Advances in Wireless and Mobile Communications.
ISSN 0973-6972 Volume 10, Number 4 (2017), pp. 539-550

http://www.ripublication.com

Energy Efficient Spectrum Sensing Routing Protocol (EESSRP) in Cognitive Radio Adhoc Network

N. Priya[1] and Dr. B. Rosiline Jeetha[2]

[1]Research Scholar, PG & Research Department of Computer Science, Dr. N.G.P. Arts and Science College, Coimbatore, Tamilnadu, India.

[2] Professor & Head, PG & Research Department of Computer Science, Dr. N.G.P. Arts and Science College, Coimbatore, Tamilnadu, India.

Abstract

Routing plays an important role in Cognitive Radio Ad-hoc Network and it has n number of problems. Routing has two major issues such as Energy efficiency, Spectrum load balance. Thus maintaing the spectrum load balance and energy efficiency becomes difficult in cognitive Radio Ad-hoc Network without infrastructure. To overcome this load balance and energy efficiency, Energy Efficient Spectrum Sensing Routing Protocol (EESSRP) is proposed. Battery Monitoring Scheme (BMS) is used to predict energy level and Weight Calculation Mechanism (WCM) is used to save energy. The EESSRP is compared with MSSS and CONS using NS2.The simulation result shows that the proposed EESSRP has improved energy efficiency than MSSS and CONS.

Keyword: - Energy, Ad-hoc, Spectrum load balance, Energy efficiency, Spectrum management.

1. INTRODUCTION

Spectrum is a precious resource for wireless communication and is managed by FCC and ITU-R. Initially the spectrum is managed using static spectrum in which, the primary user has ease of access ability, and where as secondary user can make use of spectrum causing spectrum scarcity. When the primary user uses the channel, the secondary user also uses the same channel where interference is created resulting in spectrum scarcity. To overcome, this problem, the FCC came out with a new spectrum management called dynamic access. There is a primary user who holds a license, and secondary user who does not hold a license. Thus if a band is being used by a secondary user ,and if the primary user wants to use the same band then the secondary user must vacate and move to another spectrum hole ,Because the primary user holds a license and thus there were no interference issue. Thus to execute this concept the cognitive Radio technology is used.

A cognitive radio is an intelligent radio that can be programmed and configured dynamically through cognitive capability and Re-configurability. In cognitive capability, the CR learns and observes the surrounding and comes with a decision and based on this decision the CR, reconfigures the hardware and software. To reconfigure the SDR technology is used which all the function were performed using software instead of using hardware when this SDR joins with CR, the spectrum utilization and communication efficiency are improved.

In cognitive radio, there are three types of networks. They are

1. Primary network
2. Cognitive Radio Network (with infrastructure)
3. Cognitive Radio network (without infrastructure).

In primary network, only the primary user accessed the spectrum and in Cognitive Radio Network (with infrastructure) both primary as well as secondary user accessed the spectrum only in a particular location and thus Cognitive radio network (without infrastructure) where both the users can access spectrum anywhere at any time. Thus this network is needed in maximum in the current world.

There is few functionality of Cognitive Radio Network. They are Spectrum Sensing, Spectrum management Spectrum mobility, Spectrum sharing.

a) Spectrum Sensing:-The user will be able to sense the unused spectrum at any time and location.

b) Spectrum Management:-Based on the availability, the user allocates the best spectrum band that is available.

c) Spectrum Mobility:-In the presence of any primary user i.e. (license holder) the secondary user shall vacate and move to the next available spectrum band.

d) Spectrum sharing:-It has to provide a fair and optimal spectrum allocation method among, multiple Cognitive Radio users.

There are also certain challenges that occur in this network. They are co-ordination of Asynchronous sensing, optimization of co-operative sensing, spectrum efficient sensing, decision model, distributed topology information and routing. In the above, routing is the major challenge because it is like a soul for network. And in routing the main two issues are energy efficiency and spectrum load balance. Because of these two issues it has become a challenge to manage the spectrum and to use the energy efficiency in routing.

