On The Sensitivity of Candidate Cognitive Radio Sensing Engines

James R. Kelly[(1)], Sana Salous* [(2)], and Mikolaj Chwalisz[(3)]
(1) Institute for Communication Systems, Department of Electronic Engineering, Faculty of Engineering and Physical Sciences, University of Surrey, Guildford, GU2 7XH, UK
(2) School of Engineering and Computing Sciences, Durham University, South Road, Durham, DH1 3LE, UK
(3) Technische Universität Berlin, Department Telecommunication Networks (TKN), Einsteinufer 25, FT 5, 10587 Berlin, Germany

Today communication systems such as mobile phones, WiFi, GPS, operate within pre-assigned frequency bands. Although this system has worked for decades there are several important disadvantages associated with this approach: 1) Some areas of the spectrum are overcrowded and others are underutilized, 2) Radio born interference and propagation effects (such as fading) can disrupt communication, and 3) The radio is unable to respond to changes in the user's needs. The revolutionary concept of Cognitive Radio (abbreviated to CR) was developed to address these limitations. A CR transceiver might operate within a regulated radio frequency spectrum, under special terms, and could therefore choose to operate on any frequency that seemed appropriate. CR is likely to form an important part of future generation mobile communication networks. The CRs will be required to continuously scan the frequency spectrum over which they operate. This is necessary in order to identify gaps in the spectrum as well as legacy users operating on the same frequency. This operation, known as spectrum sensing, represents one of the major challenges facing CR.

This paper presents the results of an experiment conducted as part of the CR Experimentation World (CREW) project (http://www.crew-project.eu/). The experiment involved exposing various candidate sensing engines to low-level radio frequency signals. It was hypothesized that the sensitivity of the sensing engines would vary depending on the type of signal. For that reason a variety of different types of signal were employed including a Continuous Wave (CW) signal as well as signals that would be more challenging to detect, such as frequency swept, frequency hopping, and direct sequence spread spectrum waveforms. Various different sensing engines were selected for evaluation. These included a mixture of commercial-off-the-shelf (COTS) and custom designed units ranging from high to low cost and having different internal architectures. The paper compares the performance of different sensing engines as a function of the signal type and signal amplitude and provides valuable new insight in this area. The sensing engines that capture different types of signals most accurately will be best equipped to mitigate for the hidden nodes problem and so the results will be of considerable value and interest to the community. The paper thus builds on previous work on the topics of spectrum sensing and the hidden nodes problem in CR.