Chapter 7
Spectrum Sensing Techniques: An Overview

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ABSTRACT

Cognitive radio has come a long way in the recent years with the advent of improved algorithms and instrumentation. However, for ease and efficient working of cognitive radio, there is a need to have effective detection of spectrum sensing. The objective of spectrum sensing techniques is to find spectrum holes which can be accessible by the users of cognitive radio. The deployment of suitable sensing techniques reduces undesirable congestion in traffic and enhancement of spectrum usage. All these require sensing techniques whose main goal is oriented towards efficient identification and subsequent deployment of spectrum. This chapter is aimed to give a brief overview of some spectrum sensing techniques. An attempt is made to give the characteristics of the highly deployable sensing schemes. Accordingly, the merits and demerits are comprehensively highlighted. Further, emphasis has been given to relevant future challenges.

INTRODUCTION

Cognitive radio has come a long a long way since its inception. In wireless communication, there is constant demand of either extra bandwidth or efficient bandwidth. In such cases, cognitive radio helps in identification of unused spectrum without causing any deterrence to the functional environment. It complements the existing wireless communication networks by optimizing the licensed frequency bands with a view to improving quality of services. This necessitates the effective deployment of spectrum utilization. Again, in order to effectively utilize the spectrum, there must be a way to find out holes in spectrum. Here, spectrum holes refer to unutilized portion which remain unutilized by primary user. These holes are to be provided access to be used by secondary user in right time and location. As a whole, there is a need of a reliable technique that's main objective is to detect the idle spectrum. In this direction, cognitive radio has come a long way in implementing effective monitoring of spectrum usage. Being endowed with adaptability with a varying radio environment, the CR users avail the liberty

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of using spectrum which is licensed in an opportunistic way, albeit not causing any interference with licensed users. This reduces undesirable congestion in traffic and enables enhancement of spectrum usage. All these require sensing techniques whose main goal is oriented towards efficient identification and subsequent deployment of spectrum. This chapter is aimed to give a brief overview of some spectrum sensing techniques, outlining modus operandi as well as relevant future challenges.

CHARACTERISITCS OF SPECTRUM SENSING

There are two types of users, one is primary user and the other is secondary user. Primary users are categorized as licensed users whose frequency bands are already allocated. On the other hand, secondary users fall in the category of opportunistic users. Since they basically utilize the unallocated frequency bands or unlicensed portion, hence there is always greater demand to find the spaces. The function of exploring holes in frequency bands which is solely licensed to primary user, for opportunistic user by networks in secondary category is referred to as spectrum sensing. This is indeed a vital point which directly influences the cognitive radio. With this, cognitive radio becomes capable of adapting itself to neighboring environment, thereby tracking holes in spectrum. Whatever the unused potion exists after monitoring the available spectrum bands, the CR user also ensures that the communication is within their reach.

SPECTRUM SENSING METHODS

There are several ways of sensing spectrum. Chiefly, it is categorized into two-namely co-operative and non-co-operative. However, there arises another classification known as Interference based sensing. It is depicted in Figure 1. Again, the co-operative sensing is split into three ways, viz., matched filtering, energy detection and cyclostationary detection. In the following section, the sensing techniques are elaborated.

Matched Filtering

One of the effective ways of spectrum sensing is conceived by Matched Filtering. As it requires very less time for detection with considerable accuracy, there is much enhancement in the signal to noise ratio. Generally, it triggers probability of false alarm or probability of missed detection within a very

Figure 1. General Classification of Spectrum Sensing Techniques