Improved Self CR-MAC in WSN

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Abstract— **In this paper, a Cognitive Radio based Medium Access Control (CR-MAC) protocol for Wireless Sensor Networks that utilizes cognitive radio transmission is used. In cognitive radio (CR) networks, identifying the available spectrum resource through spectrum sensing, deciding on the optimal sensing and transmission times, and coordinating with the other users for spectrum access are the important functions of the medium access control (MAC) protocols for that purpose geographic greedy forwarding algorithm is followed. In this paper, the sensor nodes are classified into nodes of critical information, and nodes of non-critical information. The CR-MAC protocol prioritizes the critical packets access to the transmission medium by transmitting them with higher power while transmitting lower priority packets using lower or higher transmission power depending upon the priority. The network throughputs can be improved by increasing number of traffic rate, also the end-to-end delay will minimizes by CR-MAC protocol. And a motive to take advantage of heavy traffic rate which may occur at the receiver, a higher priority packet experience congestion only when there are more than one critical packet transmission at the same time slot while non critical packets experience congestion when there are more than one transmission at the same time slot. Self CR-MAC is created for avoiding congestions, the coordinate find out the nearest node to forward the data. Information is remains forwarding.**

Keywords— **Wireless Sensor Networks (WSN), Medium Access Control (MAC), Quality of Service (QoS), Cognitive Radio (CR), Primary User (PU), Identity Detector (ID).**

Introduction

Accordingly today's trend of technology the demand for wireless communication introduces efficient spectrum utilization challenge. To complete this challenge, cognitive radio has emerged as the key technology, which enables opportunistic access to the spectrum. The main potential advantages introduced by cognitive radio are improving spectrum utilization and increasing communication quality. These appealing features match the unique requirements and challenges of resource-constrained multi-hop wireless sensor networks (WSN)[1].Cognitive radio is an emerging wireless communications concept in which a network or a wireless node is able to sense its environment, and especially spectrum holes, and change its transmission and reception chains to communicate in an opportunistic manner, without interfering with licensed users. Cognitive radio thus aims to improve the way the scarce radio spectrum is utilized [2][3].

The importance of differentiating traffic in wireless sensor networks is growing, and guaranteeing different (Quality of Service)QoS levels is considered a key challenge for research on wireless sensor networks [4][5].

The former approach is mainly focused on infrastructure based networks, in which a centralized coordinator or base station manages the spectrum allocation and sharing among the CR users. The CR users, however, may participate in the spectrum sensing function and provide channel information to the central controller. The standardization efforts lead to uniformity in design and policy, thereby allowing multiple independent CR operators to coexist. [6,7] As an example, the carrier sense mechanism at the MAC layer may not reveal complete information regarding the channel owing to its inability to distinguish between the energy radiated by other CR users and the active PUs in the spectrum. [8] In addition, packets may be simply retransmitted in the event of a collision with other CR users, while the transmission must cease immediately if the packet loss is due to PU activity. [9]

The importance of differentiating traffic in wireless sensor networks is growing, and guaranteeing different QoS levels is considered a key challenge for research on wireless sensor networks. Since network throughput and packet rejection rate are typically controlled at the Medium Access Control (MAC) layer, the employed MAC protocols have to provide a differentiated medium access mechanism for the sensor nodes. Many new MAC protocols are currently being proposed and tested for wireless sensor networks, but most of them focus on energy efficiency, and not on throughput and rejection rate constraints [10]. Therefore, MAC protocols that maximize network throughput, minimize packet rejection rate and differentiate network traffic are desirable. The most important attribute of a good MAC protocol for a WBAN is energy efficiency. In some applications, the device should support a battery life of months or years without intervention, while others may require a battery life of only tens of hours due to the nature of the applications.

I. ALGORITHM USED: GEOGRAPHIC GREEDY FORWARDING

"What is the geographic greedy forwarding?"

There are several types of ad hoc routing protocols, such as proactive, reactive, geographic stateless routing, and so on.

