A Review on Hybrid Spectrum Sensing based on Energy and Cyclostationary Techniques

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Abstract- Cognitive radio (CR) is a form of wireless communication in which a transceiver can intelligently notice which communication channels are in use and which are not and instantly move into vacant channels while heading off occupied ones. The idea for Cognitive radio (CR) has come out of the need to utilise the radio spectrum more efficiently, and to be able to maintain the most efficient form of communication for the prevailing conditions. Cognitive radio is an exciting and new way of thinking and researching about wireless communications. Indeed, it is already being considered as one of the key candidate technologies for the fourth-generation (4G) wireless systems. There are several drivers for the development of cognitive radio. Perhaps the most pressing of them is improved utilization of the electromagnetic radio spectrum: a highly valuable natural resource. By using the levels of processing that are available today, it is possible to develop a radio that is able to look at the spectrum, detect which frequencies are clear, and then implement the best form of communication for the required conditions. For optimal spectrum sensing and to utilize the spectrum in efficient manner, a hybrid model is implemented and analyzed. A radio or system that senses its operational electromagnetic environment and can dynamically and autonomously adjust its radio operating parameters to modify system operation, such as maximize throughput, mitigate interference, facilitate interoperability, access secondary markets. With proper channelization of the three techniques(matched filter, energy detection and cyclostationary detection) a comparison of hybrid model have been performed and the theoretical analysis and simulation is also presented.

Keywords - Cognitive radio, spectrum sharing , software _defined radio

I. INTRODUCTION

A Cognitive radio is an intelligent radio that can be programmed and configured dynamically. Its transceiver is designed to use the best wireless channels in its vicinity. Such a radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location. This process is a form of dynamic spectrum management. A cognitive radio may be defined as a radio that is aware of its environment, and the internal state and with a knowledge of these elements and any stored pre-defined objectives can make and implement decisions about its behavior. In general cognitive radio may be expected to look at the parameters such as channel occupancy, free channels, the type of data to be transmitted and the modulation types that may be used. Cognitive radios are intelligent devices which sense environment conditions and change its parameters at the regulatory requirements. In some instances it may be necessary to use a software defined radio, so that it can reconfigure itself to meet the achieve optimal transmission technology for a given set of parameters. cognitive radio has recently attracted a lot of research interest . Accordingly Cognitive radio technology and software defined radio are often tightly linked [1].

Cognitive radios have many advantages where the no. of users is high:

- more efficient use of the spectrum
- ensures connectivity
- enabling high priority communications to take precedence if needed
- Unlimited internet access.

Spectrum Sensing is the task of obtaining awareness about the spectrum usage and existence of primary users in a given frequency band, though it can also be extended to other dimensions like space, code and angle. This is a key functionality of any Cognitive radio that ensures minimal interference towards the primary occupant of the band and maximizes the transmission capacity of secondary user. But, due to attenuation, shadowing and co-channel interference, a cognitive radio must operate at very low SNR.

II. LITERATURE REVIEW

Minho Jo et al. [2013] [1] discuss cognitive radio is an opportunistic communication technology designed to help unlicensed users to utilize the maximum available licensed bandwidth. A selfish cognitive radio node can occupy all or part of the resources of multiple channels, prohibiting other cognitive radio nodes from accessing these resources. Selfish cognitive radio attacks are a serious security problem because they significantly degrade the performance of a cognitive radio network. In this article authors had identified a new selfish attack type in cognitive radio ad-hoc networks and propose an easy and efficient selfish cognitive radio attack detection technique, called COOPON, with multichannel resources by cooperative neighboring cognitive radio nodes. YTawk et al. [2014] [2] this paper discusses the fundamental principles of a cognitive-radio RF system. The key points required to achieve a true cognitive-radio device are outlined. The operation of a cognitive-radio system is mainly divided into two tasks. In the first task, a cognitive-radio device searches and identifies any part of the spectrum that is not occupied. The second task consists of achieving an optimal mode of communication by allocating the appropriate channels to be used. In this paper, the RF requirements required to operate a cognitive-radio device are detailed. Such a device can adopt one of two scenarios of a cognitive-radio system: the “interweave” or “underlay” mode of operation. For both scenarios, a cognitive cycle is followed. This cycle consists of the following four steps: (1) observe, (2) decide, (3) act, and (4) learn. A cognitive-radio engine is responsible for managing and integrating these four functions together into a single cognitive-radio device. Hung Tran et al.[2014][3] in this paper, authors analyzed the packet transmission time in a cognitive cooperative radio network (CCRN) where a secondary transmitter (SU-Tx) sends packets to a secondary receiver (SU-Rx) with the help of a secondary relay (SR). In particular, they assumed that the SU-Tx and the SR are subject to the joint constraint of the timeout probability of the primary user (PU) and the peak transmit power of the secondary users (SUs). Nicola Cordeschi et al.[2013] [4] in this paper, authors designed and tested the performance of a distributed and adaptive resource management controller, which allowed the optimal exploitation of cognitive radio and soft-input/soft-output data fusion in vehicular access networks. The goal is to allow energy and computing-limited car smartphones to utilize the available vehicle-to-infrastructure (V2I) WiFi connections for performing traffic offloading toward local or remote clouds by opportunistically acceding to a spectral-limited wireless backbone built up by multiple roadside units (i.e., cloudlets). Yuli Yang, Aissa, et al.[2014][5] in this paper, a cognitive radio (CR) network with multiple spectrum bands available for secondary users (SUs) is considered. For the SU's active spectrum-band selection, two criteria are developed. One is to select the band with the highest secondary channel power gain, and the other is to select the band with the lowest interference channel power gain to primary users (PUs). With the quality-of-service (QoS) requirement concerning delay, the effective capacity (EC) behaviors over secondary links are investigated for both criteria under two spectrum-sharing constraints. Linyuan Zhang et al.[2015][6] The Byzantine attack in cooperative spectrum sensing (CSS), also known as the spectrum sensing data falsification (SSDF) attack in the literature, is one of the key adversaries to the success of cognitive radio networks (CRNs). Over the past couple of years, the research on the Byzantine attack and defense strategies has gained worldwide increasing attention. In this paper, we provide a comprehensive survey and tutorial on the recent advances in the Byzantine attack and defense for CSS in CRNs. Abuzainab, N., Vinnakota, S.R et al. [2015][7] this paper considers a cognitive radio network in which each secondary user selects a primary user to assist in order to get a chance of accessing the primary user channel. Thus, each group of secondary users assisting the same primary user forms a coaltion. Within each coalition, sequential relaying is employed, and a relay ordering algorithm is used to make use of the relays in an efficient manner. It is required then to find the optimal sets of secondary users assisting each primary user such that the sum of their rates is maximized. The problem is formulated as a coalition formation game, and a Gibbs Sampling based algorithm is used to find the optimal coalition structure. Nhan Nguyen Thanh et al.[2015][8] in this paper Authors investigated the primary user emulation (PUE) attack, which is a serious security problem in cognitive radio (CR) networks. There exist three types of PUE attackers: 1) a selfish one, which aims at maximizing its selfish usage of channel resource; 2) a malicious one, which points for obstructing the operation of CR network; and 3) a mixed one, which is between a selfish and malicious PUE attacker. For combating a selfish PUE attacker, a channel surveillance process has to be implemented in order to determine active user's identification and so selfish PUE attacker.

