IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 63-67

Full-Duplex Cognitive Radios: From The Energy Efficiency Perspective

[1]Priya.S, [2]Mr. Anandan, M.E.
PG Student Communication System, Dhanalakshmi Srinivasan College Of Engineering
(Hod) Supervisor & Asso.Prof Dhanalakshmi Srinivasan College Of Engineering

Abstract: *In traditional cognitive radio networks (CRNs), the interweave, underlay, overlay and hybrid spectrum sharing schemes are only spectrum-efficient in specific circumstances. In order to improve the robustness of spectrum sharing schemes in a dynamic traffic environment from the perspective of energy efficiency, adaptive spectrum sharing schemes are proposed in this work for both half-duplex (HD) and full-duplex (FD) CRNs. The proposed schemes allow the secondary users (SUs) to adaptively access the licensed spectrum, provided that PUs' traffic arrives at a low rate and energy efficiency gains exist. Based on the intermittent nature of the arrival and departure processes for PUs' traffic, closed-form expressions of energy efficiency for the traditional interweave, underlay, overlay, hybrid and the proposed schemes are investigated for both half-duplex and full-duplex modes. By defining energy efficiency loss, the impacts of the spectrum sensing error and channel estimation error are analyzed to evaluate the energy efficiency of the proposed schemes. Theoretical analysis shows that the proposed adaptive spectrum sharing schemes improve the minimum energy efficiency in HD mode and improve the overall energy efficiency in FD mode. The numerical results validate the energy efficiency improvements and the robustness of the proposed schemes*.

I. Introduction

Introduction:

Cooperative wireless networks are a promising technology for future communication systems because cooperation in ad hoc networks can save limited network resources, including energy savings. In the last decade there has been a large ongoing research effort in this field. Cooperative techniques in wireless communication networks are the means to adopt the diversity, which is inherent in a wireless medium. The diversity achieved in a communication system, w hen such techniques are implemented, can be in code, frequency, space and time domains. The goal of cooperative diversity is to increase the reliability and the quality of service (QoS), coverage area range, and the data throughputs as well as improve the spectral efficiency of the wireless networks while prolonging the life of the nodes or user terminals by increasing energy efficiency. In a network consisting of independent users (ad hoc networks), achieving full diversity depends on the successful use of distributed coding and routing algorithms.

Cognitive Radio Techniques:

Cognitive radio techniques provide the capability to use or share the spectrum in an opportunistic manner. Dynamic spectrum access techniques allow the cognitive radio to operate in the best available channel. More specifically, the cognitive radio technology will enable the users to (1) determine which portions of the spectrum is available and detect the presence of licensed users when a user operates in a licensed band (spectrum sensing), (2) select the best available channel (spectrum management), (3) coordinate access to this channel with other users (spectrum sharing), and (4) vacate the channel when a licensed user is detected (spectrum mobility).

- **Spectrum sensing**:

Detecting unused spectrum and sharing the spectrum without harmful interference with other users.

- **Spectrum management:**

Capturing the best available spectrum to meet user communication requirements.

- **Spectrum mobility:**

Maintaining seamless communication requirements during the transition to better spectrum.

- **Spectrum sharing:**

Providing the fair spectrum scheduling method among coexisting 4G users.

Cognitive Radio:
Cognitive radio technology is the key technology that enables an 4G network to use spectrum in a dynamic manner. The term, cognitive radio, can formally be defined as follows

Cognitive capability:
Cognitive capability refers to the ability of the radio technology to capture or sense the information from its radio environment. This capability cannot simply be realized by monitoring the power in some frequency band of interest but more sophisticated techniques are required in order to capture the temporal and spatial variations in the radio environment and avoid interference to other users. Through this capability, the portions of the spectrum that are unused at a specific time or 4 location can be identified. Consequently, the best spectrum and appropriate
operating parameters can be selected.

