IoT: The Interference of Things

Martin Rowe - August 10, 2017

I hereby declare that IoT stands for "Interference of Things." Anything else you may have heard is just marketing hype.

While a relatively few connected gadgets will use wireline communications, the bulk of these devices—ranging in applications from farming to medical to toasters to pets— will connect wirelessly over Bluetooth, Wi-Fi, or cellular. Some will be designed to limit EMI emissions to the proper channels and reject out-of-band power, but many won't. That became abundantly clear at a technical session held August 9 at the EMC for IoT session of the IEEE EMC+SIPI Symposium.

At four-hour session, attendees learned that many connected devices won't be designed well enough to withstand outside EMI. Price, power, and size pressures will cause some companies to sell products that work just well enough to pass minimum requirements, if that. Problems will occur from the devices' intentional radiators. In some cases, "dirty" transmitters will emit excessive out-o--band energy. Conversely, some receivers will contain little or no filtering to reject out-of-band energy. The European Radio Equipment directive states:

> Equipment which intentionally emits or receives radio waves for the purpose of radio communication or radiodetermination makes systematic use of radio spectrum. In order to ensure an efficient use of radio spectrum so as to avoid harmful interference, all such equipment should fall within the scope of this Directive.

Note the phrase "avoid harmful interference." Many products will undergo EMI immunity tests at certified labs to ensure that they comply with the Directive and applicable standards. Other connected devices will undergo self-certification, some of those products would likely fail compliance tests due to excessive adjacent channel power from their transmitters (**Figure 1**) of insufficient receiver selectivity, or both.

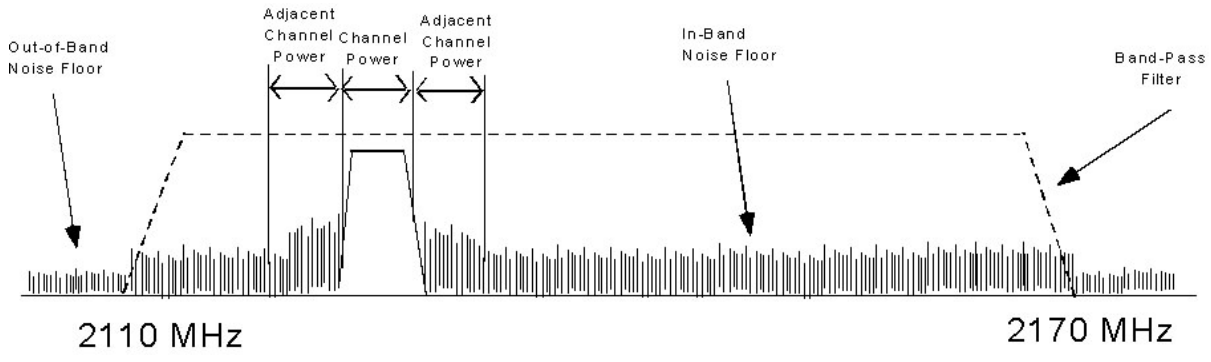

Figure 1. Some power from this CDMA signal spills over into adjacent channels.

The CDMA signal in **Figure 2** has adjacent channel power that's below the noise floor with the exception of two low-level peaks.

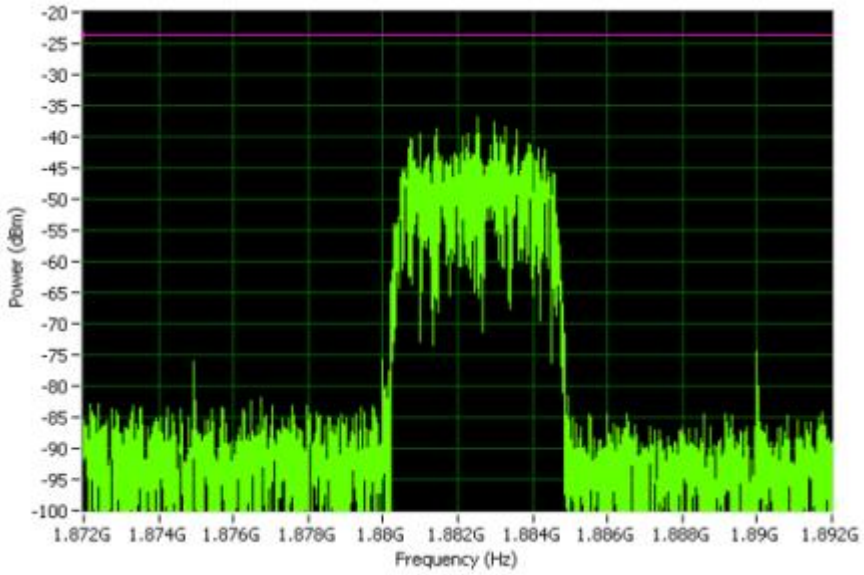

Figure 2. A clean CDMA signal fits within its 5 MHz channel.

Remember that Wi-Fi uses the unlicensed 2.4 GHz band, which covers 2500 MHz to 2690 MHz. The aeronautical radio navigation and radio location band starts at 2700 MHz, leaving 100 MHz as a band gap. Some power from cheap wireless devices could spill over across the gap. In his presentation "Vulnerability of Wireless Systems to (Intentional) EMI, Dr. Frank Leferink of the University of Twente Enschede and Thales Netherlands explained the penalty for ensuring that devices and systems won't interfere with each other is power, size, and price. "Engineers want to eliminate filters," said Leferink. "Some software defined radio (SDR) designers use no filters at all, thinking that can eliminate EMI problems in software alone."

"Superheterodyne receivers work best," he continued, "but they cost money and use power to many devices use heterodyne receivers instead. They are inexpensive and use less power." Because heterodyne receivers are more sensitive, they are more likely to succumb to interference from Jammers than superheterodyne receivers. Although jammers, according to Leferink, are illegal to use outside of the military, you can buy them for $500 in Shenzhen. He envisioned burglars using jammers to interfere with home and automotive security systems, giving the intruder access to premises or to steal a car.

In another technical session, Bill Young of NIST cited an issue where devices equipped with 4G/LTE communications spilled power into the adjacent GPS band, interfering with a GPS receiver's ability to "fix" onto satellites. Young's presentation, Shared Spectrum Metrology: Measuring the Impacts of Adjacent-band LTE Waveforms on GPS Receivers, focused on an automated test method that let NIST engineers gather enough data for regulators to use in deciding how to handle the issue.

As connected wireless devices become more popular, it's clear that the interference they cause and fail to reject will keep EMI engineers employed for many more years.

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