II. RELATED WORK

This paper deal with Spectrum allocation problem for both users, hence proper co-ordination for the use of the allocated frequency band is needed. Authors like German Capdenhourat, etc al., introduced a stochastic model to formulate the problem, considering primary user's activity and a periodically scheduled assignment scheme. To overcome the problem, a novel robust solution for which we develop a decentralized algorithm was proposed.

Zhiping Shi, Tian Tan etc.., mainly focus on energy consumption on the spectrum sensing and data transmission to obtain optimal sensing time and power allocation for SU system with a fixed circuit power. Hence, optimal sensing time and power allocation have been proposed with the help of MSSS scheme which achieves a lower level of energy consumption compared with the MOSA Scheme.

Energy harvesting is main issue in cognitive radio network. Hence the author proposed a new SST frame structure in EHCRNS and jointly optimized the save radio in closed form and transmit power allocation using Dinkelbach method to achieve the maximum energy utilization efficiency when compared better performance than the conventional scheme.

Subahankar Chatterjee,Santi P Maity author's goal is to maximize energy efficiency for Secondary User(SU) networks in terms of self and Co-Operative transmission. A set of optimal values for sensing duration, self and co-operative transmission power gains are calculated under the constraints of Primary User(PU) detection probability, SU power budget, PU and SU throughput.

III. PROPOSED METHODOLOGY:

Based on the investigations by the literature survey of various scholars, the solution to the problem is achieved which are classified and presented below. Spectrum management is based on EESSRP. Battery Monitoring Scheme and weight calculation mechanism is used by EESSRP. The proposed scheme allows the receiving node to accept a route request (RREQ) or to send a route reply (RREP) packet based on calculating scheme (BMS) of the node with respect to its PU. The BMS predicts the network energy level and WCM used to reach the destination calculation, the time and location based on threshold value .Hence, it helps to minimize the spectrum load balance and save the energy.

A) Battery Monitoring Scheme (BMS)

The proposed scheme utilizes the information related to energy provided by the PU and individual node. Based on the mobility metrics PU and SU are interconnected as follows. It is considered that the two nodes X and Y remain within the transmission range of each other.

Let (Xa and Ya) and (Xb and Yb) be the co-ordinates of the dynamic nodes a and b and Va and Vb represents the velocities of dynamic nodes a and b respectively. The direction of dynamic nodes a and b are represented using Da and Db, where, Da and Db where, Da>0 and Db≤2π.The amount of time taken by the two nodes a and b remains connected BMSa-b is estimated as given below.

Formula:-

Here,a=Va Cos da – Vb Cos Db,

b=Xa-Xb,

c=Va Sin Da – Vb Sin Db and,

D=Ya-Yb ----- (1)

RREQ packet Format:

In the proposed packet format, the spectrum management holds 9 byte. The second field is rate control which regulates the n number which connects to the particular node and it occupies 5 byte. The third field is traffic shaping which means the transmission of packets which travels with high integrity from the PU to the SU and it occupies 4 byte. The last field is waiting time. i.e.) reduces the route of discovery in the packet while transmission takes place. It occupies 9 bytes.

Table:-RREQ packet Format

Type	J	Reserved	Hop count
RREQ ID			
Spectrum Management	Rate Control	Traffic Shaping	Waiting Time
Destination IP Address			
Destination Sequence Number			
Originator IP Address			

The source route within the RREP is multicast to the nodes, so each node receiving the RREP appends the BMS and it calculates the RREQ reception time. After collecting all the RREP from all the nodes from the source node the data packets are transmitted to the route which satisfies the following conditions.

$$\text{Least } (BMS_{S\text{-}R}) \geq BMS \text{ ----- } (2)$$

Here, least [$BMS_{S\text{-}R}$] is the least value of BMS in the RREP packets, and BMS_T is the amount of time which is required to communicate with the packets in the transmitting node. Receiving more than one RREP by the source nodes based on the above function of a particular route will be chosen because it contains only least BMS and the other possible routes will be stored. In case, if at all, the obtained routes have least BMS then the routes are chosen by the node itself.

Route Request [RREQ]:

The RREQ Packets are broadcasted to one-hop neighbors of the source node. The RREQ packet contains the information related to the mobility and location of its own and the source node within the RREQ packet. Furthermore, the velocity and the co-ordinates are also provided, so that the packet contains the location, mobility and velocity information.