In this paper we used geographic stateless routing as it is the simplest routing protocol to be implemented in ns2. Why it is the simplest? It is because the property of stateless indicates that no one node in a network does not maintain any routing table. Note that we will still keep neighbors list at the routing component, but such information is available at logical link layer.

The purpose of this series is to learn how to implement a new routing protocol, thus we consider static networks where nodes are not move. The assumptions we hold for implementation include; 1) all nodes have its own geographic location (2-dimensional coordinates); 2) each node knows its neighbors location; and 3) a source node knows the ID and the location of the corresponding destination. The geographic greedy forwarding protocol that we are going to implement works as follow.

- On receiving a packet from upper layer, the source node adds a header including the destination ID and location.
- The source node sends out the packet to the neighbor closest to the destination.
- On receiving a packet from a neighbor, a node forwards the packet if there exist a neighbor closer to the destination than itself.
- If there is no neighbor closer than itself, so called local minimum, it simply drops the packet.
- When the packet arrives at the destination, routing is done.[11]

II. ALGORITHM

Algorithm 1

Header Files:
Channel/WirelessChannel;# channel type
Propagation/TwoRayGround ;# radio-propagation model
Antenna/OmniAntenna ;# Antenna type
LL ;# Link layer type
Queue/DropTail/PriQueue ;# Interface queue type
200 ;# max packet in ifq
Phy/WirelessPhy ;# network interface type
Mac/802_11 ;# MAC type
50 ;# number of mobilenodes
CRMAC ;# routing protocol
set val(x) 550
set val(y) 550
set ns [new Simulator]

Packet format: To define the source node ID, the destination node ID, and the location of the destination
Neighbor list and flow information:
#include "packet.h"

```
classGreedyNbr {
public :
    nsaddr_taddr_;        // The address
    float x_;             // x
    float y_;             // y

    GreedyNbr (nsaddr_t, float, float) ;
};
```

II. NETWORK MODEL DETAILS

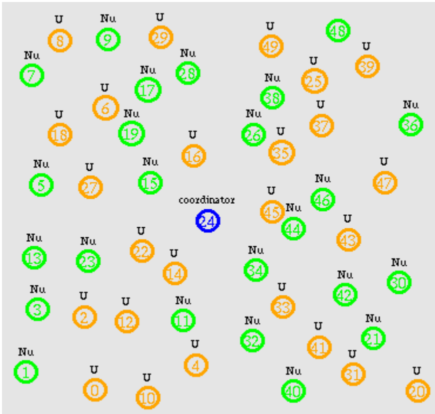

Figure 1. A star network model with U and NUn nodes

A star network model composed of a single network coordinator and 50 sensor nodes are assumed as shown in Figure 1. The sensor nodes are composed of reduced function devices (RFD) while the coordinator node is a Full-Function Device (FFD). The coordinator node can either be a standalone device or integrated within another device. In this paper, RFD nodes are battery-powered devices in which power constraints apply while the FFD coordinator node is assumed to have an external power supply. RFD nodes are classified into urgent sensor nodes (Un) and non urgent sensor nodes (NUn) according to their assigned physiological variables to measure such as blood pressure, temperature, humidity etc. depends upon the applications; The RFD node periodically reports the measured value to the FFD coordinator node. The coordinator node may process the received results before reporting them to the server via other networks such as a cellular system or WLAN.

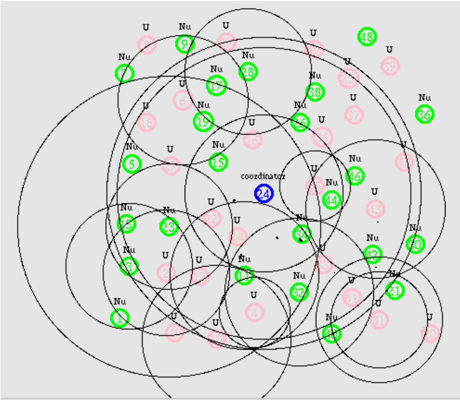

Figure.2.Self CR-MAC Network Model

RFD nodes are classified into urgent and non urgent sensor nodes according to their assigned prior informations.The RFD or U, Nu nodes periodically reports the measured value to the FFD.Fig 2.shows the environment of CR-MAC. The FFD or coordinator process the received result before reporting it to other networks such as cellulalr systems or WLANs for further process, then the information forwarding starts to the resultant node.

