Efficient Energy Based Path Selection in Sensor Ad-Hoc Cognitive Radio Network
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Abstract— the CR (Cognitive Radio) is the type of network which is provides the automatically detects available channels in wireless spectrum. The spectrum are provides the different frequency range for communication. The Sensor Network for Ad hoc CR has independent mobile nodes. And all nodes are communicated with each other through limited energy resource. The energy is one of the important issue in sensor network then efficient routing is necessary to utilizes full energy consumption and enhance the network performance. A concept of CR is used with mobile sensors network and sensor network is autonomous, self organizing and self-configuring network with the capability of rapid deployment in response to application needs. In our Energy is one of the important issue in Sensor Network then efficient routing is necessary to utilizes full energy consumption and enhance the network performance. LEACH is energy based protocol work on the cluster base mechanism to utilize the energy consumption. In this paper we analyses the performance of existing LEACH protocol with proposed energy efficient LEACH CR that utilize the energy constraint in network. Here proposed scheme are compare with previous existing scheme and normal LEACH but the performance of proposed scheme is better. The performance of proposed LEACH protocol is analysis on the basis of performance matrices. In Our experiments show that nodes have at best imprecise state information, especially under high traffic rates. proposed LEACH and DSR routing and find-out reliable path (higher energy base route selection), in our proposal LEACH generate cluster and gives information about energy of each cluster belongs zone and if energy of an of the node is higher so LEACH select that particular node for data transmission that work increases the reliability to the communication, in this paper we also analyze the result in the form of network parameter like through put, packet delivery ratio and energy consumption.

Keywords: - Sensor Network, CN, Energy, LEACH, Routing, Performance.

I. INTRODUCTION

Wireless communications systems: Wireless communications technology have become a key element in modern society. In our daily life, devices such as garage door openers, TV remote controllers, cellular phones, personal digital assistants (PDAs), and satellite TV receivers are based on wireless communications technology. Today the total number of users subscribing to cellular wireless services has surpassed the number of users subscribing to the wired telephone services. Besides cellular wireless technology, cordless phones, wireless local area networks (WLANs), and satellites are being extensively used for voice- as well as data-oriented communications applications and entertainment services. The increasing demand for wireless communications in customer electronics applications and personal high-data-rate networks indicate a promising commercial potential. The number of devices based on multiple wireless principles and technologies are significantly increasing but new problems will arise due to limited availability of radio spectrum. We are, however now at a stage where the identified problems have to be addressed to enable further growth of these promising markets and to find a substantial basis for our future information society.

1.1.2 Cognitive Radio based Networks: Cognitive radio is a new paradigm of designing wireless communications systems which aims to enhance the utilization of the radio frequency (RF) spectrum.

1.1.3 Cognitive Radio Based Sensor Networks: The capabilities of cognitive radio may provide many of the current wireless systems with adaptability to existing spectrum allocation in the deployment field, and hence improve overall spectrum utilization [1]. Among many others, these features can also be used to meet many of the unique requirements and challenges of wireless sensor networks (WSN), which are, traditionally, assumed to employ fixed spectrum allocation and characterized by resource constraints in terms of communication and processing capabilities of low-end sensor nodes. In fact, a WSN comprised of sensor nodes ready with cognitive radio may benefit from the potential advantages of the salient features of dynamic spectrum access such as:

