International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.5., 2015
(Sept.-Oct.)

RESEARCH ARTICLE

ISSN: 2321-7758

ANALYSIS & DELAY MINIMIZATION IN COGNITIVE RADIO BY ROUTER AND RESOURCES ALLOCATION

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ABSTRACT
This paper studies the disjoint design scheme of routing and resource allocation algorithms in cognitive radio. Router and resources is find shortest path for fast delivery of packet through the unused spectrum. Prior to each transmission, mesh nodes sense the wireless channel to identify available spectrum resources. Available spectrum very according to primary user activities and traffic characteristics that time the routing and resource allocation algorithms have to deal with to guarantee timely delivery of the network traffic. To focus the channel availability dynamics, the system is analyzed from a queuing theory perspective. Mainly our aim is to minimize the aggregate end-to-end delay of all the network flows. A distributed solution scheme is developed based on the Lagrangian dual problem. It is shown that the disjoint design scheme can accommodate double the traffic load, or achieve half the delay compared to joint method. Results demonstrate the performance of our proposed algorithm, as well as the efficiency of the decentralized implementation.
Keywords - Distributed resource optimization, cognitive mesh networks, joint routing and channel allocation, delay minimization.

1 INTRODUCTION

1.1 Introduction of cognitive radio

Cognitive radio is an intelligent radio that automatically detects available channels in wireless spectrum and accordingly changes its Parameters. CR n/w continuously senses the electromagnetic spectrum and detects the unused spectrum to share without harmful interference to primary user (Licensed spectrum). CR transmits packets (data) at same time and same bandwidth as like primary link. Available spectrum resources will vary between mesh transmission attempts, posing a challenge that the routing and resource allocation algorithm have to deal with to guarantee timely delivery of network traffic. To check the channel availability dynamics, the system is analyzed from a queuing theory perspective, and connect route ring and resource allocation problem as a Non-linear integer programming problem.

The main is to focus on minimize the aggregate end to end delay of all the network flows. A distributed solution scheme is developed based on the lagrangian dual problem. Joint and disjoint scheme is compared using QPM (Quadrature phase modulating) and QAM (Qauadrature Amplitude modulation) which is shows the performance result and conclusion of delay and resources in cognitive radio.CR Network is firstly recognized and then take

decision about path is followed and sent data to the destinations through unlicensed spectrum.

Cognitive radio is a hope able technology aiming at better spectrum utilization by prescribing the coexistence of licensed which is primary spectrum and unlicensed radio nodes on the same bandwidth which is secondary network and self cognitive radio [1]. One of the point challenges in cognitive radio networks is the design of dynamic spectrum allocation algorithms that enable opportunistic access to the wireless spectrum. In [2] and [3] the cognitive radio problem was investigated from an information theoretic standpoint, where the cognitive transmitter is assumed to transmit at the same time and on the same bandwidth of the primary link using complex pre-coding techniques. The concept of a time spectrum block was introduced in [4] and protocols to allocate such blocks were proposed. In [5] the authors derived optimal and suboptimal distributed strategies for channel sensing and access under a Partially Observable Markov Decision Process (POMDP) frame work. The concept of cognitive radio is desirable for a wireless mesh network (WMN) in which a large volume of traffic is expected to be delivered since it is able to utilize spectrum resources more efficiently. Therefore, it improves network capacity significantly. However, the dynamic nature of the radio spectrum calls for the development of novel spectrum-aware routing algorithms.

1.2 Network model

A cross layer joint design scheme is used router and resource allocation protocol and in cognitive radio based WMNs (Wireless mess network). In joint cross design, optimizing two independent layer, which is leads to suboptimal solution at best. For instance, consider three nodes network illustrated fig1.2a network channal idle probability. A time slot and a channel pair (t, c), is considered as the minimum unit for resource allocation, we will call it resource element. A cognitive mesh node senses its assigned channel c at the beginning of each time slot t. If the channel is detected as idle, the node transmits a packet to the next node along the route to the destination, otherwise it remains silent and keeps sensing the channel in subsequent time slots. For simplicity, we will assume that cognitive nodes have access to perfect spectrum sensing information. As it will be shown later, the case of imperfect sensing can be easily incorporated into tussle problem formulation. The receiving node acknowledges the successful reception of a packet by transmitting an ACK packet back to the transmitter.

