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Performance Analysis of Opportunistic Cooperation Schemes in Cognitive Radio based WSN

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ABSTRACT
Driven by consumers' increasing interest in wireless services, demand for radio spectrum has increased dramatically. Opportunistic unlicensed access to the (temporarily) unused frequency bands across the licensed radio spectrum is currently being investigated as a means to mitigate the spectrum scarcity. Such opportunistic access calls for the implementation of safeguards so that the ongoing licensed operations are not interfered with. This paper demonstrated that cooperative diversity provides an effective approach to improve the transmission performance of the secondary user while ensuring the QoS of the primary user, and improve the value of performance parameter like throughput, reduce end to end delay etc.

Keywords: Cognitive radio, Spectrum sensing, Throughput, End to end delay.

INTRODUCTION
Cognitive radio technology has attracted considerable attention from both academia and industry due to its strong potential in dealing with the under-utilization of spectrum resources in wireless communications. In cognitive radio networks, unlicensed secondary users (SUs) can sense the operational environment periodically and exploit the primary users' (PUs') spectrum without degrading their performance, which greatly enhances the spectrum efficiency [1]. Spectrum sensing is the key enabling technology for cognitive radio networks.

The main objective of spectrum sensing is to provide more spectrum access opportunities to cognitive radio users without interfering with the operations of the licensed network [3]. One of the most important components of CR is the ability to measure, sense, learn, and be aware of the parameters related to the radio channel characteristics, availability of spectrum and power, interference and noise temperature, radio's operating environment, throughput, end to end delay, user requirements, and applications.

The detection performance of spectrum sensing schemes is usually compromised by destructive channel conditions between the target-under-detection and the cognitive radios, since it is hard to distinguish between a white spectrum and a weak signal attenuated by deep fading. In order to improve the reliability of spectrum sensing, radio cooperation exploiting spatial diversity among secondary users. In such scenarios, a network of cooperative cognitive radios, which experience different channel conditions from the target, would have a better chance of detecting the primary radio if they combine the sensing information jointly. In other words, cooperative spectrum sensing can alleviate the problem of corrupted detection by exploiting spatial diversity, and thus reduce the probability of interfering with primary users. Since cooperative sensing is generally coordinated over a separate control channel, efficient cooperation schemes should be designed to reduce bandwidth and power requirements while maximizing the sensing reliability [8].

The majority of the DSA systems use a dedicated global control channel to coordinate the spectrum allocation. However, this assumption is not realistic in opportunistic spectrum access since there may be no permanent channel available for secondary users. A distributed group coordination solution where a common control channel is only required locally by the neighbor nodes sharing common channels. A cluster based approach where a dynamic one-hop cluster is formed by users sharing common channels and the spectrum is managed by cluster heads [2].

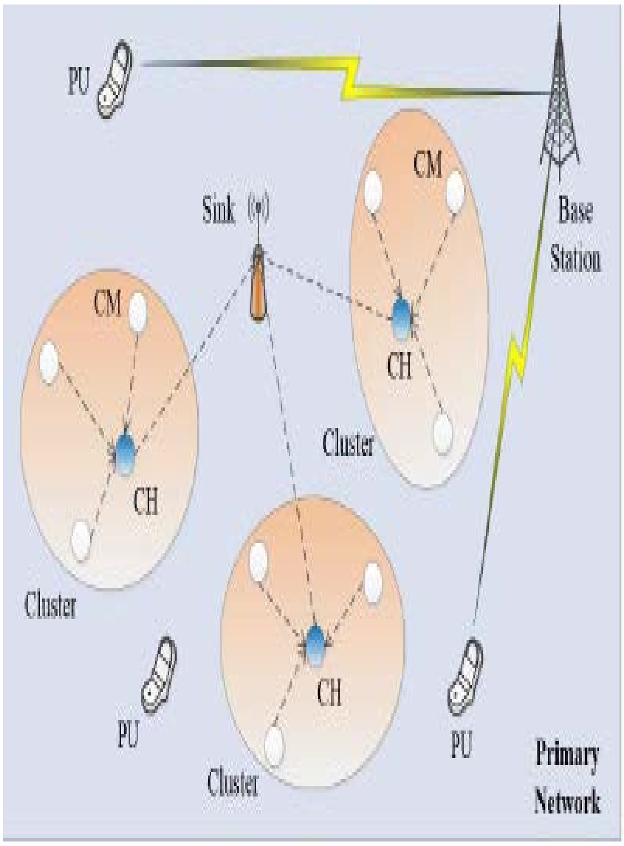

Fig 1: The architecture of CRSN [12].