II. LITERATURE SURVEY

The section describe about previous related work under the field of Cognitive Radio Network Muhammad Usman, Member, IEEE, Dongsoo Har, Senior Member, IEEE, and Insoo Koo, [1] “Energy-Efficient Infrastructure Sensor Network for Ad Hoc Cognitive Radio Network” in this title we discuss an energy-efficient network architecture that consists of ad hoc (mobile) cognitive radios (CRs) and infrastructure wireless sensor nodes. The sensor nodes within communications range of each CR are grouped into a cluster, and the clusters of CRs are regularly updated according to the random mobility of the CRs. We reduce the energy consumption and the end-to-end delay of the sensor network by dividing each cluster into disjoint subsets with overlapped sensing coverage of primary user (PU) activity. Respective subset of a CR provides...
target detection and false alarm probabilities. Substantial energy efficiency is achieved by activating only one subset of the cluster, while putting the rest of the subsets in the cluster into sleep mode. Additional gain in energy efficiency is obtained by two promising propositions: 1) selecting nodes from the active subset for actual sensing and 2) switching the active subset to sleep mode by scheduling. The sensor nodes for actual spectrum sensing are chosen considering their respective time durations for sensing. Even the only active subset is switched to sleep mode for a certain number of time slots, utilizing the history of PU activity.

Abhinav Lall, O. P. Singh, G. R. Mishra, and Ashish Dixit [2] Study of Energy Efficient Sensor Network Using Ad-Hoc Cognitive Radios in this title we discuss An Energy Efficient network is proposed that consists of Ad-Hoc (mobile) Cognitive Radios (CR’s) and infrastructure wireless sensor nodes. Sensor nodes within communication range of each CR are grouped into a cluster and the clusters of cognitive radios are regularly updated according to the random mobility of the cognitive radios. We reduce the energy consumption and end-to-end delay of the network by dividing each cluster in disjoint subsets with overlapped sensing coverage of primary user (PU) activity. Respective subsets of CR provide target detection and false alarm probability. Substantial energy efficiency is achieved by activating only one subset of the cluster, while putting rest of the subsets in the clusters into sleep mode. Additional gain in energy efficient is achieved by two promising propositions: Selecting nodes from the active subsets to sleep mode by scheduling. The sensor nodes for Real Time Spectrum sensing are chosen considering their respective time durations for sensing. We compare the proposed CR networks with existing approaches to demonstrate the network performance in terms of the energy consumption and the end-to-end delay.


N. Priya and Dr. B. Roseline Jeetha [5] “Energy Efficient Spectrum Sensing Routing Protocol (EESSRP) in Cognitive Radio Ad-hoc Network” in this title we discuss 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 maintain 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.

T. Lamaka, K. Karthikeyan, [6] “Energy Efficient Routing by Choosing Alternate Path Selection in Cognitive Radio Networks” In this title we discuss Spectrum efficiency and energy efficiency are two critical issues for wireless communication networks. In the past years, much effort has been made to enhance capacity of wireless communication networks via various technologies such as cognitive radio. Meanwhile, cognitive radio has emerged as a promising paradigm to improve the spectrum usage efficiency and cope with spectrum scarcity problem through dynamically detecting and re-allocating white spaces in licensed radio band to unlicensed users. In order to achieve this requirement, alternate path selection routing in cognitive radio networks is proposed that saves the energy by efficiently selecting the energy efficient path in the routing process. It investigates how a CR user senses multiple channels and determines the optimal transmission duration and power allocation. When performing optimization, take energy efficiency, throughput, and interference with the primary users into consideration and find a closed-form solution for transmission duration for chosen channels. It is shown that the proposed optimization approach significantly improves energy efficiency and throughput of CR networks.

Ayaz Ahmad, Sadiq Ahmad, Mubashir Housan Rehmani, and Naveed Ul Hassan[7] “A Survey on Radio Resource Allocation in Cognitive Radio Sensor Networks” In this title, we present a survey of the recent advances in radio resource allocation in CRSNs. Radio resource allocation schemes in CRSNs are classified into three major categories, i.e., centralized, cluster-based, and distributed. The schemes are further divided into several classes on the basis of performance optimization criteria that include energy efficiency, throughput maximization, QoS assurance, interference avoidance, fairness and priority consideration, and hand-off reduction. An insight into the related issues and challenges is provided, and future research directions are clearly identified.