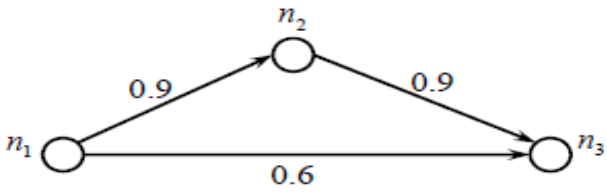

Fig - 1.2 a. Network channel idle probability

Node n_1 as source and n_3 as destination and we need to select short route through direct and indirect path for packet sending. These paths are choose at the base of Idle primary channel(i.e. transmission opportunity) as well as number of link probabilities as a route matrix and through the half duplex network. When link is follows through the route matrix indirect path will be chosen because it is more reliable path. Otherwise it choose indirect path then packet will go to n_3 node through the n_2 node, for each link indirect path is active for 50% of the time and since the channel is available for 90% of the time, then each link on the indirect path can only be active for 45% of the time. This means direct link is more preferable to forward the packets when it will active 60% of the time and resulting will provide higher throughput.

A path which is followed by the route matrix as direct link is formulated as an optimization problem having as objective minimize of and to end delay and having integer valued decision variables as formulated, optimization problem is a non-linear integer programming (NIP) problem which is combinatorial complexity. Finally Lag Ran Gain dual function used in this function, distributed solution to the optimization problem is presented. Therefore, the performance is compare to the performance of disjoint protocol.

A disjoint protocol solves firstly routing problem and then allocates resources along the constructed routes. The resources allocation main aim at minimizing the end to end delay with the preselected routes.

1.3 Channel model

The wireless channel between a node and its destination is modeled as a Rayleigh flat fading channel with additive white Gaussian noise [12]. Success and failure of packet reception is characterized by outage events and outage probabilities. Details of the channel model and outage probability calculation can be found in [12] and [10].

1.4 *Queuing model*

Each node in the cognitive mesh network has an infinite buffer. Buffer is used for storing fixed length packets. The packet transmission time equals to one time slot duration. Multiple data streams are present in the network. For data stream f having node n as source, packet arrivals at the source are modeled as a stationary Bernoulli process with i.i.d arrivals from slot to slot and mean λ_u^f [13]. In other words, the probability that a new packets arrives at any given time slot t is λ_u^f. Moreover, the packet arrival processes are assumed to be independent from one data stream to another. The state of any of the N primary channels is modeled using a two state Markov chain (idle and busy). Using the stationary distribution of the Markov chain, at any given time slot, channel c will be idle (Markov chain in the idle state) with probability αc.

1.5 Joint routing and resource allocation strategy

The main purpose of Route and Resource allocation strategy is to find the best route and resource allocation strategies in order to minimize the average end to end delay of multiple data in the CR based WMN (wireless mess network). Available spectrum in cognitive mesh network are varying in both space and time due to primary node activity. Therefore, a successful routing strategy will have to work closely with the resource allocation strategy for make sure that any selected route will have enough resources available to guarantee the required quality of services. We proposed to deal with routing and resource allocation strategies in a joint design such rather than separating the two problems.

Before presenting joint design strategy, firstly need to analyze the effect of the routing and resource allocation decisions on the network performance. This is achieved by relying of queuing theory to models the different aspects of the cognitive mesh network and to form a basis for our routing and resource protocol design.

1.2 Brief History

Joseph Mitola III was the first person who proposed the concept of cognitive radio in a seminar at KTH(Royal institute of technology. In Stockholm) in 1988. Then in 1999 Mitola and Gerald Q. Maguire published in an article. In wireless communication cognitive radio was the novel approach which was then described as an important point in PAD's and the networks that are related intelligent about computer to computer communication and radio resources to find user communication needs and to fulfil those needs , appropriate wireless service and radio resource must be provided. **Prior to cognitive radio SDR was discovered since 1992 by the Joseph mitola & then CR was evolved since 1998 by joseph mitola.**

Mitola's views on SDR, defining it be "a radio employing model-based reasoning for achievement of a specified level of competence in radio-related domains". **Haykin** [1] defines it as "An intelligent wireless communication system that is aware of its surrounding environment (i.e., outside world), and uses the methodology of understanding-by building to learn from the environment and adapt its internal states to statistical variations in the incoming RF stimuli by making corresponding changes in certain operating parameters (e.g., transmit-power, carrier-frequency, and modulation strategy) in real-time, with two primary objectives in mind: highly reliable communications whenever and wherever needed and efficient utilization of the radio spectrum. (Known as OODA loop), the system was originally used to help military

1.3 Result analysis

Matlab as simulation tool is used to construct a regular network which a number of parameters are defined are given below.