III. FINDINGS OF THE LITEARTURE REVIEW

The literature survey in the previous chapter infers that the recent research in the field of Cognitive radio can be defined as it is a technology which is able to select the frequency band, the type of modulation, and power levels most suited to the requirements, prevailing conditions and the geographic regulatory requirement. In order to utilize spectrum more efficiently and to exploit the primary user, spectrum sensing is accomplished. The selection can be done on the basis of the secondary user’s application frequency requirement. Before transmitting on the selected band the power level should be maintained such that it provides minimal interference to other users . Depending on the distance and the error performance requirement the modulation scheme used can be varied. Spectrum sharing should be allowed so that other secondary users can also access the empty bands.

- To study Energy Detection Technique and Cyclostationary Technique for spectrum sensing in Cognitive Radio.
- To purpose and implement a Hybrid spectrum sensing Technique based on energy and Cyclostationary techniques.
- To test and compare the results with existing techniques.

IV. METHODOLOGY

A number of different methods are proposed for identifying the presence of signal transmission. From our Literature survey we conclude that out of the various techniques available for spectrum sensing in cognitive radio, the most important ones are Energy Based and Cyclostationary based methods. So in our proposed work we are going to combine the advantages of above mentioned methods.

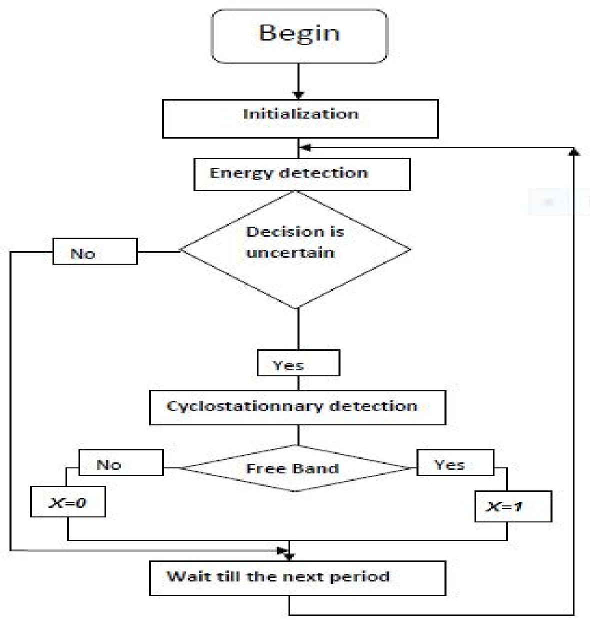

Fig1:Algorithm for energy detection

Step1: Initialisation of the system.
Step2: First of all energy detection is done using the energy detector.

Step3: If the decision of energy detection is uncertain that means that if the decision is nor clearly showing content or rejection.

Step4: Then it will move to Cyclostationary detector.

Step5: If the Cyclostationary detector also does not give satisfactory values(X=1) for free band then it will wait till the next period of detection and shift otherwise(X=0).

Step6: Otherwise if the decision of energy detector is in favor of free band it will shift and it is not in favor completely it will wait for the next period of detection.

V. CONCLUSION

In today's world, use of wireless devices has inflated considerably with the advances in wireless technology. In the near future significant growth of connected devices is predicted with mass adoption of IoT huge quantity of spectrum is needed to support this increasing number of wireless devices but the spectrum available is a scarce resource. If we tend to check current spectrum allocation chart, it's terribly exhausting to search out free spectrum to support forthcoming volumes of wireless devices and mobile data traffic. A cognitive radio may be outlined as a radio that's responsive to its surroundings, and therefore the internal state and with a knowledge of the elements and any stored pre-defined objectives will create and implement choices concerning its behavior. cognitive radio is the great accomplishment for forthcoming wireless communications with reliable high speed communications, versatility, and additional bandwidth for quick developing data applications. some of the present techniques utilized in cognitive Radio include spectrum sensing, spectrum database and pilot channel. These techniques are either complicated that needs high computational power to detect unused spectrum or fail to take advantage of spectrum space created in real-time..

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