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STUDY OF COOPERATIVE SENSING APPROACH IN COGNITIVE RADIO NETWORKS

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ABSTRACT

Radio Spectrum is regarded as a fundamental unit in Wireless communication network, as it plays an important role of transmission medium; and with the advent of technologies dealing with radio spectrum; cognitive radio has emerged as a effective solution to the problem of limited radio spectrum. Cognitive radio uses spectrum sensing to study surrounding environment and to demonstrate the appropriate plan for spectrum sharing.Cooperative sensing is an approach inspectrum sensing which eliminates error in spectrum sensing mechanism by sharing information. However, it is a method which improves detection using spatial diversity to eliminate shadowing, multipath fading and receiver uncertainty issues. This review paper is a simple theoretical study that enlightensfeatures of cooperative sensing approach in cognitive radio.

Keywords: Cognitive radio, Primary user (PU), Secondary user (SU).

I. INTRODUCTION

With the increase in wireless technologies there is no increase in radio spectrum and it has been limited. Every country's government agencies regulate and allocate limited spectrum to avoid interference. From studies it is clear that spectrum is not occupied completely many of the times and much of licensed band remains idle for durations which is a waste of available resource. Studies have proved that there exist unoccupied spaces in the given spectrum and these are considered as spectrum holes as is clearly shown in fig.1

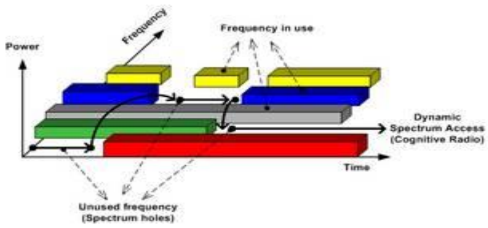

Fig 1: Figure specifying spectrum holes

These existence of spectrum holes motivate researchers to bring cognitive radio as new a field to efficiently utilize radio spectrum.According to studies policy of static spectrum allocation offers inefficient use of radio spectrum. Cognitive radio Allowsthe access to spectrum at the time when it is idle; thus efficiently utilizing the spectrum by filling while hole, not used by primary user or licensed user. Secondary users or unauthorised users use white hole when it is vacant or unused of PU thus maintaining Quality of Service for PU as they are the band owners. The cognitive radio balances between PU and SU, as it is always ready to serve SU at the same time promising acceptable interference level to the PU [1]. To achieve so, cognitive radio has to sense spectrum in an optimistic way to detect white holes,vacant bands.

Spectrum sensing performed by cognitive radio must find the presence or absence of PU. If a PU is found then the SU must immediately vacant the band for maintaining Quality of Service for PU. For spectrum sensing numerous techniques can be used likeradio identification base sensing, Matched Filter, Cyclostationary detection,energy detection,sensing with multiple antennas, waveform base sensing and cooperative sensing. Cooperative Spectrum sensing is the most sophisticated and preciseas per its mechanism in merging the results of sensing of many cognitive radio nodes optimizing the perception of surrounding environment to reach to the suitable decision of spectrum exploiting [2].

II. ASSOCIATED WORK

Cooperative sensing is the most accurate technique of spectrum sensing and thus many studies focus the area to find and analyse the features so that a better solution can be suggested that improves its sensing accuracy. Depending on the fusion center rule there are many approaches to cooperative sensing. SU send independently their spectrum sensing result to fusion centerwhere all the data is merging to enhance and improve decision making.

The fusion rules are AND, OR and Optimal rule which are differentiated on the basis of required capabilities in the fusion center and capacity of channel. However, specifically optimal fusion rule exceeds the AND and OR fusion rule as it increases the correct detection probability and decreases wrong opportunity detection probability.The advantages of that is demonstrated by the capability of reducing the cost, increasing control channel capacity and improving the sensing technique [3].