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Ramesh Patil, Dr. Vinayadatt V. Kohir, [9] “Energy Efficient Flat and Hierarchical Routing Protocols in Wireless Sensor Networks: A Survey” in this title we discuss a Wireless sensor network (WSN) is an emerging technology for exchanging data in various real-time monitoring systems. The WSN has distributed nature and dynamic topology which introduces very special requirements in routing the data. Various protocols developed for routing in WSNs are broadly classified in to four categories i.e. based on Network Structure, Communication Model, Topology and Reliable Routing. Many energy efficient routing protocols are proposed for WSNs in recent years. Network structure based routing protocols are more commonly used in various applications. To save the energy and for providing the extension of the network life time network structure based protocols are used.

III. PROBLEM STATEMENT
Wireless sensor network is a recent communication technology that provides low cost communication between sensor devices with the help of radio frequency and channel selection by cognitive radio network. WSN is a group of lightweight sensor nodes which coordinated by base station. Each sensor nodes characteristics are low storage capacity, limited energy resource and low processing capability. So our aim to design an Efficient Energy based path selection Mechanism for Sensor Ad-hoc Cognitive Radio Network and to resolve the energy issue by minimum power requirement based route selection and cluster formation and improve the network performance with all contrast of network parameters.

IV. PROPOSED WORK
In an sensor ad hoc cognitive radio network, secondary users access the channels temporarily bases those channel unused by primary users, and the existence of a communication link between two secondary users depends on the transmitting and receiving activities of nearby primary users. In the sensor ad-hoc cognitive radio network primary user those who have capable for routing and provide the connectivity between two secondary users. In the base paper they split the clusters into sub-clusters and they uses two modes active and sleep modes. In active modes those nodes belongs whose participate in route or data transmission and rest of member in sleep mode that means two sub-clusters are form that work minimized the energy consumption from the network and compare with standard routing of low energy adaptive cluster head (LEACH) and conclude that their proposed work better than the LEACH protocol. In the statement of research problem is to efficient energy based path selection in sensor ad-hoc cognitive radio network provide the more reliable and better energy utilization mechanism that enhanced the performance of existing work. Proposed approach multiple sensor nodes form a cluster based on radio zone and distance from base stations. Each cluster divided into two category i.e. cluster head and members of clusters. Single base station coordinates and communicates through multiple cluster zones from radio channel provided by cognitive radio network. Proposed method initiate the election message for the cluster head selection in time to time (depends upon energy of nodes or movement) those message broadcast to all nodes whose belongs in particular range of base station, while the message receives by every sensor nodes in particular zone elect the cluster head based on maximum number of node cover, energy of particular node, energy consumption rate. After the cluster head selection join the member through multicaustic routing approach and provide the communication from one cluster zone to another or within the cluster. The next phase is route decision phase for the communication from source to receiver node (inter or intra cluster zone) decide the path from cluster head, it responsible to provide minimum consumption of energy path from source to receiver, so that network life time will increases. Cluster head also split single cluster into two sub-cluster zone sleep or active mode, whose participate in communication all those in active modes, rest of node in sleep mode that minimize the energy consumption from the overall network and improve the network life time. Selected communication path calculate the energy consumption of each node and while the energy is less than of decided threshold value than cluster head alternative route are provide using local route repair method. Local route repair provide the lightweight and efficient route finding process that joint the disconnected route through eliminate the disable node and join new node whose capability according to network demand. Proposed mechanism also change the cluster head time to time based on remaining energy, neighbor connection and movement of cluster head, it means of the energy of cluster head less than the threshold, neighbor connectivity minimized (less than five) and head move from their initial location to other region and provide low signal strength then re-initiate the election message and repeat the procedure of selection the cluster head. Proposed approach fulfill the all objective, which describe in the objective section and provide efficient energy based communication from source to receiver node for sensor ad-hoc cognitive radio environment.