Relay Channel:
In this chapter, the shared relay, one of the identified sub networks in Section 1.2, is addressed. The system model is depicted in Fig. 5.1, and consists of two base stations, B 1 and B2, and two terminals, T1 and T2, that are paired such that Bi and Ti , with i ∈ {1, 2}, wish to attain two - way communication. All nodes are assumed to be half - duplex, there are no direct links between the base stations and the terminals. The relay and the base stations are each equipped with 2M antennas and the terminals have M antennas.

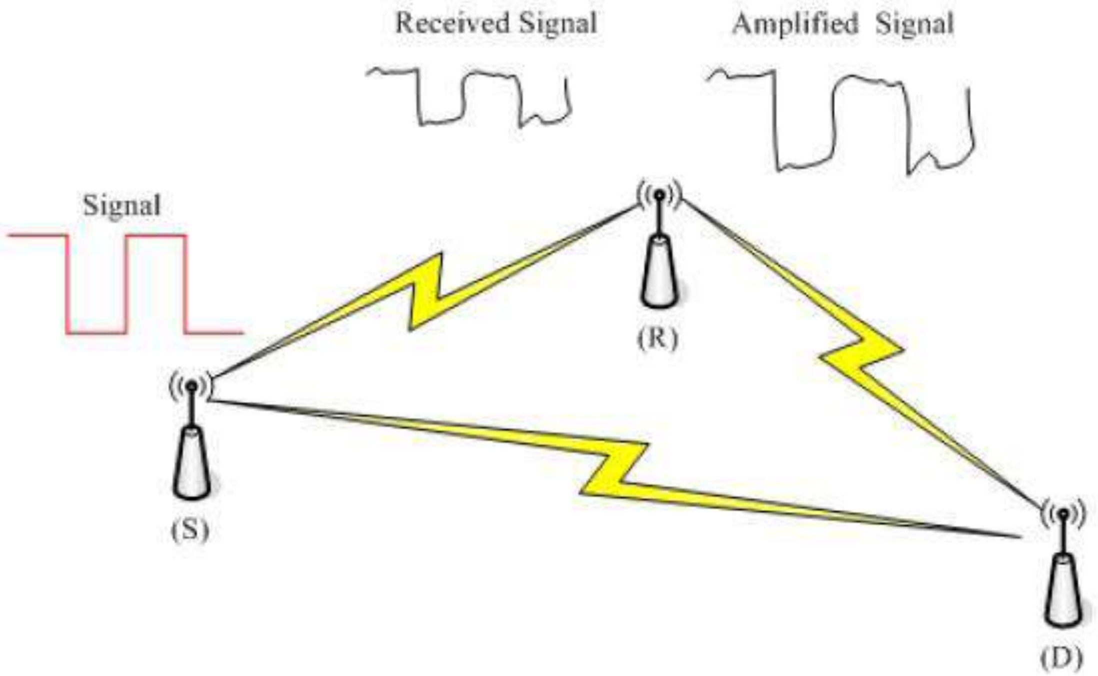

Fig 1.1 relay based network

In this network, the rates of each of the communication flows are denoted by Ri and RBi , i.e. the rate of the communication flow from terminal i to base station and from base station i to terminal i, respectively. The objective is to find the best achievable rates subject to a certain performance metric. In this thesis, the Weighted Minimum Rate (WMR) performance metric is used. The metric is defined as

WMR(RB1, R1, RB2, R2) = min(w1R1, wB1RB1, w2R2, wB2),

Amplification Factors:
In the derivation of the scheme, there are four amplification factors, $\eta(n)$, $\eta(c)$, $\gamma(n)$ and $\gamma(c)$, that distributes the power among the subspaces S(n) and S(c) in MA - and BC - phase, respectively . The objective is to choose these parameters along with the division constant α in such a way that the rates achievable using the scheme are maximized. To make the terminals and relay use the available power, the power of the signals in

(3.3),(3.5), (3.10) and (3.14) are computed and equated to the power constraints, yielding the following equations.

