A Performance Comparison of Different Spectrum Sensing Techniques

In this work we present a set of experiments that have been carried out in the scope of the CREW project to evaluate and compare different spectrum sensing approaches. The FP7 project CREW (www.crew-project.eu) targets the development of a federated testbed for cognitive radio systems by physically and virtually interconnecting radio equipment of the individual project partners, each focusing on specific aspects related to cognitive networking. The testbeds that are part of the CREW federation can be used to focus on robust cognitive networking, coexistence in the unlicensed bands, vertical sharing in the licensed cellular bands or opportunistic usage in the licensed TV bands. Each of these usage scenarios is very diverse in terms of cognitive networking solutions, spectrum environment characteristics and hence also sensing requirements. By combining sensing solutions from each of those scenarios, it becomes possible to make a cross-platform study of the use of sensing, and the usefulness of various sensing solutions that range from inexpensive off-the-shelf solutions, to expensive monitoring equipment, to dedicated sensing equipment developed by the CREW consortium. Each of the solutions offers different RF flexibility, sensing speed and accuracy, and varies in the way the samples are processed and stored.

The presentation will focus on a set of simultaneous experiments that were carried out in a specific location on a given day using different hardware platforms. These platforms include dedicated integrated sensing hardware, USRP software-defined radios (SDRs), small, low power sensor nodes, off-the-shelf, low cost USB spectrum analyzers as well as high cost, high precision spectrum analyzers. .During the experiments, an 8 MHz DVB-T signal was generated in the 2.4 GHz ISM band. Sensing measurements for varying transmit power, varying distances between transmitter and sensors, and line-of-sight and non-line-of sight scenarios were recorded. All platforms were capable of recording basic energy levels allowing for the comparison of energy detection. Some of the dedicated sensing solutions additionally employed more advanced techniques such as feature detection on the DVB-T signals.

The results of the conducted experiments allow us to compare the performance of the investigated sensing hardware and algorithms. Although the investigated scenarios were rather simple, we believe that they provide an important first step for a standardized, systematic comparison of different sensing solutions. We will extend these initial experiments and define benchmarks to objectively compare different sensing solutions.

Recent announcements and studies by regulatory bodies have stated that sensing technology is not mandatory for current cognitive radio deployments. The main reason is the belief that local sensing is not yet reliable and cheap enough. The FCC recognized the value of sensing for TVWS in the following statement: “We continue to believe that spectrum sensing will continue to develop and improve. We anticipate that some form of spectrum sensing may very well be included in TVBDs on a voluntary basis for purposes such as determining the quality of each channel relative to real and potential interference sources and enhancing spectrum sharing among TVBD”. Although spectrum sensing is no longer a mandatory requirement in the TV bands, the FCC has still defined the technical rules for its use. The experiments carried out in the CREW context to compare different sensing solutions in various sensing scenarios are hence an important step to assess systematically the performance-cost of different sensing solutions and their viability in the various scenarios that are the basis of the CREW federation.