Analysis & Delay minimization in cognitive radio by router & resource allocations

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Abstract

In this paper, analysis and delay minimization in CR (cognitive radio) by the router and resource allocation. Firstly cognitive radio was evolve through the software defined radio since 1998 by Joseph mitola. Prior to cognitive radio, SDR was discovered by the Joseph mitola since 1992. A disjoint scheme has compared from joint scheme. Result implemented on mat lab simulation using QAM, it provide high data rate compared to QPSK Modulation. The main 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.

Index Terms - Distributed resource optimization, disjoint routing and channel allocation, delay minimization. Queuing model, 32 bit QAM, QPSK, system design.

Introduction

Cognitive radio is also known as intelligent radio, the important features are flexible, intelligence and reconfigurable, by sensing the external environment, and using artificial intelligence techniques to learn from the environment, changing some operating parameters. Dr. Mitola proposed the concept of cognitive radio in 1999 to solve the problem of spectrum resource utilization. The key idea of CR is using spectrum sensing and intelligent learning capability to achieve dynamic spectrum allocation.

After development of CR, the concept of cognitive radio network (CRN) was proposed by many institutions such as Motorola and Virginia Technology. Cognitive networks, can perceive current network status, response, and adaptive operates and changes in the environment with self-configuring. Routing protocol is a key issue to improve the performance of CR networks. The two basic operations of the routing protocol are determining the best path and transmit information to destination.

Figure 1.1 shows two views of Cognitive Radio system structure. The block diagram show on the left explains the relation between the CE cognition system and the radio platform, and the behavioural diagram on the right illustrates the cognitive functionality of combining the machine learning process with radio operation. The radio's receiver senses the radio environment and reports to the CE using a standard parametric format called "meters". it makes a decision according to these meters, and passes the decision to the radio with another standard parametric format, called "knobs". The radio carries out reconfiguration

to meet these knobs' values. This scenario can be simply expressed as "The CE reads the meters from the radio and turns the knob of radio.

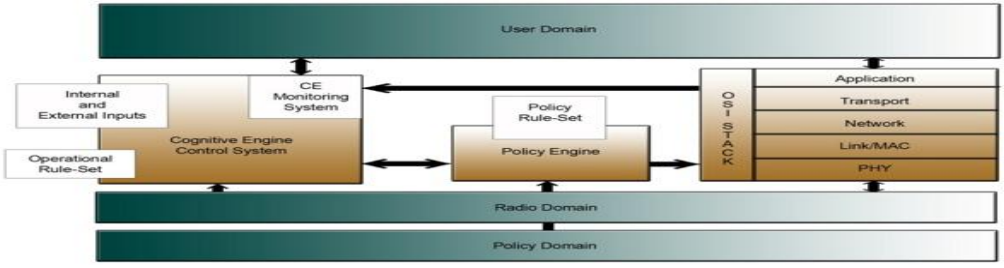

Figure 1.1 Structural and behavioural architecture of the cognitive radio system.

This meter-knob fact illustrates a hardware independent interface that has been designed to bridge arbitrary cognitive engines and radio platforms. It has two major advantages: it supports general machine learning and application specific algorithms, and it supports heterogeneous SDR and reconfigurable radio platforms.

This hardware independent interface consists of general radio configuration and control APIs, standard waveform and platform representations, and supporting information modules. At the AI side, algorithms need not to be platform specific, so general knowledge and learning can be freely applied for a variety of applications' problems. At the radio side, different radio platforms can be enabled to support cognitive functionality so far as they provide the needed reconfigurability.

In the CR node, this interface is implemented as a general radio interface supported by a set of radio domain knowledge.

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 fig1.2 network channal idle probability

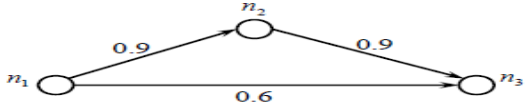

Fig1.2-Network channel idle probability

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 based 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 though put.

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 of the proposed 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.

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 scheme 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 quencing theory to models the different aspects of the cognitive mesh network and to form a basis for our routing and resource protocol design.

Requirement of cognitive radio

Mainly three problems are probed that make research in Cognitive Radio. These are:

- **Complexity**: declare big, irregular models of interactions.
- **Wireless networking**: a networking field which represents more attributes of complexity.
- **QoS**: a motivation to end-to-end network control.
- **Spectrum Scarcity**: caused by overloading of present networks the spectrum is becoming scarce to fulfill the demand.

Advantages

Increase data rate of the channel.

(1) Cost minimized.
(2) CR can help in improvement link output or performance by adopting some new channels.

Disadvantages

(1) Control reduced
(2) Concern of regulatory
(3) Similar disadvantages just like that of software defined radio (SDR).

Result analysis

Matlab as simulation tool is used to constructed 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

Matlab as simulation tool is used and the graph is generated for the comparisons of the results that are obtained. The delay between the packets on the existing system between the nodes in the proposed mesh network as well as the proposed system communication is compared between the nodes during the transmission of the packets. Here we are able to identify the drastic fall of delay in the proposed system which is indicated in green color. The x axis consists of the time limit and y axis consists of the delay ratio in both the systems and the result is compared.