$$\frac{1}{n}\hat{\mathbf{x}}_b^{(j),\mathrm{H}}\hat{\mathbf{x}}_b^{(j)} + \tilde{\mathbf{x}}_b^{(j),\mathrm{H}}\tilde{\mathbf{x}}_b^{(j)}$$

Cognitive Overlay Networks:

Here we consider a cognitive overlay channel with instantaneous power scaling amplify – and - forward relaying as shown in Fig. 1, with TX and RX denoting the transmitter and receiver, respectively. Channel coefficients h0, h1, h2, h3, and h4, shown in Fig. 3.1, are estimated at the receivers. Channel estimation is not specific to our method. Denote PU' s message by x1(t) and the relayed PU's message by the SU as x2(t). The receiving module of SU TX has noise n ST .

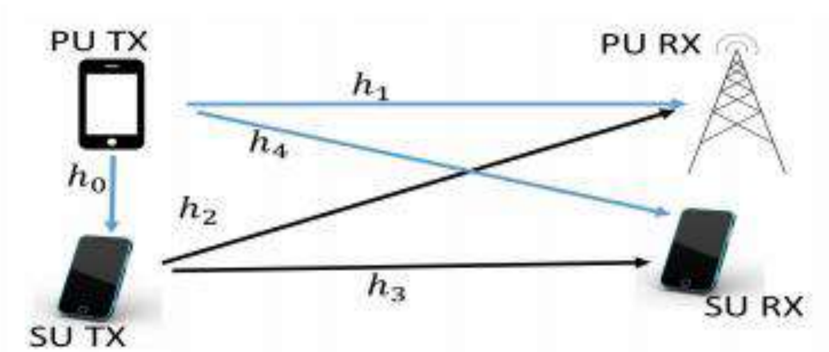

Fig 3.1 Cognitive overlay channel with the SU

System Model

In this section, it will be attempted to illustrate how system works. TABLE 1 will facilitate the illustration of this method. We have all the possible cases of 4 bits transmission. When one antenna is employed then a 16 - Quadrature Amplitude Modulation (16-QAM) constellation signal will be used so as to map bits into symbols. In the case now that 2 antennas are deployed each antenna will be designated to transmit a lower constellation sig nal namely an 8
QAM.

Hybrid A F Relaying

The main promise of overlay CRN is to provide an acceptable SINR for the PU (by choosing the right α) and use 1 − α of the power for the SU. We verified through simulations that the PU received SINR in asynchronous overlay CRNs is greater than that in synchronous overlay CRNs. Since time - asynchrony in overlay CRNs results in better SINR at the PU receiver, the constant α can be less than that of synchronous CRNs. As such, 1 − α, which is the amount of power allocated to transmit the SU's message, becomes larger.

Maximum Likelihood (ML) Detector

The r esultant DeF –CR is capable
of striking a flexible tradeoff in terms of
the achievable
BER, complexity and unequal error protection
.
Moreover, by
exploiting the benefits of our
low
-
complexity relaying protocols and inter
-
element
interference (IEI) model, th
e destination node (DN) is
capable of jointly detecting

the signal received from the
SD and RD links using the proposed low
-
complexity
maximum
-
likelihood (ML) detector.

