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Power Conservation in Cognitive Radio Networks using Hybrid Routing Algorithms

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ABSTRACT

Cognitive radios are used in number of networking areas such as spectrum sensing that is the most important application of networking. It is important to properly utilize spectrum so to stop the wastage of spectrum .in many applications cognitive radio networks co-exist with other cognitive radio networks, they use same spectrum without causing any interference. A number of methods are used for spectrum sensing which Non-cooperative spectrums are and sensing Cooperative spectrum sensing. In a single cognitive radio have a problem of interference; it's of the issues of shading from the primary user, a secondary primary user act as receiver able to hear both primary users and signal from cognitive radio network. In the proposed system we developed a protocol which is cognitive leach protocol to find the route in the Cognitive radio network by considering the energy of each primary user. Minimum distance is found in the proposed system with the help of C-Leach to save the energy spectrum in cognitive radio networks for primary users.

Keywords: Cognitive Radio Networks, C-Leach, Power Consumption in Cognitive Radio Networks.

I. INTRODUCTION

The wireless communication systems are used to transfer data from wireless telephony to interactive internet data and multi-media type of applications, for required higher data rate transmission. Cognitive radio is a very useful concept for wireless communications in future, and its gaining more interest of the academia, industry, and other regulatory bodies. Cognitive Radio provides the opportunistic way to use frequency bands that are not heavily occupied by their licensed users it is a tempting solution to spectral crowding problem. An interconnected set of cognitive radio devices that share information is defined as a ***Cognitive Radio Network*** (CRN). Cognitive Radio Network performs the cognitive operations such as sensing the spectrum, managing available resources, and making user-independent, intelligent decisions based on cooperation of multiple cognitive nodes.

Cognitive user should be capable of sensing the environment for the estimation of available resources and application requirements and could adopt their performance parameters according to user request and available resources. Secondary (cognitive) user can utilize the licensed spectrum (available white spaces) without affecting the priority utilization of the spectrum by primary user [1]. In this way, it maximizes the efficient licensed spectrum utilization.

Therefore we find three characteristics of cognitive radio networks: awareness, cognition, and adaptability.

Awareness: It is the ability of the radio [2] to measure, sense, and be aware of its environment and internal states.

Cognition: It is used to process information, we come to know about the environment, and take decisions according its operating nature to fulfill all the predefined objectives.

Cognitive radio energy challenges [4]

A cognitive radio is used to take real time decisions about the sensing of spectrum bands, when, and for how long. This sensed information is used to reach accurate conclusions regarding the radio environment for

Cognitive Radios. Furthermore, spectrum sensing must be a fastest way for sensing temporal variations of the radio environment. Such requirements of spectrum sensing does not only put stringent requirements on the hardware implementation of CRs in terms of the sensing bandwidth, the processing speed, and the RF circuitry, but also represent the main energy-hungry component of a CR.

A. CR Hardware High Energy Consumption

There are lots of factors which contribute the energy consumption of spectrum. This can be sensed in cognitive radios. First need for that process is the cognitive transceiver hardware which helps to detect diverse and frequency dependent primary at different power levels. It also requires sensitivity, linearity and dynamic range of the circuitry in the RF bfront-end. Especially the antennas, power amplifiers and the analog-to-digital conversion units are needed.

B. Listen-Before-Talk Idle Sensing

This spectrum sensing technique is based on the detection of the activities of the primary transmitters. Generally primary transmitter detection schemes are divided into some classes. These classes are matched filter detection, energy detection, feature detection and interference temperature measurement. There is no practical way in which Cognitive radio terminals can measure the interference nearby primary network receivers. This is because primary uses do not share their information with the Cognitive radio networks terminals. Such spectrum sensing techniques explodes the bi-directional nature of some primary networks. Though such spectrum exists but such schemes are unable to provide the way to measure the cumulative interference at the primary receiver. The major common feature of all the above spectrum sensing techniques is that they use one of the LBT (listen before talk) strategies to detect primary transmitters. LBT strategies help to assess the availability of spectral opportunities. Ever while the Cognitive radio is actually not receiving data during idle listening process but it still consumes power, idle listening used in LBT schemes contributes to the energy consumption of the Cognitive radio.

