lab to run a complete automated test or diagnose areas of failure by focusing only on the area of interest. This capability helps save troubleshooting time, especially when failures occur only at a certain frequency.
Figure 2. Screen to configure test parameters for ETSI adaptivity test, similar to the FCC CBP test

Figure 3. Test results data are available in graphical and tabular formats
The software can generate results in both graphical and tabular form or save them for future reference. It also supports several report format templates and custom formats.

Figure 4. Example report format for ETSI adaptivity test
Conclusion

The Keysight IOT0047A regulatory test solution is a valuable addition to independent test labs and in-house pre-compliance test labs. It gives test engineers multiple ways to cover more tests in less time. Even with the complex new tests required for regulatory certification, test engineers can get products to market faster. For more information about the IOT0047A regulatory test solution, visit www.keysight.com/find/IOT0047A.