ZONE-BASED SENSING SCHEDULING APPROACH IN COGNITIVE RADIO SPECTRUM SENSING

by

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# ABSTRACT

Project Name : Zone-Based Sensing Scheduling Approach in Cognitive Radio

Spectrum Sensing

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Summary :

**Cognitive radio (CR)** improves spectrum efficiency by enabling CR users to opportunistically reuse the idle spectrum bands of licensed users, i.e., primary users. To avoid causing interference to the primary users, spectrum sensing, which detects idle licensed bands, is one of the most important issues.

**Spectrum Sensing**: detecting the unused spectrum and sharing it without harmful interference with other users. It is an important requirement of the Cognitive Radio network to sense spectrum holes. Detecting primary users is the most efficient way to detect spectrum holes. Spectrum sensing techniques can be classified into three categories:

* *Transmitter detection*: cognitive radios must have the capability to determine if a signal from a primary transmitter is locally present in a certain spectrum. There are several approaches proposed:
  + matched filter detection
  + energy detection
  + cyclostationary feature detection
* *Cooperative detection*: refers to spectrum sensing methods where information from multiple Cognitive radio users is incorporated for primary user detection.
* *Interference based detection*.

In this project we will implement a simulator to analyze and optimize the efficiency of ***Zone-Based Sensing Scheduling in Cognitive Radio***. The project will construct a CR cell and zones in this cell. Then it will generate primary and secondary users both trying to communicate in the cell. It will measure the performance of the system with respect to various parameter sets. Here we assume that the secondary users use energy detection method for spectrum sensing.

# 1. INTRODUCTION

In today’s world, wireless technologies are the basic mean of the communication. Obviously these technologies utilize available wireless channel bands which can be divided into two main groups. These groups are licensed bands and unlicensed bands. Most of the available spectrum is already allocated to current wireless technologies to communicate. However, these bands are not well utilized. So, even though there is available bandwidth to communicate for other emerging technologies since the bands are already allocated to previous technologies, these new technologies cannot have their own frequency bands.

Cognitive Radio (CR) has emerged as a solution for this problem. CR does not require its own licensed band instead it uses unutilized available portion bandwidth of other current technologies. CR’s communication is based on detecting spectrum holes of licensed or unlicensed users’ bandwidths. That is, it uses other technologies’ bandwidths while they are not using it themselves. During the communication of CR if a licensed (primary) user tries to use its own bandwidth, CR user changes its communication parameters, such as communication frequency, medium access protocol, to communicate from another available band. This whole communication cycle of CR contains four phases:

* *Spectrum Sensing:* A CR monitors the available spectrum bands, captures their information, and detects the spectrum holes.
* *Spectrum Decision:* Based on the spectrum availability, CR users can determine a channel. This operation not only depends on spectrum availability, but it is also determined based on internal (and possibly external) policies.
* *Spectrum Sharing:* Multiple CR users try to access the spectrum. CR network access should be coordinated in order to prevent multiple users colliding in overlapping portions of the spectrum.
* *Spectrum Mobility:* CR users are regarded as “visitors” to the spectrum. If primary users need a specific portion of the spectrum, then the CR users must continue in another vacant portion of the spectrum.

Among these phases spectrum sensing is one of the most important, difficult, and costly task. Because in case of miss detection both primary users’ and CR users’ communication will be garbage. On the other hand, in case of false alarm CR users will not use available channel although there is no primary user uses it, which will cause underutilization of available bandwidth. Due to these problems, in our project we try to optimize performance of spectrum sensing.

# 2. COGNITIVE RADIO SPECTRUM SENSING

In spectrum sensing acknowledgment of spectrum sensing results from each of the cognitive users suffices a broad bandwidth since all of them will try to announce their own measurements at the same time.

Moreover, all collaborative sensing of spectrum in whole cell would cause some inefficient situations in spectrum sharing. For example, while in some region of the cell a frequency is not available, in some other regions it may be available. However, since spectrum sensing is done collaboratively in the entire cell it will be decided that if one frequency is not available in some region of the cell, it is not available anywhere. This situation will cause underutilization of available spectrum, and so inefficiency in bandwidth allocation.

In our project we develop a simulator to measure the performance of zone-based spectrum sensing approach and to optimize it. In zone based approach a cognitive radio cell is divided into sectors, sectors are divided into slices, slices are divided into sections. This final division constructs zones in the cell.

In each zone all CR users broadcasts their sensing measurements with low power. The first CR user who makes its broadcast declares itself as *leader* of zone. Since all CR users in the zone can hear each other, the leader will have the information about spectrum sensing measurements of other users in the zone. Therefore, the leader alone will have the information of sensing results in the entire zone. Hence, only leader’s acknowledgement to CR base about sensing result is necessary to acknowledge the base station. Consequently, instead of acknowledgement from all users in the zone only by making leader acknowledge the CR base station, the bandwidth requirement of spectrum sensing result acknowledgement will be minimized.

The zone-based spectrum sensing approach also produces a solution to second problem mentioned above. Since the sensing results are reported for each zone separately the CR base station can keep track of available frequencies for each zone separately. By doing so, it can decide a frequency as available in one zone while it is not in another. So, it can utilize that frequency also by assigning it to available zone.

# 3. GENERAL DESIGN OF THE SOFTWARE

The simulation software we developed so far consists of two main modules.

# 4. DESIGN OF THE CLASSES

# 5. CONCLUSION

# BIBLIOGRAPHY