C. Spectrum Coordination Messaging CO2 Emission

The coordination between multiple CR users is one of the major challenges from both types of point of view a: networking point of view and from energy consumption prospective. If Medium access control protocol (MAC) were used in CRN's, all CR users would exploit the sensed opportunity greedily.CR users adopt such MACs strategies which help to utilize a channel access in its best way. The output of the CRN is gained at its highest level by such strategies. The exchanges of spectrum coordination messages contribute CO2 emission of CRNs. It is because a lot of messages are exchanged for collecting the spectrum information from different CR terminals. For reducing the amount of CO2 emission of CRNs, spectrum should minimize the explicit information sharing by either relying on local decisions or exploiting learning techniques.

Energy efficiency

Energy efficiency is simply about getting more work done with the same amount of energy, or getting the same amount of work done with lesser energy expended. Reduction in the amount of energy consumed in a processor system, or by an organization or society, through economy, elimination of waste, etc.

The remainder of this paper is organized in following ways: Section 2 defines the computational environment parameters that were varied in the simulations. Section 3 will provide the definitions of algorithms. Section 4 examines selected results from the simulation study. Section 5 will conclude the work.

II. METHODS AND MATERIAL

In cognitive radio networks, there are two types of users: primary and secondary. The primary users are part of the primary network, which consists of a primary base station and number primary users, distributed uniformly within the coverage of the base station. Each of the primary users possess a license to exclusively use one frequency band for either downlink or uplink transmission. The primary network setup adopted in this work resembles any standard wireless infrastructure network, such as cellular, TV transmission etc. Further, the cognitive radio network comprises of secondary users equipped with frequency agile devices known as

CRs. The SUs aim to opportunistically reuse primary user frequency bands to communicate with their intended single hop receivers, subject to interference constraints at primary users. The PUs are legacy systems providing communication range with relatively large coverage range (of the order of 0.5 km for Cellular networks or few miles for TV broadcasting). On the other hand, the communication range of the SUs is small compared to that of PUs. Therefore, the SUs are present in communicating range of each other and form a single hop network covering a small area; however CRs can cover a larger area by forming by forming a multi hop ad hoc network. This work precisely deals with single hop CR networks.

Primary Network Model

Regardless of the types of the PUs, the primary networks are considered to operate on N non overlapping frequency bands, such that each primary users is assigned exclusively a single band for either downlink or uplink communication. Each of these N channels can be modelled at any time as either ON or OFF.

Secondary Network Model

The network architecture of CRNs can either be centralized or distributed. In a centralized setup, a base station is responsible for monitoring the entire CR network and performs critical functions such as frequency channel assignment, transmit power allocation for CR users. Also, in centralized mode all CR nodes can communicate with the BS using predefined control channels to acquire control information. But as the scale of the network increases, it becomes infeasible to acquire global information due to the associated overhead. This motivates us to have a distributed setting where CR pairs form small clusters, with critical network functions being carried out by a mutually chosen cluster head. The cluster head in this case devises network strategies based on local information i.e., information gathered from members of a particular group. Such a distributed architecture may lead to suboptimal performance, but nevertheless it reduces network overhead and also results in conservation of power.

The proposed algorithm works in two stages:

1. Finding the shortest path in radio network
2. Finding the dynamic route using the shortest algorithm find in the step1.

Shortest Distance Finding algorithm

Step1: At first the distance between adjacent nodes are measured and the power consumed by each node is also calculated by formula

$$D = \sqrt{\ x_{i+1}2\_\ x_i{}^2}$$

Step 2: Next, the height of each node is calculated. The height of each node is defined as the minimum number of hops required reaching from that node to destination.

Step 3: Now the node which has minimum of H+D+P {Height (H) + Distance (D) + Power consumption (P)}, is selected and the path from source to that node is established. Next, that node will be treated as the source node for the rest nodes in the network.

Dynamic route finding algorithm

Step 1: Input number of nodes to be added in the network (keeping the other sensor nodes to be intact). These nodes are added randomly in the network.

