

Network Scalability Using Opportunistic Routing Protocol for Cognitive Radio Sensor Networks

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ABSTRACT: A Wireless Sensor Network (WSN) consists of spatially distributed sensors to monitor physical or environmental condition and to cooperatively pass their data through the network to a main location. In the existing work Geographic opportunistic routing protocol (GEOR) is implemented for WSNs. The major issues in GEOR is network scalability which is somewhat low due to high work load and also signal problem occurs due to the presence of multiple interfaces in single path. To overcome this problem, Cognitive networking with opportunistic routing protocol (CNOR) for WSNs is introduced. The purpose of the proposed protocol is to improve the direction of network performance after increasing network scalability. Then, a discrete event simulator is applied to examine the performance of the proposed protocol in comparison with a geographic opportunistic routing protocol. By using the opportunistic routing protocol performs better results with respect to throughput, packet delay ratio, delay and packet over head.

KEYWORDS: CNOR, CR, wireless sensor networks, scalability

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have attracted the attention of many researchers. Wireless Sensor Networks (WSNs) are used for various applications such as surroundings monitor, computerization, cultivation, and safety measures. While frequent sensors are usually deployed on remote and unapproachable spaces the consumption and maintenance should be easy and scalable. Wireless sensor network consist of large number of little nodes. The node after that sense ecological change and report them to other nodes over flexible network architecture. Sensor nodes are great for exploitation in hostile environments or over large geographical areas.

Wireless sensor networks have recently come into prominence because they hold the potential to revolutionize many segments of our financial system and life, beginning ecological monitor and preservation to manufacturing and business superiority organization to automation in the transportation and health care industry The design, execution, and action of a sensor network requires the confluence of a lot of authority, other than signal processing, network and protocol embed system information management and distributed algorithm. Such network is again and again deployed into resource-constrained environment, for instance through battery operate nodes running undeterred. This constraint order that sensor network exertion are best approach in a hostile method by together considering the physical, network and application layer and making major design tradeoffs across the layer.

A. Wireless Sensor Network Architecture

Wireless Sensor Network mechanism is reasonably simple, effortless and appropriate to a variety of fields. It is base on less significant nodes, regulator, radio transceiver, and battery. The enter to stimulate the sensor network is the algorithm sponsor multi-router phenomenon. The structure is completely dependent relative on the nodes and the harmony established between them through proper frequency. These nodes are of dissimilar sizes according to the function they execute. In the direction of stimulate the monitor or tracking function of these nodes a radio transmitter is

attached to forward the information signals in the form of emission They are controlled through the microcontroller according to the purpose and appliance in which they are used. Each and every one the system remains in working condition with the help of power supply which is in the form of battery.

The Wireless Sensor Network perform function concurrently where nodes are autonomous bodies incorporated in the field spatially for the correct result; the information transmits through proper channel taking the information collecting it in the form of data and send to the base.

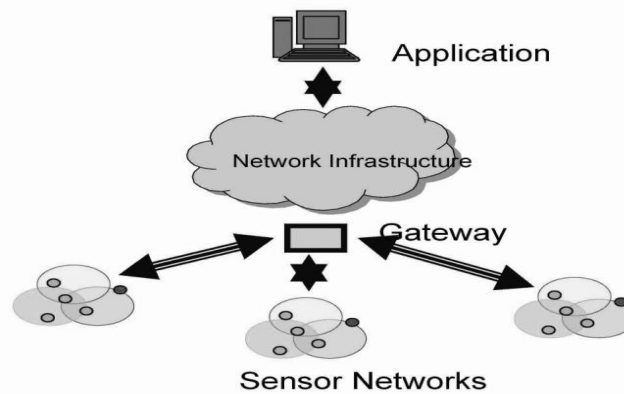


Figure 1. Wireless Sensor Networks

Sensor networks extend the existing Internet deep into the physical atmosphere the ensuing innovative network is orders of enormity more expansive and dynamic than the current TCP/IP networks and is creating entirely new types of traffic that are quite different from what one finds on the Internet at present. Information collected by and transmitted on a sensor network describes conditions of physical environment for exemplar, temperature, wetness or vibration and requires advanced query interfaces and search engines to effectively support User-level functions. Sensor networks may inter-network with an IP core network via a number of gateways. A gateway route user query or directives to appropriate nodes in a sensor network. It also routes sensor data, at times aggregate and concise to user who have request it or are accepted to utilize the information. A data ordnance or storage space service may be present at the gateway, in addition to data logging at each sensor.