In a fading environment, however, spectrum sensing is challenged by the uncertainty arising from the channel fading since the secondary user now has to distinguish between a white space, where there is no primary signal and a deep fade, where it is hard to detect the primary signal. As such, under channel fading, a single user relying solely on local (signal) processing may be unable to provide the detection sensitivity, required by the regulator, in a reasonable time limit. To tackle this issue, different secondary users may share their measurements and cooperatively determine whether the primary user is present [6]. We consider two types of users operating within a certain frequency band. The primary (licensed) users have the right to access the spectrum any time and their operation should not be compromised by any harmful interference caused by other systems. TV broadcasters, public safety users, cellular operators, and point-to point microwave links are examples of primary users. On the other hand, the secondary (unlicensed) users are allowed to access the spectrum on an opportunistic basis by identifying (through sensing) and utilizing only the white spaces. Secondary users may form an ad hoc network or communicate to a centralized access point [6].

Cognitive radio sensor networks (CRSN) are proposed to mitigate spectrum scarcity specifically in dense deployed sensor networks and enable distributed sensing over temporally unoccupied portions of the licensed spectrum. Incorporation of cognitive radio (CR) into distributed sensing requires sharing of spectrum opportunities among CRSN nodes while addressing event specific sensing requirements, while adhering to the inherited collaborative and energy- constrained nature of sensor networks. Furthermore, cognitive radio actor nodes can collect observations of CRSN nodes and cooperate to reach a global estimate, i.e., consensus [14].

As the demand for additional bandwidth continues to increase, spectrum policy makers and communication technologists are seeking solutions for the apparent spectrum scarcity. Meanwhile, measurement studies have shown that the licensed spectrum is relatively unused across many time and frequency slots [7]. To solve the problem of spectrum scarcity and spectrum underutilization, the use of CR technology is being considered because of its ability to rapidly and autonomously adapt operating parameters to changing requirements and conditions.

The rest of this paper is organized as follows in the first section we describe an introduction of about the wireless sensor and cognitive radio network. In section II we discuss about the spectrum sensing in wireless sensor networks. In section III we discuss about the comparative experimental study for the existing and proposed methods, finally in section IV we conclude the about our paper which is based our complete comparative result study and the future scope.

II SPECTRUM SENSING

Spectrum sensing enables the capability of a CR to measure, learn, and be aware of the radio's operating environment, such as the spectrum availability and interference status. When a certain frequency band is detected as not being used by the primary licensed user of the band at a particular time in a particular position, secondary users can utilize the spectrum, i.e., there exists a spectrum opportunity. Therefore, spectrum sensing can be performed in the time, frequency, and spatial domains. With the recent development of beam forming technology, multiple users can utilize the same channel/frequency at the same time in the same geographical location. Thus, if a primary user does not transmit in all the directions, extra spectrum opportunities can be created for secondary users in the directions where the primary user is not operating, and spectrum sensing needs also to take the angle of arrivals into account [2]. Primary users can also use their assigned bands by means of spread spectrum or frequency hopping, and then secondary users can transmit in the same band simultaneously without severely interfering with primary users as long as they adopt an orthogonal code with respect to the codes adopted by primary users. This creates spectrum opportunities in code domain, but meanwhile requires detection of the codes used by primary users as well as multipath parameters. Spectrum management is an important functionality in cognitive radio networks which involves dynamic spectrum access/sharing and pricing and it aims at satisfying the requirements of both primary and secondary users [15].

III EXPERIMENTAL RESULT ANALYSIS

In this paper we propose a cooperation scheme with time slot handing over in cognitive radio networks. Under the proposed scheme, the SU will either help forward the PU's packets, or transmit its own packets based on a priority factor. We analyze the probability of time slot handing over due to buffer empty, based on which the average service rates of buffers at the SU are calculated. Combining the packet arrival rates and the service rates, we further obtain the buffers' steady state probabilities and calculate the average buffer length. Here we compare two methods such as Opportunistic Cooperation Schemes with Buffer added Network and proposed methods. Our proposed method shows better results than the previous methods.