Upon receiving a RREQ packet by one-hop neighbors the estimation of BMS is performed with respect to the source node and the route to the source node that updates all the information related to the mobility, location and velocity which are appended into the source node .i.e.) BMS is estimated with reception of RREQ packet and it is also estimated with respect to the sender node. By forwarding this RREQ packet through the network, the path for communication will be obtained.

Algorithm:-

For each route

for each link

if (least ($BMS_{S\text{-}R}$) ==BMS_T)

Send all packets through this route//after //sending packets no other//routes are checked.

end If

end for

If (no route it’s found)

Set Least-BMS=max-value//max-value is any//constant value greater than // all the BMSs of each route//already known.

for each route

for each link

If (least ($BMS_{S\text{-}R}$)>BMS_T)

If (least-BMS>least ($BMS_{S\text{-}R}$))

Least-BMS=least ($BMS_{S\text{-}R}$)

end for

end for

If (least-BMS ≠ max-value)

Send all packets through the route has BMS value equal to least-BMS

else

No route found

end if

end if.

B. Weight Calculation Mechanism (WCM):

The session is to assign the weight individual node in spectrum access based on threshold value. Where initialize the PU access the spectrum within the computation time. Checking the PU Mobility movement speed where the channel access either to transmit a packet when the access channel is idle or to harvest RF energy when the selected channel is busy by PU activity. It should increase on $\partial_x= \partial_x+1$to minimize the hidden terminal problem where the channel switched to assign alternative path selected route in cognitive radio networks is proposed to saving the energy by efficiently selecting the energy of the efficient path in the route location with periodical time process. It investigates how a CR user senses multiple channels and determines the optimal transmission duration and power allocation using weight calculation mechanism.

Algorithm:-

Begin

Initialization of parameters

If P_u>o then

Compute time (T) and Spectrum access;

If V_{max}<0 then

$\partial_x = \partial_x + 1$;

end if

if $T(P_u) <= \partial_x$ then

//Accept channel switching along the paths and test terminate;

end if

if $T(P_u) >= \partial_x$ then

//Initialize zero and accept channel switching;

return;

$P_u = P_u + 1$

p-loc=c-loc;

p-time=c-time;

end if

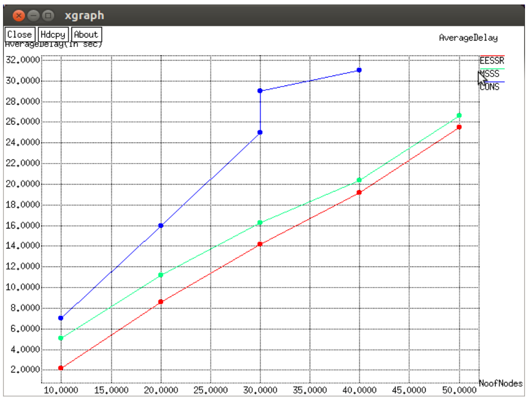
end if

IV. SIMULATION SETTING AND PERFORMANCE METRICS:

The simulation for EESSRP is done by using NS2.The area is chosen as 1000m*1200m with 50 nodes.CBR is used for the transmission from source to the destination .The simulation of time is set as 50s with 5m/s speed. The frequency is 9mhz.The packet size is 512 byte and -95dbm is taken as carrier sense threshold value and -115dbm is taken as carrier received threshold value.

Average Delay:

Average Delay is calculated by dividing interval arrival for 1^{st} packet time and 2^{nd} packet time. This can be calculated using simulating of time.

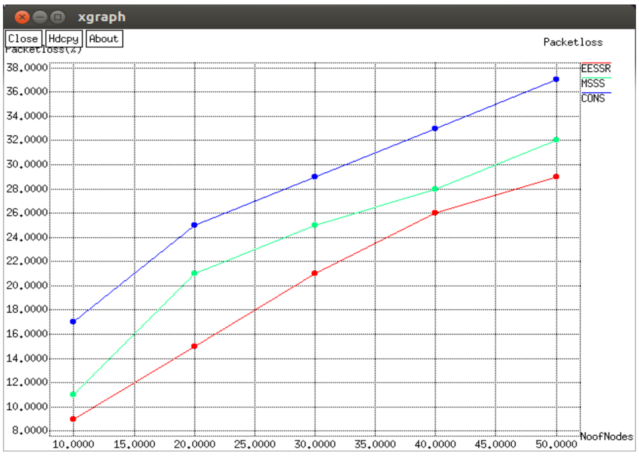


Delay=interval between the arrival of 1st packets time and 2nd packet time/simulation time.