II. Results:

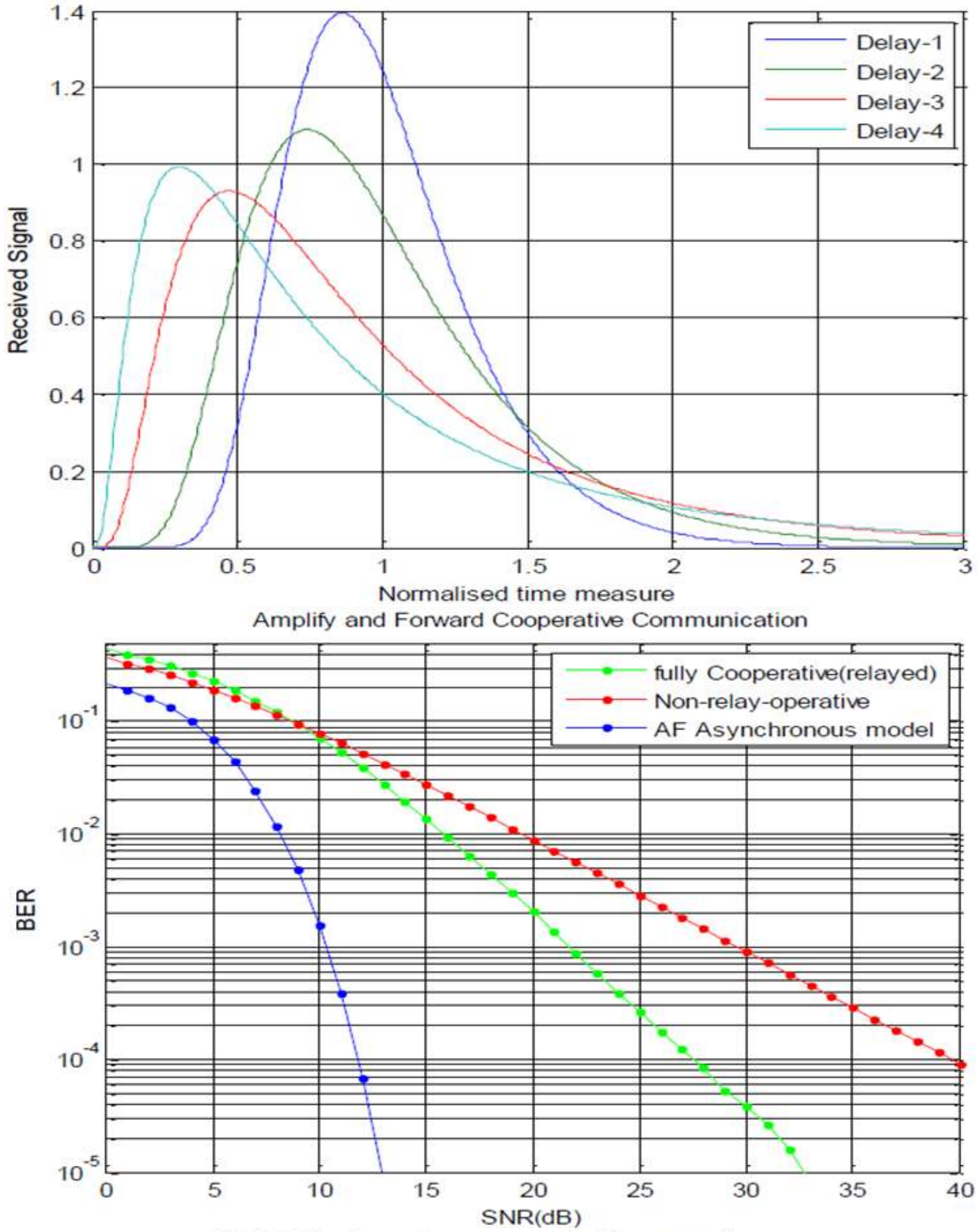

Fig. 5.1 Signal strength over propagation distance metrics

III. Conclusion

In this paper we analyzes the improved BER performance of asynchronous transmission in cognitive radio networks with and without realy based transmissions for different rate of modulations. We proved that for a given modulation we can achieve various Qos service by varying transmission distance . We showed that asynchrony in overlay CRNs results in enhanced SINR at the PU and SU receivers. This reduces the portion α of the SU power dedicated to relaying the PU's message, in exchange for spectrum sharing between the PU and SU.

IV. Future Work

Here SU with maximum possible mapping rate is used for high throughput based on spectrum availability. If we use ML detector for 64-QAM leads overall system complexity. By using suboptimal detectors number of constellation point are divided & detected separately using suboptimal detectors. The performance of the suboptimal detectors is very close to ML performance.