B. Cognitive Radio Sensor Networks (CRSN)

Wireless Sensor Networks (WSN) exclusively operates over unlicensed band. Today, significant increase in the application that uses these bands brings about the coexistence problem. Therefore, WSN requests added capabilities to combat the interference incurred by the other applications.

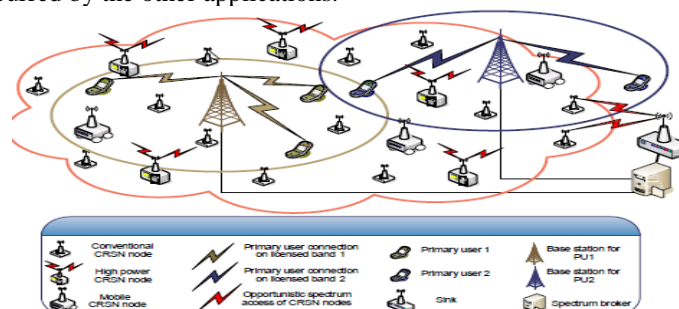


Figure 2. CRSN Architecture

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Cognitive radio sensor nodes construction wireless communication architecture of CRSN as shown Fig. 3.3.2 (a) in excess of which the information obtain from the pasture is convey to the sink in multiple hops. The most important responsibility of the sensor nodes is to carry out sensing on the environment. In adding up to this conventional sensing logic of duty, CRSN nodes also perform sensing on the spectrum. Depending on the spectrum accessibility sensor nodes transmit their reading in an opportunistic method to their next step cognitive radio sensor nodes, and eventually to the sink. The sink may be also capable of with cognitive radio capability, i.e., cognitive radio sink. In computation to the occasion interpretation sensors may exchange added information with the sink including control data for collection formation, spectrum allocation, spectrum handoff-aware route determination depending on the specific topology. Representative sensor pastures contain resource-constrained CRSN nodes and CRSN sink. Though, in definite appliance scenarios, extraordinary nodes among high power source, i.e., actor, which acts upon the sensed result, possibly part of the architecture as well. These nodes execute added tasks like local spectrum bargain or acting as a spectrum broker. Hence, they may be actively part of the network topology. It is assumed that the sink has unrestricted power and a number of cognitive transceivers, enable it to transmit and receive multiple data flows simultaneously.

II.BACKGROUND AND RELATED WORK

Michele Zorzi [1] have proposed the detailed description of a MAC scheme based on these concepts and on collision avoidance and report on its energy and latency performance. A simplify testing is given first, some relevant tradeoffs are decorated, and parameter optimization is pursue Further, a semi-Markov model is residential which provides a more accurate performance valuation. Simulation results supporting the validity of our analytical approach are also provided.

Petro's Spachos [2] suggested that Opportunistic routing schemes have been studied over the past decade to provide better performance in multihop wireless network, by taking the benefit of the broadcasting nature of wireless channel Simulation tools designed for such study are important and have been investigated to understand the network behavior.

Ian f. Akyildiz [3] have concentrated on to solve current wireless network problems resulting from the limited available spectrum and the inefficiency in the spectrum usage by exploiting the existing wireless spectrum opportunistically. XG networks, equipped with the intrinsic capabilities of the cognitive radio, determination make available an ultimate spectrum-aware communication paradigm in wireless communications.

Kaushik R. Chowdhury[4] are envisaged to extend Internet access and other networking services in personal, local, campus, and metropolitan areas. Mesh routers (MR) form the connectivity backbone while performing the dual tasks of packet forwarding as well as providing network access to the mesh clients. However, the performance of such networks is limited by traffic congestion, as only limited bandwidth is available for supporting the large number of nodes in close proximity. This problem can be alleviated by the cognitive radio paradigm that aims at devising spectrum sensing and management techniques, thereby allowing radios to intelligently locate and use frequencies other than those in the 2.4GHz ISM band. These promising technologies are integrated in our proposed Cognitive Mesh Networks (COMNET) algorithmic framework, thus realizing an intelligent frequency-shifting self-managed mesh network.