1. Number of nodes
2. Distance of nodes
3. Minimum & Maximum value for the no. of nodes are defined

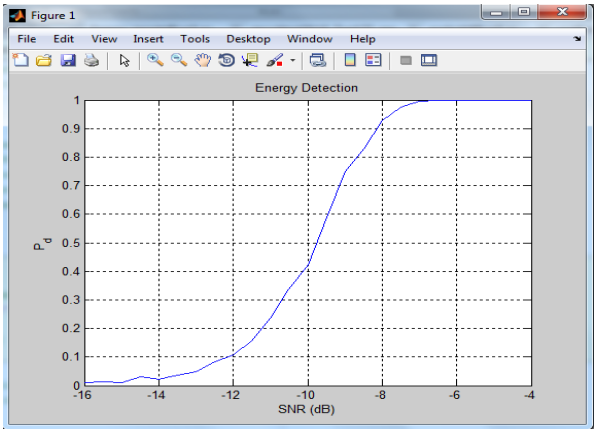

Fig1.3.a Energy detection

A specific energy is detected and tells about that spectrum in the idle state and we can sent our signal through the cognitive radio.

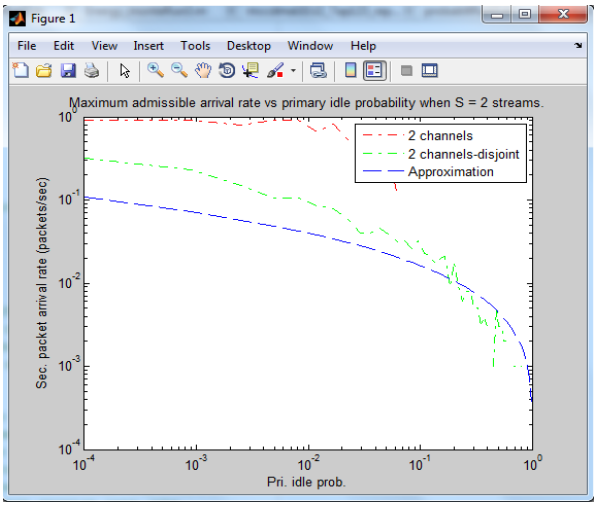

Fig1.3.b Comparison of joint and disjoint

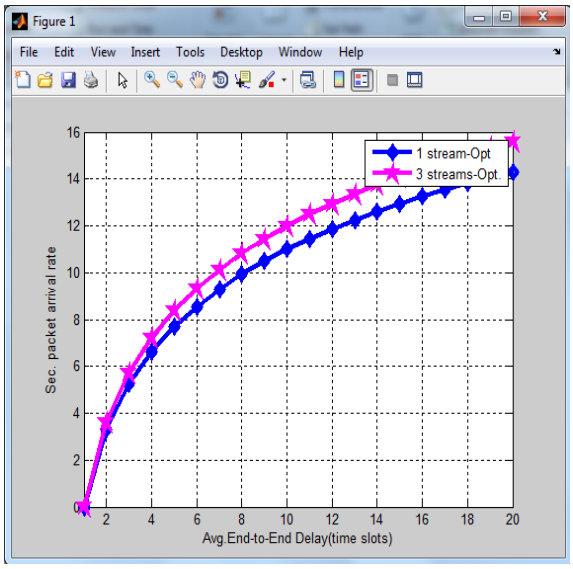

Fig.1.3.c Reduction of delay

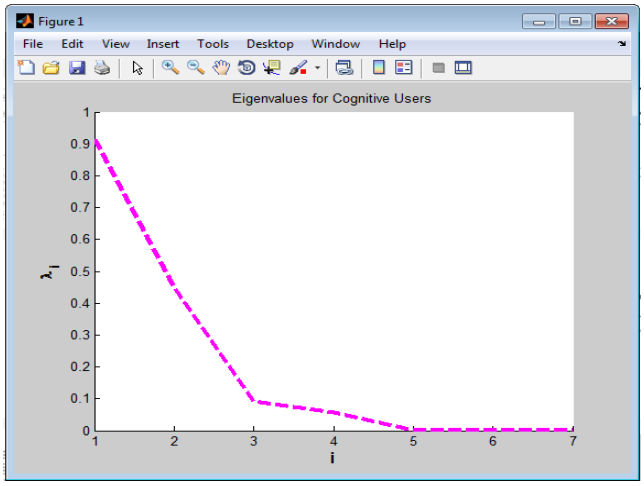

Fig 1.3.d Regular structure of Eigen value for cognitive radio

Regular network structure where x-axis and y-axis defines the Eigen value of cognitive radio users over the plot or area under which network is residing. The density a network can be varied also as verified further.