This resulting in seconds comparing to existing value delay is being reduced.

Packet loss:-

This is the difference of both receiving packets and sending packets.

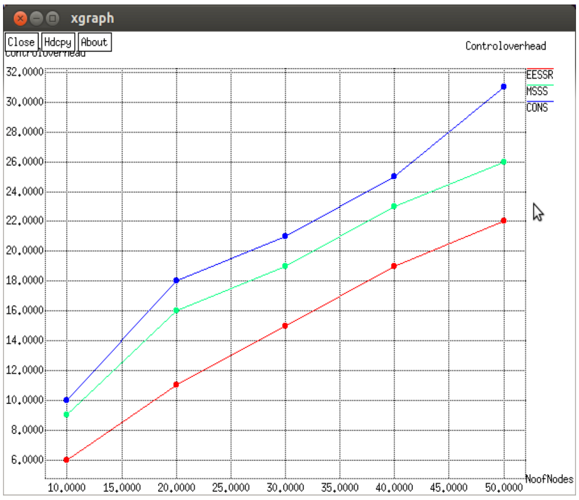


Packet loss=No. of packet received-No. of packet sent

The result is found in packets; hence here the packet drop is reduced by comparing to the existing method.

Control overhead:-

This describes as the No. of routing packets required for network of communication by using the formula.

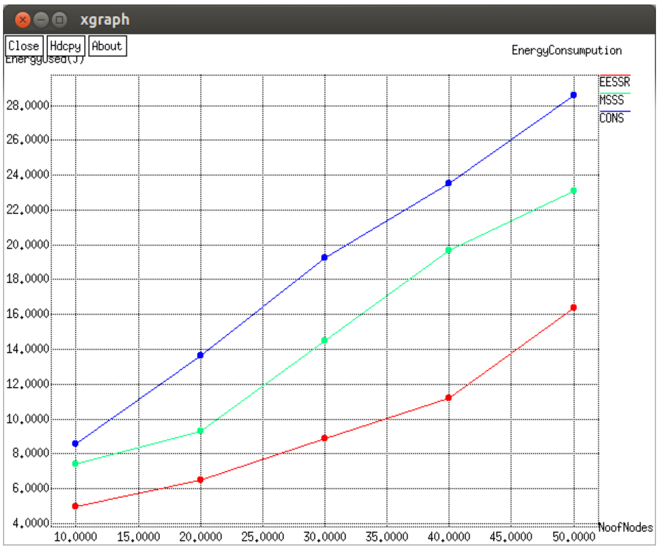


Routing overhead=Routing packet counts

Here, the result is in packets, similarly in the other parameter, the existence also is minimum in control over head.

Energy consumption:

The average energy consumed on idle, sleep, transmit and receive with respect to total energy consumed

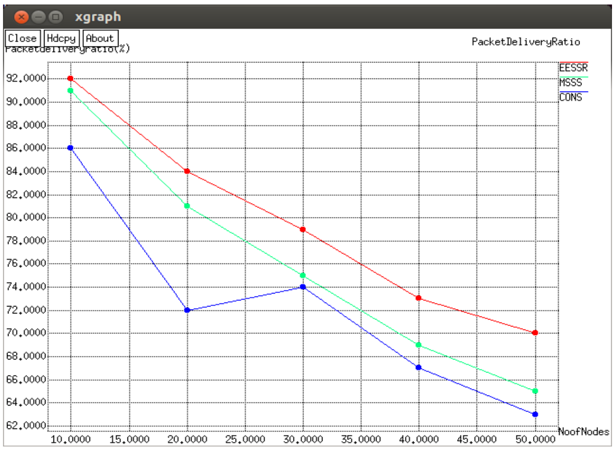


Energy consumption =Current value – initial energy value

The value is considered as joule. Hence there is a reduction in the energy consumption comparing to the existing method.