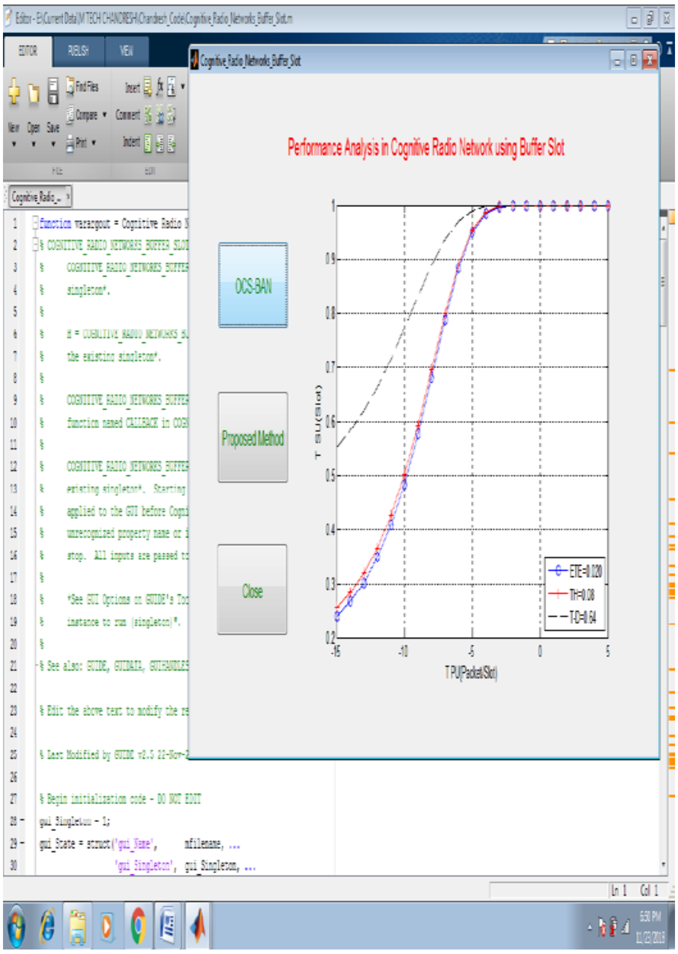

Fig 2: This windows shows that the Opportunistic cooperation schemes with Buffer added Slot in wireless sensor network.

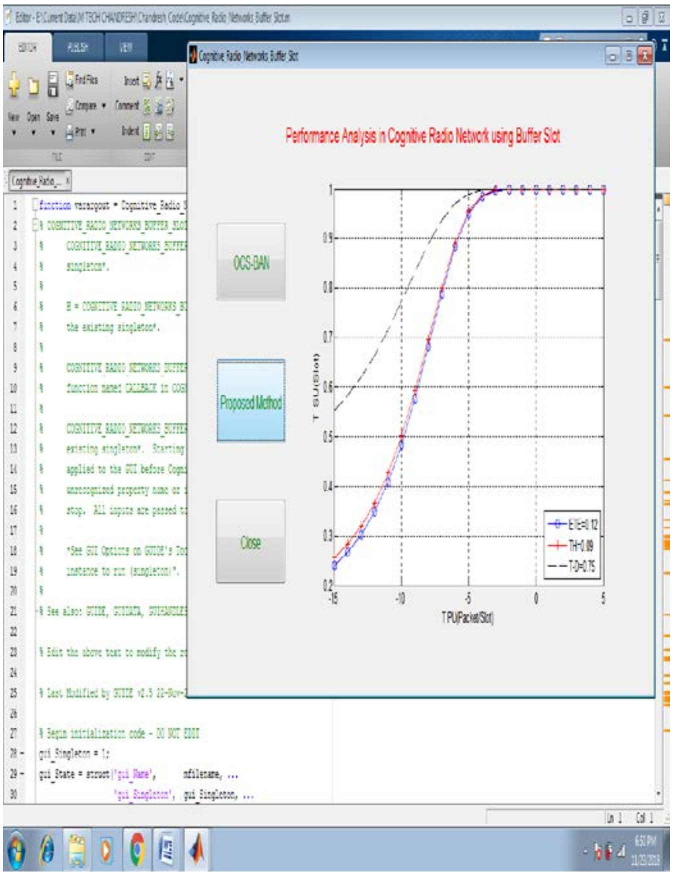

Fig 3: this windows show that the Proposed methods for Opportunistic cooperation schemes in wireless sensor network.

IV CONCLUSIONS AND FUTURE SCOPE

With the increasing demand for radio spectrum on one hand and inefficient usage of the licensed bands on the other, a reform of the spectrum access policy seems inevitable. Opportunistic spectrum access is envisioned to resolve the spectrum scarcity by allowing unlicensed users to dynamically utilize white spaces across the licensed spectrum on a non interfering basis. In this paper we consider the probability of time slot handing over due to buffer empty and calculate the steady state probabilities, based on which the average buffer length, the stable throughput region, and the end-to-end transmission delay are derived. In our future research, we plan to jointly consider relay selection and channel assignment to enhance the dynamic spectrum access efficiency.

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