A. Proposed Algorithm
Sensor ad-hoc cognitive radio network is useful for the emergency situation and resolve the problem of uncovered area. Proposed algorithm provides the framework to simulate the energy based path selection approach under cognitive radio network. That divided into sub modules i.e. cluster head election, route selection and data transmission and produce the expected outcomes. Here algorithm work in three parts these are input parameters or variable declaration, expected outcomes and procedure or execution of algorithm.

Input: M: nodes
S: sender nodes
R: receiver nodes

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incremental ad hoc network. In this table shows the simulation parameters which is used for analyzing the network activity, those parameters are number of nodes, routing protocol, transport protocol, traffic type etc. In this research we proposed the simulation of three protocols first one is normal LEACH, second is Leach protocol in CR network and proposed LEACH in CRN. The performance of proposed leach approach is provides better routing performance.

<table>
<thead>
<tr>
<th>Area of Simulation</th>
<th>800m x 600m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna Type</td>
<td>Omni-</td>
</tr>
<tr>
<td>Mobile Nodes</td>
<td>100</td>
</tr>
<tr>
<td>Radio Range</td>
<td>550</td>
</tr>
<tr>
<td>Transferring Mode</td>
<td>Multi-hop</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>Random</td>
</tr>
<tr>
<td>Routing Protocol</td>
<td>AODV, LEACH</td>
</tr>
<tr>
<td>Transport Layer</td>
<td>TCP, UDP</td>
</tr>
<tr>
<td>Traffic</td>
<td>CBR</td>
</tr>
<tr>
<td>Application Layer</td>
<td>FTP</td>
</tr>
<tr>
<td>Simulation Time</td>
<td>500</td>
</tr>
<tr>
<td>Packet Size</td>
<td>512 bytes</td>
</tr>
</tbody>
</table>

5.1. Cluster Formation and Members Analysis at 100th Second of Simulation

According to time instant nodes energy is depleting in network and the communication capability of nodes are also degrades in network. The particular node selection in routing is enhancing the possibility of link breakage but proposed approach selects the nodes according to their higher energy level. This graph represents the cluster formation of mobile nodes in case of proposed LEACH protocol and rest of two cluster based routing at 100 second. Here the number of cluster formation in case of proposed LEACH protocol and the number of members in this protocol is more. The highest member’s quantities in cluster is 38 in original LEACH, the quantities of cluster in existing protocol is also less than LEACH and the number of cluster members in proposed CRN is more but energy consumption is efficient.

5.2. Cluster Formation and Members Analysis at 200th Second of Simulation

The cluster formation and members in cluster are decided the better communication in dynamic network. The more number of cluster formation are reduces the possibility of energy efficient routing but if the cluster formation are less then larger number of members are communicate in single cluster Head. This graph represents the cluster formation of mobile nodes in case
of proposed CRN LEACH protocol, Existing Protocol and Normal LEACH- routing at 200 second. Here the performance of existing scheme is about total 52 cluster members are maximum present in one cluster. The performance of proposed CRN leach at time 200 seconds is better than normal LEACH protocol.

5.3. Cluster Formation and Members Analysis at 300th Second of Simulation
The better data receiving is provides the excellent performance in network and also shows the sign of strong and reliable link establishment. This graph represents the cluster formation of mobile nodes in case of proposed LEACH protocol and Old cluster based routing at 500 second. Here the number of cluster formation in case of proposed LEAH protocol is remains in network and the number of members in this protocol is more. The highest member's quantity is 16 but the performance of rest of the protocols is not reaches more than 3. That means the performance of proposed scheme is shows the better energy utilization.

5.4. Alive Nodes Calculation
The routing packets in network are consumes energy it means minimum number of routing packets are deliver maximum amount of data packets in efficient routing. This graph represents the alive nodes analysis in case of proposed cluster based scheme; existing scheme and normal cluster based routing at simulation time of 400 seconds. In this graph we clearly notice the smooth depletion of energy from initial energy to energy remain in nodes after the end of simulation time. It means the proposed scheme based routing selection strategy are maintained the reliability in network. The number of nodes quantity in case of proposed approach is high as compare to other approaches.