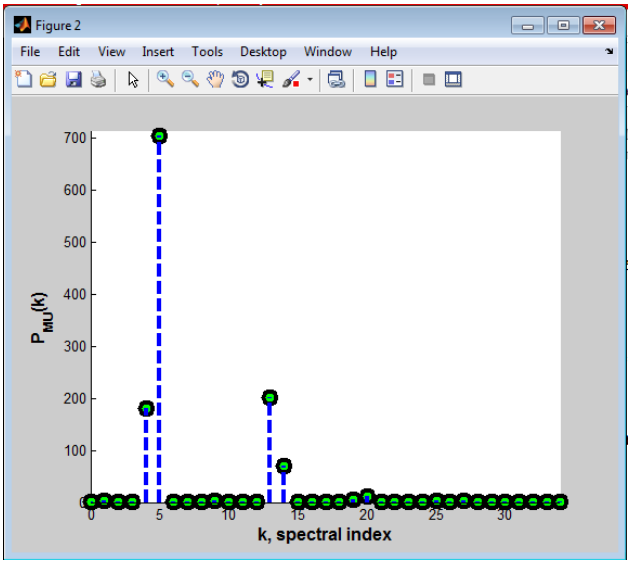

Fig 1.3.e possible and optimal paths between the communicating k spectral index

From fig1.3e, it is found that between given spectral of k, a number of paths are possible and all these are shown by blue lines connecting various nodes.

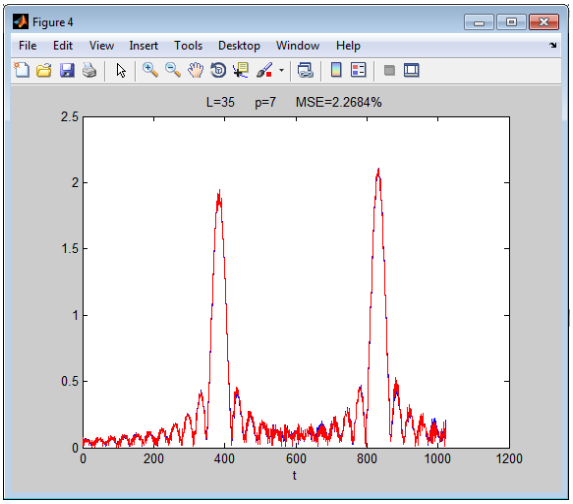

Fig. 1.3g. possible and optimal paths b/w communicating nodes.

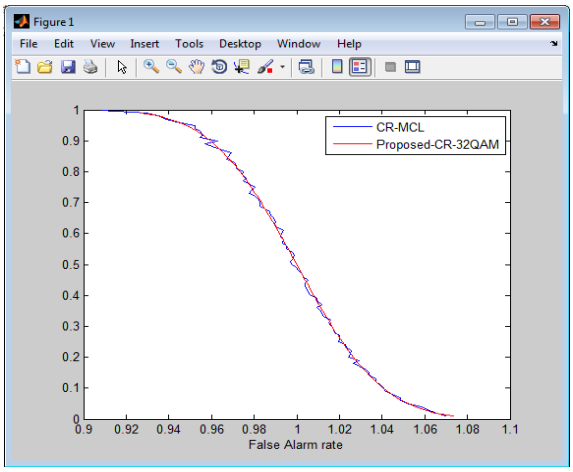

Fig 1.3h. comparison graph of Basic &proposed over False alarm rate

1.4 Conclusion

The idea of a CR Network is proposed by this research: a network consists by elements that, via reasoning and learning, dynamically adapts to a varying network conditions so that end-to-end performance can be optimized. In a CR Network, decisions are made by the whole network , not for the individual network components. And we increased streams of secondary users.

For a particular instance of time with given delay the packet arrival rate increases. Firstly this work was done using QPSK modulation and later with QAM which performed better false alarm rate detection and decreases false alarm rate as comparison with the first scheme (qpsk modulation) scheme. Energy sensing also increases in QAM as compared with qpsk, therefore better energy sensed provide more times cognitive spectrum.

1.4.1 Advantages

(1) Increase data rate of the channel.
(2) Cost minimized.
(3) CR can help in improvement link output or performance by adopting some new channels.
(4) It provides spectrum and link performance

CR can be very good because its frequency agility increased interoptability and the ability to sense a large number of interference

1.4.2 Disadvantages

(1) Control reduced
(2) Concern of regulartory
(3) Similar disadvantages just like that of software defined radio (SDR).
(4) Security of data
(5) Reliability on the software part.

1.5 Future work

This research was given the first serious investigation into CR networks, there is plenty of work yet to be done.

This list represents a few open topics and questions.

1.5.1 The cognitive element architecture

While this work provided a framework for the CR Network to operate in, it did not specify much detail for a generic or normal cognitive element. Capabilities of function such as a data repository, cognitive engine, or inter-element communication framework are still ill defined and open to interpretation.

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