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An Overview of Cognitive Radio Architecture

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Abstract: Cognitive Radio (CR) is a technique which is used to improve the utilization of the radio spectrum. It is a software controlled radio that senses the unused frequency spectrum at any time. The main problem in wireless sensor network was spectrum crowding, due to which there is inefficient utilization of available spectrum. In this paper WSN, spectrum crowding in WSN and a new architecture is suggested that is Cognitive Radio, which can give better resource utilization.

Keyword: wireless sensor network, spectrum crowding, cognitive radio, re-configurability, cognitive capability, cognitive cycle.

I. INTRODUCTION

Wireless networks are characterized by a fixed spectrum assignment policy. The limited available spectrum and the inefficiency in the spectrum usage necessitate a new communication paradigm to exploit the existing wireless spectrum opportunistically. Cognitive Radio (CR) networks are a technology advanced to solve the problem of spectrum scarcity [1]. In CR networks, the spectrum bands (i.e., radio channels) are exclusively reserved for use by licensed users, called Primary Users (PUs). The available channels not being used by PUs can be temporarily used by unlicensed users, called Secondary Users (SUs) [2]. Secondary users are allowed to use the licensed bands without causing interference to the licensed or primary users [3],[4].

II. SPECTRUM CROWDING IN WSN

The usable electromagnetic radio spectrum-a precious natural resource-is of limited physical extent. However, wireless devices and applications are increasing daily. It is therefore not surprising that we are facing a difficult situation in wireless communications. Moreover, given the reality that, currently, the licensed part of the radio spectrum is poorly utilized [5], this situation will only get worse unless we find new practical means for improved utilization of the spectrum. Cognitive radio, a new and novel way of thinking about wireless communications, has the potential to become the solution to the spectrum underutilization problem [6], [7].

III. COGNITIVE RADIO CHARACTERISTICS

There are two important characteristics of Cognitive Radio that are cognitive capability and Re-configurability.

A. COGNITIVE CAPABILITY

Cognitive capability is the capability to get the information about the unused spectrum in the radio environment so as to provide the cognitive users with best operating parameters to use the spectrum efficiently without any interference to the primary users. This capability makes it versatile and efficient to interact with the real radio environment in order to detect appropriate communication parameters that are necessary for cognitive users to use [8].

B. RECONFIGURABILITY

The re-configurability of a cognitive radio is the capability of programming the radio dynamically without any modification in hardware components. Cognitive radio can be programmed to be used as transmitter or receiver, also in different frequency or cognitive radio can use different modulation techniques with variable transmission power with respect to the communication link. This capability is realizable as an intrinsic result of the development of software-defined radio (SDR)

platform which is a fully reconfigurable wireless device that is able to adjust its communication parameters in response to either network or user demands. A software-defined radio (SDR) system is a radio communication system which can tune to any frequency band and receive any modulation[9].

IV. COGNITIVE CYCLE

A typical duty cycle of CR, as illustrated in Fig.1.1, includes detecting spectrum white space, selecting the best frequency range, coordinating spectrum access with other users and vacating the frequency when a primary user appears. Such a cognitive cycle is supported by the following functions:

- Spectrum sensing and analysis;
- Spectrum management and handoff;
- Spectrum allocation and sharing.

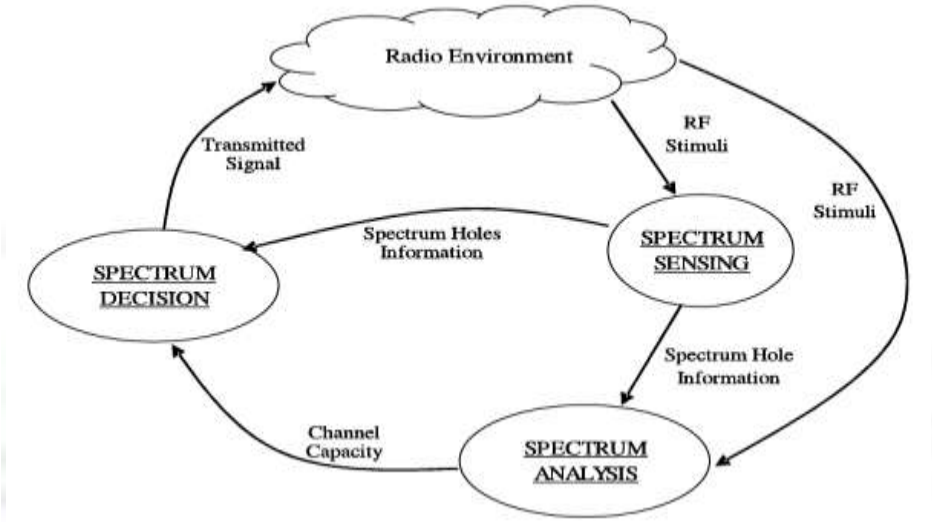

Figure 1.1: Cognitive cycle

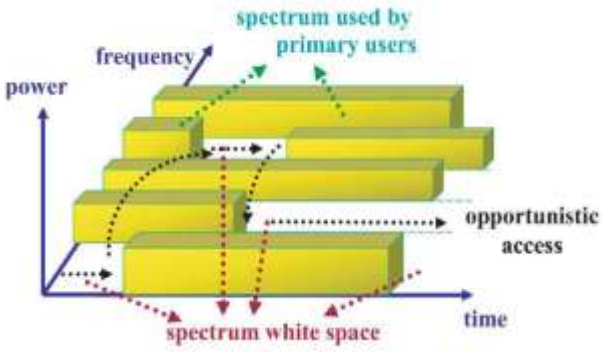

Fig.1.2: Illustration of spectrum white space

Through spectrum sensing and analysis, CR can detect the spectrum white space (see Fig.1.2), i.e., a portion of frequency band that is not being used by the primary users, and utilize the spectrum [10]. On the other hand, when primary users start using the licensed spectrum again, CR can detect their activity through active sensing, so that no harmful interference due to secondary users' transmission. After recognizing the spectrum white space by sensing, spectrum management and handoff function of CR enables secondary users to choose the best frequency band and hop among multiple bands according to the time varying channel characteristics to meet various Quality of Service (QoS) requirements. A good spectrum allocation and sharing mechanism is critical to achieve high spectrum efficiency [11]. Since primary users own the spectrum rights, when secondary users exist in a licensed band with primary users, the secondary user's interference

level should be limited by a certain threshold. When many secondary users share a frequency band, their access should be co-ordinated to avoid collisions and interference.

V. CONCLUSION

Spectrum is a very valuable resource in wireless communication systems and it has been a major research topic from last several decades. Cognitive radio is a promising technology which enables spectrum sensing for opportunistic spectrum usage by providing a means for the use of white spaces. Considering the challenges raised by cognitive radios, the use of spectrum sensing method appears as a crucial need to achieve satisfactory results in terms of efficient use of available spectrum and limited interference with the licensed primary users.

As described in this paper, the development of the cognitive radio network requires the involvement and interaction of many advanced techniques, including spectrum sensing, interference management, cognitive radio reconfiguration management, and cooperative communications. Furthermore, in order to fully realize the CR system in wireless communications for efficient utilization of scarce RF spectrum, the method used in identifying the interference and/or spectrum sensing should be reliable and prompt so that the primary user will not suffer from CR system to utilize their licensed spectrum.

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