ENERGY DETECTION BASED SPECTRUM SENSING IN COGNITIVE RADIO NETWORK

B.Thangalakshmi
Under Graduate Department of ECE, New Prince Shri Bhavani College of Engg and Technology, Pallikaranai, Chennai.
Email: bthangalakshmi@gmail.com

Abstract— Cognitive radio (CR) is the enabling system for sustaining dynamic spectrum admittance: the policy that addresses the spectrum shortage difficulty that is encountered in many countries. The spectrum sensing trouble has gained new features with cognitive radio networks. Radio spectrum is the most expensive reserve in wireless communication. The cognitive radio and cognitive based networking are transforming the fixed spectrum allocation based communication systems in to dynamic spectrum allocation. Cognitive radios are smart devices with ability to detect environmental situations and can change its factors according to the necessity to get the optimized performance at the individual nodes or at network level Thus, CR is widely regarded as one of the most talented technologies for future wireless communications.

Keywords - cognitive radio; dynamic spectrum access; software-defined radio

1. Introduction

Radio spectrum is a important commodity, and a matchless natural resource shared by different types of wireless services. Unlike other natural resources, it can be frequently re-used, provided certain technical situation is met. In practice radio spectrum can accommodate a limited number of synchronized users. Therefore, radio spectrum requires alert planning and management to maximize its charge for all users. Presently, spectrum regulatory framework is based on static spectrum distribution and obligation policy. Radio spectrum is internationally billed to the radio services on the primary or secondary basis. This is reflected in the Radio Regulations published by the International Telecommunication Union (ITU) [1], which contains definitions of these services and a table defining their allocations for each of three ITU geographic world regions. On the European level, radio spectrum is governed in the European Union by the Radio Spectrum Policy Group (RSPG) and Radio Spectrum Committee (RSC) and by European Conference of Postal and Telecommunications Administrations (CEPT). Additionally, national regulatory agencies define national allocation table and assign radio spectrum to permit holders on a long time for large environmental areas on exclusive basis. Usually, user can use radio spectrum only after acquiring entity license issued by national regulatory agency. In technical point of view, this approach helps in scheme propose since it is easier to make a method that functions in a enthusiastic band than a system that can use many different bands over a large frequency range. In accumulation, spectrum licensing suggests a useful way to sufficient feature of service and to check interference, but it unfortunately leads to highly ineffective use of radio spectrum resource.

This paper presents short summary of cognitive radio functions and corresponding investigate area. In this paper we explain concept of spectrum holes for opportunistic spectrum access, present definition of cognitive radio and explain its basic functions using cognitive cycle concept. Active and Passive spectrum awareness as key techniques for identifying spectrum access opportunities is presented. Spectrum sensing algorithms for primary transmitter and receiver detection are investigated and explained. Paper also present main functions of spectrum management and transmit power control for implementation in cognitive radio environment.

2. Cognitive Radio

For reconfigurability, a cognitive radio looks naturally to software- defined radio to perform this task. For other tasks of a cognitive kind, the cognitive radio looks to signal-processing and machine-learning measures for their execution. The cognitive procedure creates with the inactive sensing of RF stimuli and culminates with *action*.

In this paper, we focus on three *on-line* cognitive tasks3:

1) Radio-scene study, which encompasses the following:
   - Estimation of interference temperature of the radio environment;
   - Detection of spectrum holes.

2) Channel identification, which encompasses the following:
   - Estimation of channel-state information
   - Prediction of channel capacity for use by the transmitter

3) Transmit-power control and dynamic spectrum management.

Tasks 1) and 2) are carried out in the receiver, and task 3) is carried out in the transmitter.

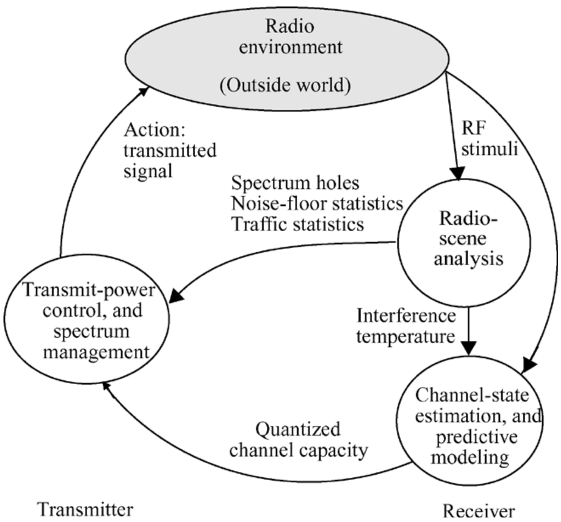

Figure: 1 Cognitive Cycle

Through communication with the RF surroundings, these three tasks form a cognitive cycle, 4 which is pictured in its most basic form in Fig. 1. From this brief discussion, it is apparent that the cognitive module in the transmitter must work in a pleasant way with the cognitive modules in the receiver. In order to preserve this harmony between the cognitive radio's transmitter and receiver at all times, we need a response channel connecting the receiver to the transmitter. Through the feedback channel, the receiver is enabled to express information on the performance of the forward link to the transmitter. The cognitive radio is, therefore, by necessity, an example of a feedback communication system. One other observation is in order. Generally defined cognitive radio knowledge accommodates a level of conflicting degrees of cognition. At one end of the scale, the user may simply pick a spectrum hole and build its cognitive cycle around that hole. At the other end of the scale, the user may employ multiple execution technologies to make its cognitive cycle around a wideband spectrum hole or set of narrowband spectrum holes to offer the best predictable performance in terms of spectrum management and transmit-power control, and do so in the most highly secure manner possible.

