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# ABSTRACT

## Ph. D. THESIS

### „Hybrid sensing method in mobile ad-hoc networks”

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The dissertation deals with a sensing – the issue of one of the basic functionalities of cognitive radio (CR). It involves monitoring broad spectrum bands and detecting the channels temporarily not occupied by primary (licensed) users. Spectrum sensing can be implemented using different methods since there is no universal method that could be used in any conditions and would ensure short detection time while maintaining the required reliability. Each of the sensing methods is characterized by both advantages and disadvantages that reduce their effectiveness.

The subject of the dissertation is a hybrid detector, which is a combination of various single-phase methods to increase the efficiency of conducted sensing. The tests were carried out for various environmental (propagation) conditions, taking into account the uncertainty of spectral density of noise power estimation and the multipath losses of the signal. The aim of the tests was to prove the thesis of the dissertation: **“The hybrid spectrum sensing provides increased detection efficiency for priority users in an ad-hoc cognitive networks”**. The following metrics were used to assess the effectiveness of sensing: sensitivity of sensing, probability of detection, reliability and time needed for detection. In this regard, four detailed sub theses were defined, and the fifth one assuming that in order to optimize the sensing methods it is necessary to know the structure of the detected signal.

The dissertation consists of five chapters. In the first chapter, the research area has been formulated, where the subject of the dissertation has been characterized and the main research problem has been presented. Then, the research methods have been characterized and the aim and thesis of the dissertation have been formulated.

The second chapter presents the characteristics of the main problems and challenges that the spectrum sensing detector must meet. There has been presented the meaning of hybrid sensing and the solutions proposed in the literature. Next, the detailed description of



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the hybrid method used in the dissertation has been included and the single-phase methods included in its composition have been characterized.

The third chapter contains a description of the elements of the research scenario such as the radio channel models used in tests and the licensed user systems applied, i.e. WiMAX and military radio communication of the range  $225 \div 400$  MHz (the signal recorded during the transmission of the radiostation). The chapter also characterizes the measures used to assess the sensing methods.

The results obtained have been presented in the fourth chapter. The scope of the conducted research has been divided into two stages, according to the systems of the licensed user. The first stage presents the results for two considered hybrid detectors for the WiMAX system. These results have been compared with the results obtained for single-phase methods. On this basis, a hybrid detector has been selected for the second stage of research, where the registered OFDM signal from the military radiostation has been used.

The last, fifth chapter contains a summary of the research carried out and the resulting conclusions.