FCC Technological Advisory Council

Noise Floor Technical Inquiry, Final Revision 6/6/16

The FCC Technological Advisory Council is requesting input to help answer questions about the study of changes to the Spectrum Noise Floor over the past 20 years. Like many spectrum users we believe that the noise floor in the radio spectrum is rising as the number of devices in use that emit radio energy grows. However, in search for concrete evidence of increased noise floors, we have found limited available quantitative data to support this belief. We are looking to find ways to add to the available data in order to answer important questions for the FCC regarding this topic.

Radio spectrum noise is generated by many different types of devices. Devices that are not designed to generate or emit radio frequency energy but do so as a result of their operation are called *Incidental Radiators*. Most electric motors, light dimmers, switching power supplies, utility transformers and power lines are included in this category. There is little regulation governing the noise generated by these devices. Noise from such sources is expected to be minimized with "Good Engineering Practices."

Devices that are designed to generate radio frequency energy for internal use, or send radio frequency signals by conduction to associated equipment via connected wiring, but are not intended to emit RF energy, are called *Unintentional Radiators.* Computers and many portable electronic devices in use today, as well as many new high efficiency lights, are included in this category. Current regulations limit the levels of emitted radio frequency energy from these devices.

Intentional Radiators are devices that are designed to generate and emit radio frequency energy by radiation or induction. Cellular phones and base stations, unlicensed wireless routers, Bluetooth devices, broadcast TV and radio stations, and radars of many types, are all examples of intentional radiators. Such emitters contribute to the noise floor with emissions outside of their assigned frequencies. These are sometimes generated as spurious emissions, including, but not limited to, harmonics of desired frequencies and intermodulation products. Regulations that permit the operation of these devices also specify the limits of emissions outside of licensed or allowed (in the case of unlicensed devices) frequencies of operation.

We are looking for responses to the following questions to help us identify aspects of a study to determine trends in the radio spectrum noise floor.

1. Is there a noise problem?
    a. If so, what are the expected major sources of noise that are of concern?
    b. What services are being most impacted by a rising spectrum noise floor?
    c. If incidental radiators are a concern, what sorts of government, industry, and civil society efforts might be appropriate to ameliorate the noise they produce?
2. Where does the problem exist?
    a. Spectrally
        i. What frequency bands are of the most interest?
    b. Spatially
        i. Indoors vs outdoors?

ii. Cities vs rural settings?
iii. How close in proximity to incidental radiators or other noise sources?
iv. How can natural propagation effects be accounted for in a noise study?

c. Temporally
i. Night versus day?
ii. Seasonally?

3. Is there quantitative evidence of the overall increase in the total integrated noise floor across various segments of the radio frequency spectrum?
   a. At what levels does the noise floor cause harmful interference for particular radio services?
   b. What RF environment data from the past 20 years is available, showing the contribution of the major sources of noise?
   c. Please provide references to scholarly articles or other sources of spectrum noise measurements.
4. How should a noise study be performed?
   a. What should be the focus of the noise study?
   b. How should it be paid for?
   c. What methods should be used?
   d. How should noise be measured?
      i. What is the optimal instrumentation that should be used?
      ii. What are the measurement parameters for the instrumentation used?
      iii. At what spatial and temporal scales should noise be measured?
      iv. Is directionality an important measurement?
      v. Is there an optimal height above ground for measurements?
   e. What measurement accuracy is needed?
      i. What are the statistical requirements for sufficient data? Would these requirements vary based on spectrum, spatial and temporal factors?
      ii. Can measurements from uncalibrated, or minimally calibrated, devices be combined?
      iii. Is it possible to “crowd source” a noise study?
   f. Would receiver noise measurements commonly logged by certain users (e.g. radio astronomers, cellular, broadcast auxiliary licensees) be available and useful for noise floor studies?
   g. How much data must be collected to reach a conclusion?
   h. How can noise be distinguished from signals?
      i. Can noise be characterized and its source identified?
      ii. Is there a threshold level, below which measurements should be ignored?