Packets delivery ratio:

This is the radio between the received packets by using the destination and generated packets by the source by using,



Packet Delivery radio=Total packets received / Total packets sent * 100

The result is determined in radio, and thus there is an increase level of ratio when compared to the existing value.

V. CONCLUSION AND FUTURE SCOPE:

The EESSRP is developed to improve the energy efficiency of cognitive Radio Ad-hoc network without infrastructure. The simulation is done using NS2.The proposed Energy Efficient Spectrum Sensing Routing Protocol(EESSRP) minimizes the delay, control overhead, packet drop and energy consumption. Hence packet delivery ratio is increased. Thus the proposed EESSRP has improved the energy efficiency when compared to MSSS and CONS. Further research work can be carried out in CRAHNs, every user has independent and asynchronous and transmission schedules, and it is common to detect CR and PU user.CR user does not distinguish the transmission of CR and PUs. But the transmission can be detected. As a result, there is a false alarm of CR users and it leads to increase in spectrum opportunities. QoS are improved by reducing a false alarm.

REFERENCE

[1] G. Capdehourat et al., “Decentralized robust spectrum allocation for cognitive radio wireless mesh networks”, pp.1-20 Elsevier Ad Hoc Networks (2015)

[2] Zhiping Shi, Tian Tan, Kah Chan Teh and Kwok Hung Li, “Energy efficient cognitive radio network based on multiband sensing and spectrum sharing” pp. 1499–1507, Vol. 8, Iss. 9,IET Commun., 2014.

[3] Chengyu Wu, Qingjiang Shi, Chen He and Yunfei Chen, “Energy Utilization Efficient Frame Structure for Energy Harvesting Cognitive Radio Networks” pp. 1 – 1, Vol: PP, Iss: 99, IEEE Wireless Communications Letters,2016.

[4] Subhankar Chatterjee , Santi P. Maity and Tamaghna Acharya “On Optimal Sensing Time and Power Allocation for Energy Efficient Cooperative Cognitive Radio Networks ”, Advanced Networks and Telecommuncations Systems (ANTS), 2015 IEEE International Conference on,2015.

[5] Ilker Basaran,Hasan Bulut “An intelligent location discovery algorithm for vehicular ad hoc networks “The Journal of Mobile Communication, Computation and Information”, Iss: 1022-0038 November 2016

[6] Yan Jiao and Inwhee Joe, “Energy-Efficient Resource Allocation for Heterogeneous Cognitive Radio Network based on Two-Tier Crossover Genetic Algorithm”,pp. 112-123, vol. 18, no. 1, Journal Of Communications And Networks,2016.

[7] Muhammad Usman, Dangsoo Har, and Insoo Koo, “Energy-Efficient Infrastructure Sensor Network for Ad Hoc Cognitive Radio Network”, pp 2775 – 2787, Volume: 16, Issue: 8, IEEE Sensors Journal,2016

[8] Subhankar Chatterjee , Santi P. Maity and Tamaghna Acharya “On Optimal Sensing Time and Power Allocation for Energy Efficient Cooperative Cognitive Radio Networks ”, Advanced Networks and Telecommunications Systems (ANTS), 2015 IEEE International Conference on,2015.

[9] Jian Chen , Lu Lv, Yiyang Liu, Yonghong Kuo and Chao Ren, “Energy efficient relay selection and power allocation for cooperative cognitive radio networks”, pp.

[10] Chengyu Wu, Qingjiang Shi, Chen He and Yunfei Chen, “Energy Utilization Efficient Frame Structure for Energy Harvesting Cognitive Radio Networks” pp. 1 – 1, Vol: PP, Iss: 99, IEEE Wireless Communications Letters, 2016.

BIOGRAPHY

Mrs. Dr. B. Rosiline Jeetha, working as a Head & professor, Department of PG and Research department of Computer Science, Dr N.G.P Arts and Science College, Coimbatore.

Miss. N. Priya Pursuing Ph.D Research Scholar, PG and Research Department of Computer Science, Dr N.G.P Arts and Science College, Coimbatore.