Weima [5] have developed Cooperative spectrum sensing in OFDM based on energy detection in MIMO cognitive radio sensor networks. Soft combination of the observed power values from different cognitive radio users is investigated. Square-law-combining (SLC) is theoretically proved to be nearly optimal in low signal-to-noise ratio (SNR) region, a usual scenario in the context of MIMO cognitive radio sensor network. In predominantly, the OFDM base MIMO cognitive radio sensor networks detect the primary user OFDM signal, everywhere CR receiver is equipped through multiple antennas based power detector. We pragmatic significant improvement in primary user detection with SLC based energy detection at the MIMO cognitive radio sensor networks.

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Shih-Chun Lin [6] suggested that Cognitive Radio (CR) emerges as a key technology to enhance spectrum efficiency and thus create opportunistic transmissions over links. Supporting the routing occupation on top of frequent opportunistic links is a necessity to route packets in a general cognitive radio network (CRN) consisting of multi radio systems. However, there lacks complete thoughtful of these highly dynamic available links and a reliable end-to-end transportation mechanism above CRN. Would-be to meet this need, we propose novel spectrum aware opportunistic routing (SAOR) algorithm suited for the CRN under wireless fading channels. Along with innovative institution of the spectrum map from local sensing information and the beginning of the routing metric for opportunistic links known as opportunistic link transmission (OLT), the opportunistic passageway metrics, and the CR node metrics, the promising SAOR employs a accommodating scheme to enable multi-path transmissions and maintains the statistical QOS guaranteed throughput for practical applications. Result in performance evaluation confirms that SAOR enjoys less delay with guaranteed throughput in CRN.

Bhorkar [8] has developed A distributed adaptive opportunistic routing scheme for multi-hop wireless ad-hoc networks are proposed. The proposed scheme utilizes a reinforcement learning framework to opportunistically route the packets even in the absence of reliable knowledge about channel statistics and network model. This system is made known to be optimal with respect to an expected average per packet remuneration criterion. The proposed routing designs mutually address the issues of learning and routing in an opportunistic environment where the network structure is characterized by the transmission success probability.

Guoru ding [9] suggested that Cognitive sensor network (CSN) is a promising paradigm to address the spectrum scarcity problem in traditional wireless sensor network. Dependable spectrum sensing is essential to enable the normal operation of a CSN. Existing studies have shown that by exploiting spatial diversity, cooperative sensing (CS) can greatly improve the detection performance over non cooperative sensing (NCS) in opportunity-homogeneous environment. However, in practice, at a given time cognitive sensors at different locations may experience heterogeneous spectrum opportunity, construction the cooperation among cognitive sensors intractable

III OBJECTIVE AND OVERVIEW OF THE PROPOSED MECHANISM

A. Objectives

In this paper, we propose

1. To develop cognitive networking with opportunistic routing protocol.
2. To compare the performance of **CNOR** with geographic opportunistic routing protocol.
3. To decrease workload of the network and improve the network performance after increasing the network scalability.

B. Overview of proposed mechanism

Cognitive Networking with opportunistic Routing Protocol is proposed to improve network performance. Cognitive Radio is a radio that can change its transmitter parameters based on interaction with the environment in which it operates. The CNOR protocol is an accurate channel model to built Routes are discovered only when it is needed. CNOR with opportunistic routing protocol going to achieve throughput, delay, packet delivery ratio and packet-overhead.

IV SYSTEM ARCHITECTURE AND MODULES DESCRIPTION

A. System Architecture:

The System architecture shown in figure 3.3 depicts the process towards achieving the warning message dissemination process. The overall structure of the system is briefly explained through the following diagram.