3. Energy Detection

Spectrum sensing is the necessary and essential mechanisms of Cognitive Radio (CR) to locate the vacant spectrum. This paper presents an summary of CR design, discusses the characteristics and benefits of a CR. Energy detection based spectrum sensing has been future and used widely because it doesn't need transmitted signal properties, channel information, or even the type of modulation. In this paper, a review of energy detector over Additive White Gaussian Noise (AWGN), dissimilar fading channels for spectrum sensing methodologies in cognitive radio is presented. Theoretical analysis of time domain energy detection and threshold setting is investigated.

Energy detection (also denoted as non-coherent detection), is the signal detection device using an energy detector (also known as radiometer) to state the attendance or nonattendance of signal in the band. The most often used approaches in the energy detection are based on the Neyman-Pearson (NP) lemma. The NP lemma criterion increases the probability of detection for a given probability of false alarm. It is an necessary and a common approach to spectrum sensing since it has reasonable computational complexities, and can be implemented in both time domain and frequency domain. To regulate the entrance of detection, energy detector needs information of the power of noise in the band to be sensed. Compared with energy detection, matched filter detection and cyclostationary detection require a previous information of the PUs to function efficiently, which is hard to understand practically since PUs differ in special condition. Energy detection is not best but simple to apply, so it is broadly adopted. The signal is sensed by comparing the output of energy detector with threshold which depends on the noise floor.

Initially RF signal passed through the band pass filter. Now band pass filter selects the specific bands of frequency. These signal passed through the integrator. Finally decision device makes decision between primary user present or not.

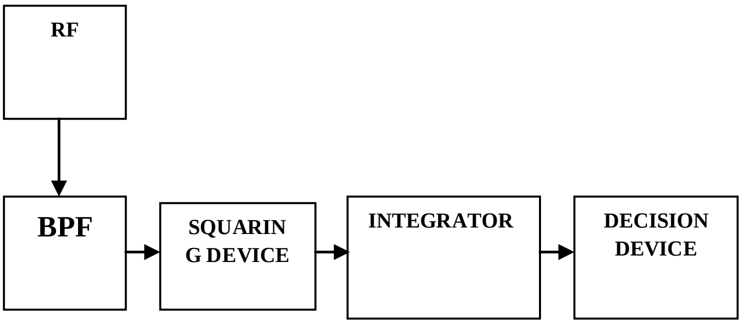

Figure: 2 Energy Detection

4. Results And Implementation

The probability of detection is of main concern as it gives the probability of properly sensing for the presence of primary users in the frequency band. Probability of miss-detection is presently the balance of detection probability. The goal of the sensing schemes is to maximize the detection probability for a low probability of false alarm. But there is always a trade-off between these two probabilities. Receiver Operating Characteristics (ROC) presents very expensive information as regards the behavior of detection probability with changing false alarm probability (Pd v/s Pf) or miss-detection probability (Pm v/s Pf).

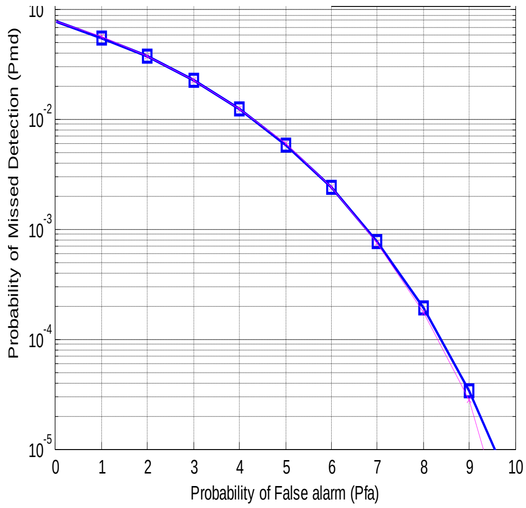

Figure: 3 Output of Energy Detection

Probability of Detection (Pd):

H0 turns out to be TRUE in case of presence of primary user i.e. P(H1/H1) is known as probability of detection.

Probability of Miss-Detection (pm):

H0 turns out to be TRUE in case of presence of primary user i.e. P(H0/H1) is known as probability of miss detection.

Probability of False Alarm (pf):

H1 turns out to be TRUE in case of absence of primary user i.e. P(H1/H0) is known as probability of false alarm.

5. Conclusion

In this paper and evaluate of the CRs technology was obtainable. Energy Signal Detection is introduced as a figure of merit on which to base quantitative assessment of a radiometer's design including its calibration design and algorithm. The trouble of the spectrum detection schemes was formulated which include Energy detection in time and frequency domain. Energy detection has been adopted as an alternative spectrum sensing method for CRs due to its simple circuit in the practical implementation and no information requires about the signal needed to detect.

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