III. ENERGY EFFECT AND THROUGHPUT EFFECT AND PERFORMANCE IN COOPERATIVE SPECTRUM SENSING

Performance in cooperative sensing scheme relies on two parameters : the fusion scheme used and sensing time.Assuming that SU uses cooperative sensing to determine the PU’s presence with the k out of N fusion rule to provide appropriate level of protection to them. As theperformance of spectrum sensing depends on sensing time then the algorithm for cooperative spectrum sensing is designed so, that optimal values of sensing time and k can be found that maximizes throughput of SUs andyielding enough security to PUs. It is clear from simulation that at the optimal values of sensing time and fusion scheme there is substantial improvement in the throughput of SU. Optimal number of cognitive radios can be obtained under two scenarios: energy efficient and a throughput optimization setup. The cognitive nodes are minimized to k with all constraints as before in fusion energy setup rule. An optimization of maximum throughput is arranged by optimal time sensing method for cognitive radio system. Simulated result shows a better performance with OR and majority rules instead of AND rules in particulars to efficient energy [4].Cooperative sensing scheme’s expected performance is straightly effected by fusion center rule.Additionally,in cooperative spectrum sensing another study emphasises on the fusion center rules concerned over Rayleigh fading channel. Employing simulation, the performance has been examined through probability of missed detection versus differentprobability of false alarm values in Rayleigh fading channel. Cooperative sensing’s performance over relay fading is compared with the non-cooperative spectrum sensing. According to study ORrule is better than AND and MAJORITY rule in performance. Also, it has been observed that spectrum sensing is better when cooperation exists. [5]. A model using identical energy detectors with correlated log-normal random variables has been proposed and studied in order to optimize cooperative spectrum sensing and it combines the decision of individual nodes. A linear-quadratic (LQ) fusion scheme had also been designedbased on deflection. From simulation it is clear the LQ detector significantly outperforms the Counting Rule (the fusion rule obtained after ignoring the correlation). Also from simulation it is clear that though theobservations at the sensors are easily correlated, it is necessary to stabilize the correlation among the nodes tocombine the local decisions made at the SU.The LQ detector can also be used for general statistical models for the signals, as it requires only statistics of lower order moments of the correlated decision variables, which can be calculated simply.Better probability of detection couldbe achieved using LQ detector for a system containing a large number of cooperating nodes, without altering the thresholds at the cooperating users. However it is also possible that LQ detectors can be employed for cooperative users using higher level quantizers. But for this fusion center's task will become complex as calculating LQ detector moment will become complex[6]. Spectrum detection technique is improved by utilizing co-operative sensing schemewith better wireless environment variable determination technique.In fully modelled distributed consensus scheme an effective co-operative sensing schemeovercomes the fixed and random bidirectional connections between SU's. The modelled SU has the ability of initiation of co-ordination in local interaction without fusion node loaded centrally hence minimizing the probability of both missing detection and false alarm. Thus the above contribution shows improved performance and is being verified [7].It is obvious that the main task of cooperative sensing scheme is identifying and detecting PUs. In cooperative sensing scheme the sensitivity level needed for individual devices is reduced. Similarly many benefits are offered by cooperative scheme, but despite of so many benefits malicious users sending wrong sensing information can acutely deteriorate cooperative scheme performance. To reduce the harm caused by malicious users a technique has been proposed, simple and fast average scheme that detects malicious nodes and cancels its effect. Results of simulation differentiates proposed scheme users and malicious nodes [8]. Though cooperative sensing scheme is considered as potential sensing scheme, other sensing schemes like matched filter detection can prove efficacious in detecting signals from PU. As cognitive radio environment gets effected by sensing schemes, also BER performance is affected my modulation schemes [9].

V. CONCLUSION

Cooperative sensing is based on merging information from several nodes via fusion center rules and is used in complex environments and complicated situations.Thereare several techniques of sensing in cognitive ratio. Detecting primary users accurately is the main issue of cognitive radio and also the maodulation type used is quiet important parameter of cognitive radio as it effects BER.

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