The trace file is generated by using static tool and the output of CNOR is fed into the network simulator as input. In NS2, the remaining is implemented using Tcl scripting language and the performance analysis is achieved using graph. The outputs of the network simulator are gathered into the corresponding trace file and this file is used for the performance analysis. AWK scripts are used to take the information from the trace file that helps graph for analysis

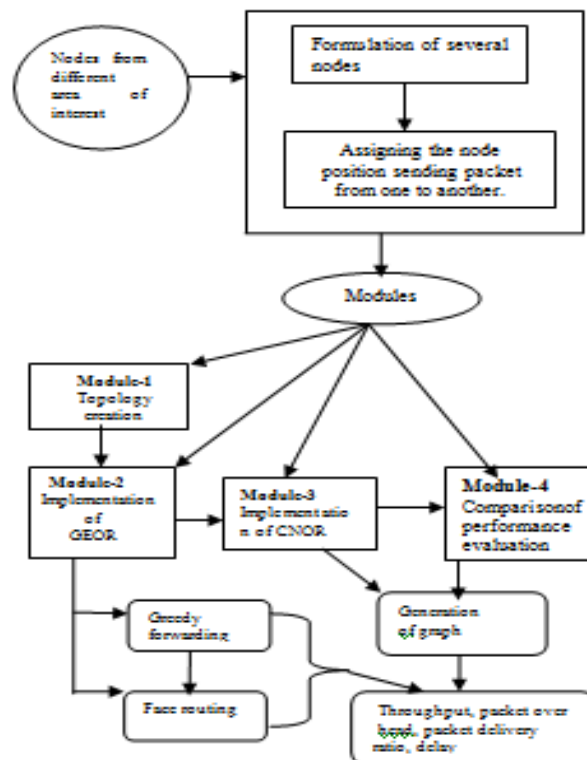


Figure 3. System Architecture

B. Modules Description

The major components of the system architecture are normal scheme implementation, GEOR implementation, access point based scheme CNOR implementation. Here various modules of preserving system are briefed below:

MODULE 1: Creating Network Topology

Grid Topology with more number of nodes is created using stationary nodes. The result is traced in to trace file.

The output trace file is fed as input to Network Simulator tool for scalability of nodes. Currently the packets transfer using a wide-ranging wireless network and this can be implemented using tool command language (tcl) and c++.

The base file creation of nodes and transfer of packets is done using normal scheme and parameters such as end to end delay, packet delivery ratio, throughput, packet-overhead is calculated and the output is shown using graphs.

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MODULE 2: Implementation of GEOR

This module is implemented on NS2 and using the output of scalability stationary trace file as input for the support of scalability of stationary (nodes). Here the GEOR can implementing was using two techniques. Each node is assigning access point to reduce delay and increase throughput.

Two techniques were used:

1. Greedy forwarding
2. Face routing

Greedy forwarding will select the neighbours which are closer to destination node. The disadvantage of greedy forwarding is when the node faces a dead end packet, it will get drop so at that time face routing will help. Face routing will select the next neighbour which is closer to destination. It is same as AODV-Ad hoc On Demand Distance Vector Routing technique. In GEOR there will be high radiation while sending the packets each time.

MODULE 3: Implementation of CNOR

Implement the simulation of the opportunistic routing in the CRSN network system. CRSN will helps increasing the network performance after increasing the network scalability. This scheme will increasing the network performance to analysis with the QOS parameters such as end to end delay, packet delivery ratio, throughput and packet overhead is calculated and the output is shown using graphs.

MODULE 4: Performance Evaluation

This module evaluates the network performance in terms of QOS metrics such as delay, throughput, and packet delivery ratio, packet-overhead. The comparison graph show the result analysis of each modules GEOR model, CNOR model by using graph.

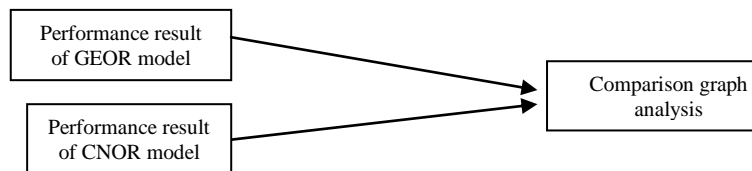


Figure 4. Performance analysis.

To make certain with the intention of the increased network performance is achieved, the metrics such as end to end delay, throughput, packet delivery ratio and packet over head are calculated and the analysis is taken as representation with respect to each metrics and time.