5.5. Packet Delivery Ratio (PDR) Performance Analysis
The Packet Delivery Fraction (PDF) analysis is represents the successful percentage of data received at destination. This graph is represents the packet percentage in case of proposed energy based routing and previous normal energy shortest path selection routing. Here this graph represents the more PDF in proposed LEACH cluster based routing it is about 93%, performance of existing protocol is about 91 % but the routing load in normal cluster formation are 80 % up to end of simulation. If the routing load in network are more it means energy consumption are more by that the life of nodes are lost early as compare to proposed. It means PDF value is good not show that the overall performance of network are also better.

5.6. Number of Routing Packets Flooding Analysis
The routing packets in network are consumes energy it means minimum number of routing packets are deliver maximum amount of data packets in efficient routing. In this graph in case of normal cluster based routing with energy factor the routing load are more it means the problem of connection failure are occur more here by that the more routing packets are required then energy also required for routing packets transmission and in proposed LEACH cluster based routing with multipath the cluster formations are more that reduces
consumption and minimizes the routing overhead. The routing overhead of existing protocol is about little bit more than proposed CRN LEACH but overhead of normal LEACH is really very high that shows the modification in routing is required.

5.7. Overall Performance Analysis
This table 5.2 represents the overall analysis in case of normal LEACH, previous existing scheme and proposed LEACH cluster based scheme. Here we clearly notice that in case of proposed scheme large number of packets are sending in network are more as compare to normal routing. The value of PDF is really gives appreciable performance. The reduction in routing load and delay are definitely reduces consumption of energy.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Leach</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Send</td>
<td>8365</td>
<td>9684</td>
<td>10707</td>
</tr>
<tr>
<td>Data Receive</td>
<td>6665</td>
<td>8324</td>
<td>9930</td>
</tr>
<tr>
<td>ROUTINGPKTS</td>
<td>14752</td>
<td>5272</td>
<td>5042</td>
</tr>
<tr>
<td>PDF</td>
<td>79.68</td>
<td>91.63</td>
<td>93.21</td>
</tr>
<tr>
<td>Normal Routing Load</td>
<td>2.21</td>
<td>0.63</td>
<td>0.51</td>
</tr>
<tr>
<td>No. of dropped data</td>
<td>1700</td>
<td>760</td>
<td>727</td>
</tr>
<tr>
<td>Average Energy Consume (Joule)</td>
<td>42.2</td>
<td>22.92</td>
<td>19.2</td>
</tr>
</tbody>
</table>

VI. CONCLUSION
The Cognitive Radio Network (CRN) is used to detect channel in Radio Frequency Spectrum (RFC). The Sensor Ad hoc CRN is the collection of nodes or battery dependent devices that are forming temporary infrastructure for communication in decentralized manner. The all sensor devices are get-together and forming dynamic link for data delivery. The multipath routing protocol are reduces the possibility of link breakage because of nodes leave the particular link and heavy load condition. The energy or power in sensor nodes is limited and it is necessary to utilize it efficiently for better network life time. In this research we proposed a modified version of LEACH protocol in Sensor Ad hoc CRN. The proposed scheme is selected the reliable nodes is term of higher energy level by that the strong link is established that reduces data drop possibility due to energy deficiency. In proposed LEACH protocol the number of nodes live in network are remains more, it means the nodes are ready for further communication in Sensor Ad hoc CRN. The performance of previous existing protocol in Sensor Ad hoc CRN provides better performance than normal LEACH protocol. The Cluster Head (CH) and cluster member analysis is measured up to 500 simulation time and observe that the number of CH is more count in different time interval and number of members in CH is also less but in proposed the measurement is just apposite i.e. the sign of energy efficient routing. The rest of the performance metrics like throughput and routing overhead are showing the better routing performance in proposed LEACH as compare to normal LEACH.

REFERENCES
[10]. http://www.isi.edu/nsnam/ns/