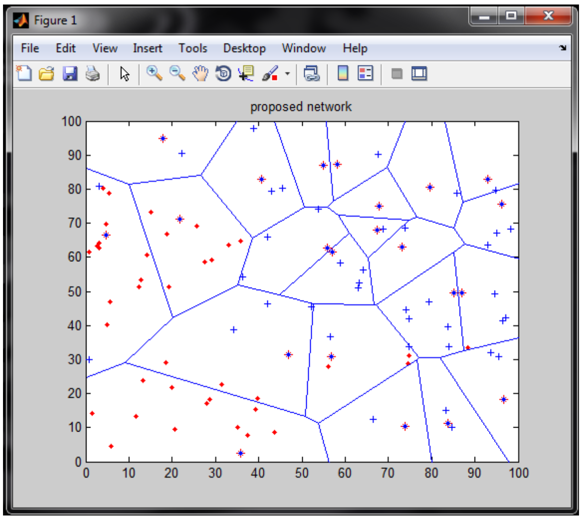
Step 2: Determine the positions of the new nodes and append these new nodes in the network.

Step3: It find the cluster heads of clusters of the network.

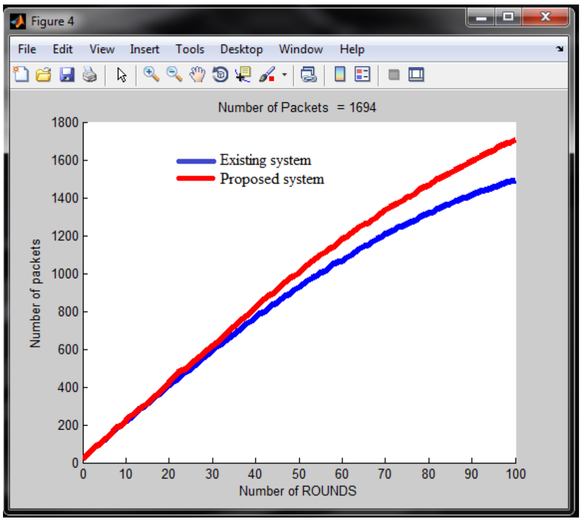
Step 4: Follow the shortest path algorithm described above on cluster heads.

In addition to these approaches multithreading techniques are used to increase the overall performance of the system.

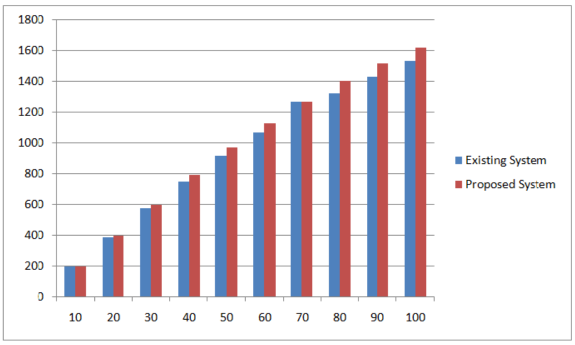
III. RESULTS AND DISCUSSION



This figure shows the proposed system network that show the dead nodes and alive nodes.



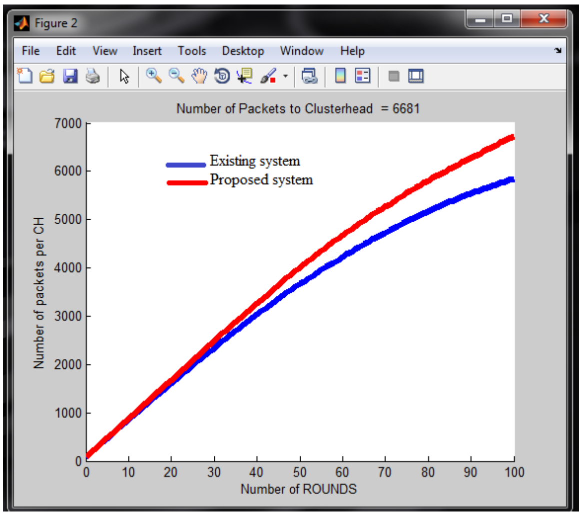
Comparison Graph representing the number of packets to base station