V. PERFORMANCE METRICS

We evaluate the network performance according to the below metrics:

THROUGHPUT

It is a measure of the amount of data transmitted from the source to the destination in a unit period of time (second). The throughput is measured in total bits received per second. Also to be distinguished is that this metric only measures the total data throughput; ignore all most recent overhead, more than the network. The throughput of a node is calculated by first counting the total number of data packets successfully received on the node, and compute the number of bits received, which is after all divided by the complete simulation runtime. The throughput of the network is next to last distinct as the average of the throughput of all nodes involved in data transmission.

Therefore, throughput can be stated as:

$$\text{Throughput of a node} = (\text{Total Data Bits Received}) / (\text{Simulation Runtime}) \text{ ----- (1)}$$

Correspondingly the throughput for the network can be defined as:

$$\text{Network Throughput} = (\text{Sum of Throughput of Nodes Involved in Data Trans}) / (\text{Number of Nodes}) \text{ ----- (2)}$$

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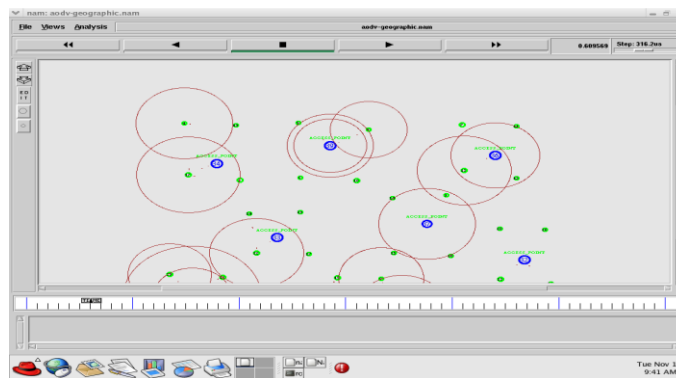
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DELAY

The end-to-end delay is the time taken for a data packet to reach the function node. The delay for a packet is the time taken for it to reach the destination. As well as the average delay is calculated by taking the average of delays for every data packet transmitted. The parameters come into play only when the data transmission has been successful.

$$\text{Packet Delay} = \text{Receive Time at Destination} - \text{Transmit Time at Source} \text{ ----- (3)}$$



$$\text{Average Delay} = \text{Sum of all Packet Delays} / \text{Total Num of Received PkTs} \text{ ----- (4)}$$

PACKET DELIVERY RATIO

It indicates the percentage of the transmitted data packets that are effectively received. It is an significant metric which can be used as an indicator to a crowded network. Yet again the delivery ratio is only considered for data packets. Initially the total number of transmitted packets is count follow through the total number of received packets and the total number of dropped packets. The delivery ratio is calculated as the percent of packets received to the packet transmit. The numbers of packets dropped do not take into account retransmissions. However the drop due to retransmission is not taken into account and is only counted when the packet is eventually dropped, and still in those cases it's counted as a particular drop. However, if the packet is effectively received by the destination after several retransmissions, the drop not considered. This would effectively construct the number of transmitted packets equal to the sum of the number of received packets and number of dropped packets.

$$\text{Packet Delivery Ratio} = (\text{Number_of_Received_Packets} / \text{Number_of_Transmitted_Packets}) \text{ ----- -- (5)}$$

PACKET OVERHEAD

It is the network traffic occurred in the topology. Traffic is the overhead which occurs in the network. Traffic should be low for the proposed protocol. It indicates the percentage of the transmitted data packets that are effectively received. It is an important metric which can be used as an indicator to a crowded network. Though the delivery ratio is only measured intended for data packets. Primarily the total number of nodes transmitted packets is calculation follow through the total number of received packets and the total number of dropped packets. The packet overhead is calculated as the percent of packets received to the packet transmit. The numbers of packets drop do not obtain into account retransmissions. Though the drop due to retransmission is not unavailable into explanation and is only calculation when the packet is ultimately dropped, and still in those cases its count as an exacting drop. While the other hand if the packet is successfully received by the destination after several retransmissions, the drop not measured

$$\text{Packet Overhead} = (\text{Number of nodes send packets at a time} / \text{number of received packets}) \text{ ----- (6)}$$

VI. SIMULATION AND RESULTS

A. Simulation

We ran the simulator by using stationary model generation by CNOR and NS2 simulation is conducted to evaluate the performance of network. We simulate to create a network topology and assigning the access point; we consider every 4 nodes fixed access point and send packet from the source to destination

Figure 5. Snapshot for the simulation of GEOR model

Figure 5 shows that the simulations of normal scheme by NS 2.34, in which four nodes are simulated with access point. The result of the scalability generator is fed into NS2 simulator. In GEOR there will be high radiation while sending the packets in each time. Then the NS2 use them. In each 4 node there is one access point and the normal user present with unique colour representation of blue and green respectively. The normal packet transmission is implemented. The simulation shows the transmission packets from sender to receiver as the flow of red. packets between them.