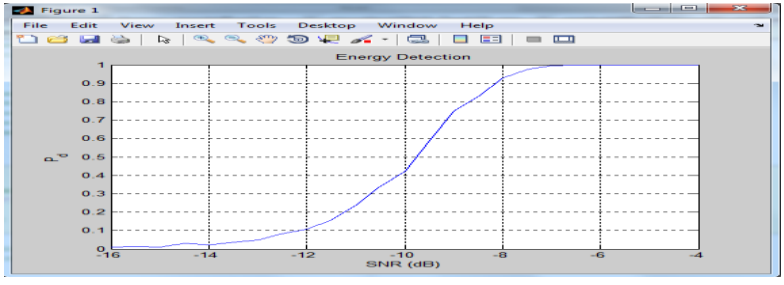

Fig1.3 Energy detection

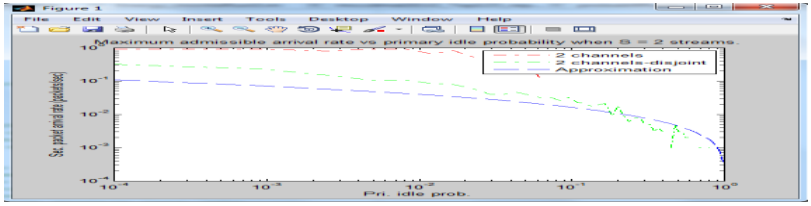

Fig1.4 Comparison of joint and disjoint

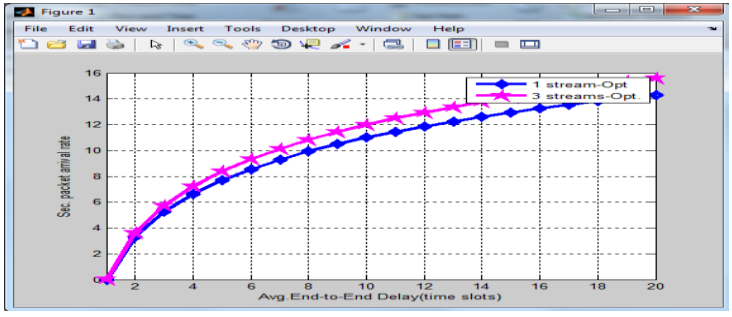

Fig.1.5 Reduction of delay

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.

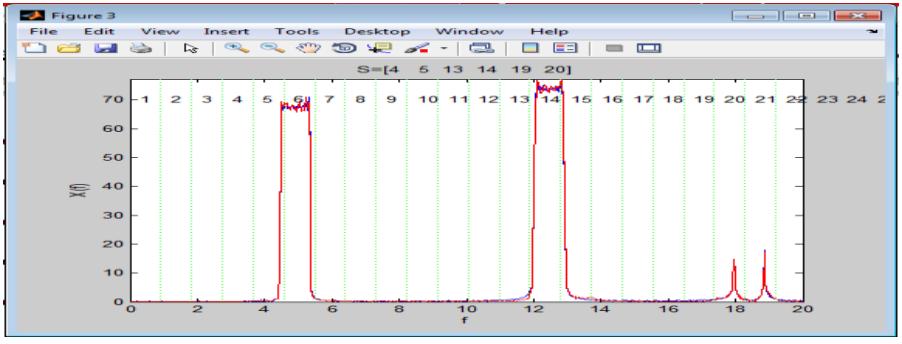

Fig. 1.6 regular network structure with increased no. of nodes

Here no. of nodes is increased and the simulated network. In the same way possible paths are identified out of which optimal path is detected through which communication is performed.

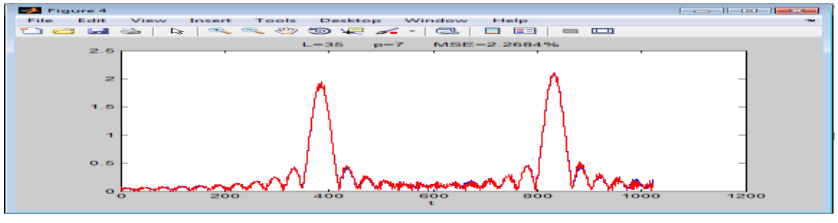

Fig. 1.7 possible and optimal paths between the communicating nodes

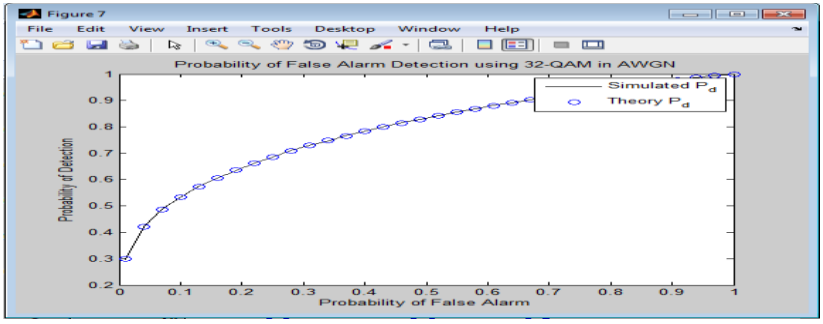

Fig1.8 Probability of false alarm in simulation.

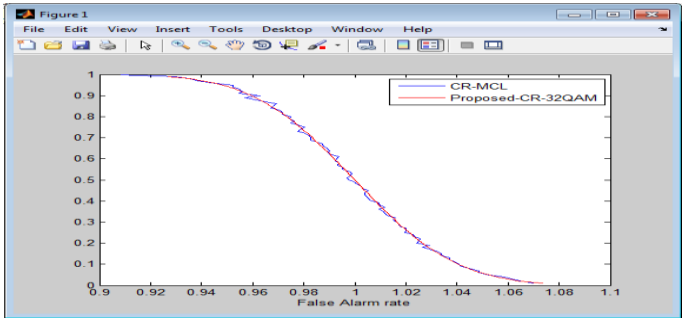

Fig 1.9 comparison graph of Basic & proposed over False alarm rate

This result show the comparison between QPSK (red line) & QAM (green line) scheme, the performance of QAM is better than QPSK , provide high data rate, & also reduce end- to- end delay.

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.

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.

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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