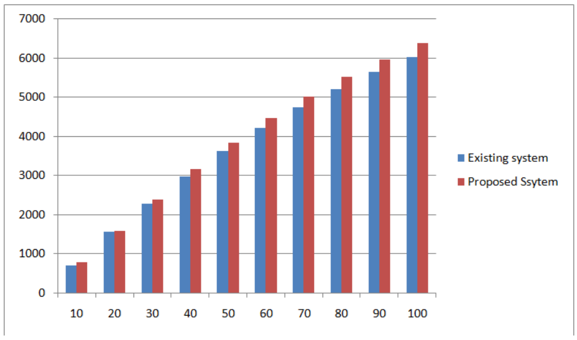
Bar Graph representing the number of packets to base station

	Existing Work	Proposed work
No. of Rounds	No. of Packets Delivered	No. of Packets Delivered
10	199	200
20	390	400
30	576	600
40	753	796
50	919	971
60	1069	1131
70	1270	1272
80	1325	1403
90	1435	1518
100	1533	1694

Comparison table representing the number of packets to base station



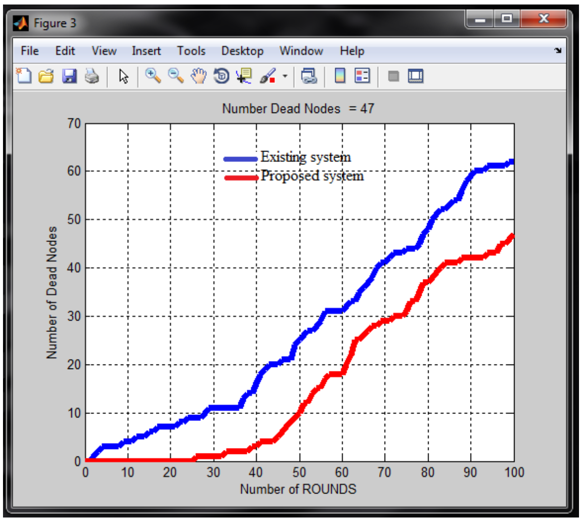
Comparison graph representing the number of packets to Cluster Head



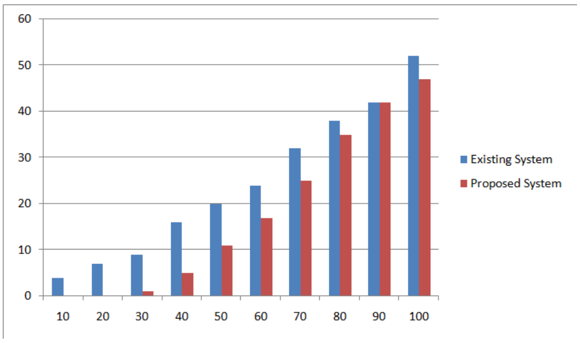
Bar graph representing the number of packets to Cluster Head

	Existing Work	Proposed Work
No. of Rounds	No. of packets to cluster Head	No. of packets to cluster Head
10	715	800
20	1579	1600
30	2289	2397
40	2987	3164
50	3636	3856
60	4220	4480
70	4752	5032
80	5217	5535
90	5650	5977
100	6030	6681

Comparison table representing the number of packets to Cluster Head



Comparison Graph representing the dead nodes per round



Comparison Graph representing the dead nodes per rounds

	Existing Work	Proposed Work
No. of Rounds	No. of dead nodes	No. of Dead nodes
10	4	0
20	7	0
30	9	1
40	16	5
50	20	11
60	24	17
70	32	25
80	38	35
90	42	42
100	52	47

Comparison table representing the dead nodes per rounds

IV. CONCLUSION

In the proposed work we have implemented the Cognitive Leach for data transmission in Cognitive Radio Network. In the proposed work we have decreased the delay in data transfer, increase the throughput than existing techniques and minimize the energy dissipation then existing system. The proposed work is tested on 100 nodes to evaluate the results. In future more robust and secure protocol for Cognitive Radio Network to minimize the energy dissipation can be designed.

V. REFERENCES

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