The simulation is based on time since NS2 is a discrete event tool. On all graphs the X-Axis is the Time, and Y – Axis is the energy spent for packet overhead, throughput for throughput analysis, packet delivery ratio for PDR analysis and end to end delay for delay analysis. The simulation time for each run is 100 seconds.

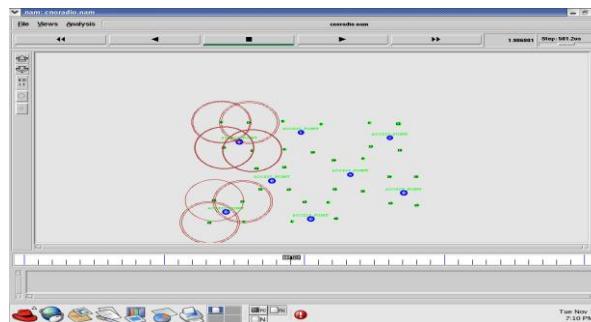


Figure 6. Snapshot for the simulation of CNOR model

Figure 6 shows that the simulation of CNOR by NS 2.34, in which four nodes is simulated with access point. That's the output of the scalability generator is fed into NS2 simulator. Then the NS2 use them. In each 4 node there is one access point and the normal user present with unique colour representation of blue and green respectively. Here the packet has been transmitted without shows visualization. Packet transmitted through radiation in 10sec interval.

B. Results

The comparison results are analyzed and evaluated their performance in terms of Quality of Service parameters of the network. The graph results are compared for the modules implemented in this phase are shown below

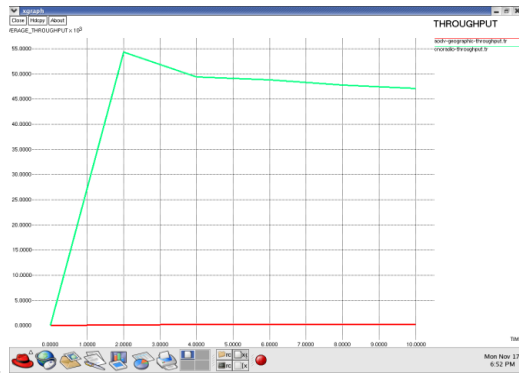


Figure 7. Comparisons graph for Throughput

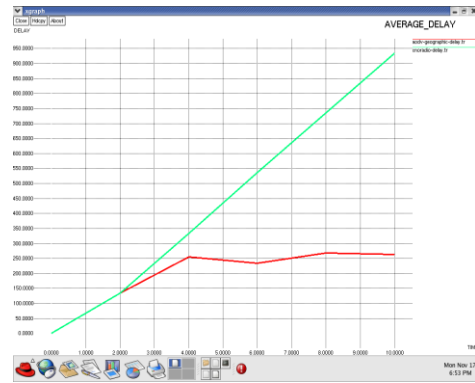


Figure 8. Comparisons graph for Delay

Figure 7 shows the comparison graph results of throughput for all nodes in the simulation for GEOR model, and CNOR model implementation. The red colour line represents throughput result of the GEOR model. The green colour line represents the throughput result of CNOR model. The comparison result concludes that the CNOR model improves the throughput.

Figure 8 shows the comparison graph results of average delay of all nodes in the simulation for GEOR model and CNOR model implementation. The red colour line indicates the Delay result of GEOR model. The green colour line indicates the Delay result of CNOR model. The comparison result concludes that the average delay is decreased in GEOR model.



Figure 9. Comparisons graph for PDR

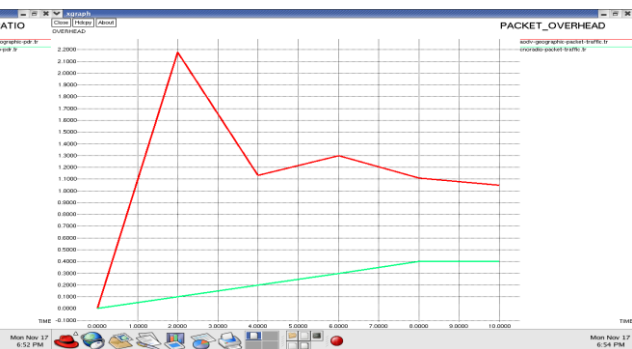


Figure 10. Comparisons graph for Packet-overhead

Figure 9 shows the comparison graph results of packet delivery ratio for all nodes in the simulation for GEOR model and CNOR model implementation. The red colour line represents the PDR result of GEOR model. The green colour line represents the PDR result of CNOR model. The comparison result concludes that the CNOR model increases the packet delivery ratio.

Figure 10 shows the comparison graph results of packet-overhead for all nodes in the simulation for GEOR model and CNOR model implementation. The red colour line shows the Packet-overhead result of GEOR model. The green colour line shows the packet-overhead result of CNOR model. The comparison result concludes that the CNOR model decreases the packet-overhead.

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VII. CONCLUSION

It is concluded that a cognitive networking with opportunistic routing for WSNs is introduced to improve network scalability. The protocol dynamically changes path and packet that are used for transmission, to fastly adapt to any changes of the network. The performance of the proposed protocol is compared with a GEOR. An accurate channel mode can provide signal strength in different environment. The introduced protocol shown to be efficient in terms of throughput, packet delivery ratio, packet traffic, and delay .The CNOR protocol quickly adapt to any changes in the network scalability where in network complexity and the implementation provide enough for WSNs.

REFERENCES

- [1] M. Zorzi and R. R. Rao, "Geographic random forwarding (GeRaF) for ad hoc and sensor networks: Energy and latency performance," *IEEE Trans. Mobile Comput.*, vol. 2, no. 4, pp. 349–365, Oct./Dec. 2003.
- [2] S. Biswas and R. Morris, "Opportunistic routing in multi-hop wireless networks," *SIGCOMM Comput. Commun. Rev.*, vol. 34, no. 1, pp. 69–74, 2004.
- [3] Ian F. Akyildiz, Won-Yeol Lee, Mehmet C. Vuran *, Shantidev Mohanty" Next Generation/ Dynamic Spectrum Access/Cognitive Radio Wireless Networks" *Computer Networks* 50 (2006) 2127–2159.
- [4] Kaushik R. Chowdhury, Student Member, IEEE, and Ian F. Akyildiz, Fellow, IEEE" Cognitive Wireless Mesh Networks with Dynamic Spectrum Access" *IEEE journal on selected areas in communications*, vol. 26, no. 1, january 2008.
- [5] Wei Ma#1, Mu Qing Wu#2 Dong Liu *3, Meng Ling Wang*4" User Sensing based on MIMO Cognitive Radio Sensor Networks" **IEEE Trans 2009**.
- [6] S.-C. Lin and K.-C. Chen, "Spectrum aware opportunistic routing in cognitive radio networks," in *Proc. IEEE Global Telecommun. Conf. GLOBECOM*, Dec. 2010, pp. 1–6.
- [7] L. Hanzo and R. Tafazolli, "Qos-aware routing and admission control in shadow-fading environments for multirate manets," *IEEE Trans. Mobile Comput.*, vol. 10, no. 5, pp. 622–637, May 2011.
- [8] [9] A. Bhorkar, M. Naghshvar, T. Javidi, and B. Rao, "Adaptive opportunistic routing for wireless ad hoc networks," *IEEE/ACM Trans. Netw.*, vol. 20, no. 1, pp. 243–256, Feb. 2012.
- [9] Guoru Ding Jinlong Wang, Qihui Wu Fei Song, and Yingying Chen" Spectrum Sensing in Opportunity-Heterogeneous Cognitive Sensor Networks: How to Cooperate?"*IEEE Tran's* vol. 13no. 11 pp. 4247-4255 nov.2013.