III RESULTS

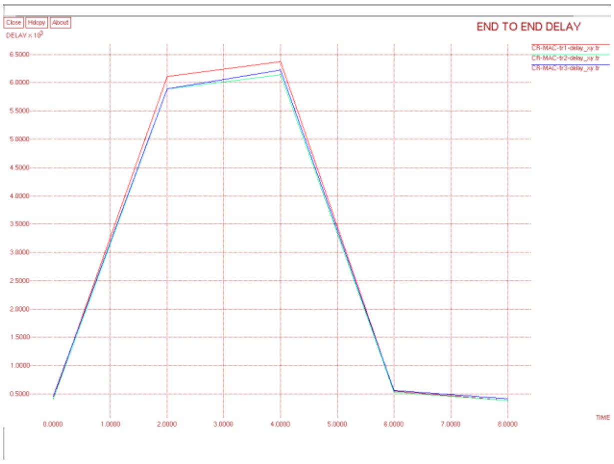

Figure.3. end to end Delay in different traffic

The above response graph of WSN in CR-MAC protocol shown in figure.3.it is for end to end delay in different traffics. It is the derived network traffic throughput and network traffic rejection rate mathematical formulas in Section 3 are solved numerically using the above parameters values. For each parameters setting, the critical and non critical nodes throughput and their packet rejection rates are mathematical computed. The obtained mathematical results are shown in Figures 3 and Figures 4.

Figure 4 shows the analytical results of the critical nodes, non critical nodes and aggregate system throughput; we have hundred nodes and are differentiated as 50 urgent i.e. critical nodes and 50 of non-urgent or non critical nodes. As the number of allowed packet retransmission is increased, the critical and non critical nodes throughput is increased. However, as the number of packet retransmission exceeds 8 non critical nodes throughput starts to decline while critical nodes throughput continues to increase. The reason behind such change is the effect of traffic differentiation through the use of cognitive radio transmission.

Figure 4 is showing the improved response of end to end delay for simple CRMAC and the self CRMAC when the network is having the critical information and the destination sensor node is busy then the geographical greedy algorithm find out the idle node for forwarding the critical information to the sensor node.Similarly, fig.5. showes the improved throughputs when the network is working in self CR-MAC than that of CR-MAC.

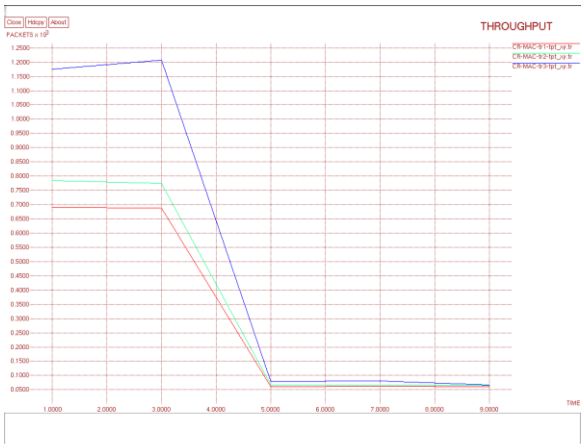

Figure.4. Throughputs at Different traffic

In CR-MAC protocol, critical traffic collision occurs only when there are more than one critical packet transmission at the same time slot while the non critical traffic collision happens whenever there is more than one packet transmission; critical or non critical, in a time slot. Therefore, critical traffic collision occurs less frequently than non critical traffic collision. So, the geographic greedy forwarding algorithm in wireless sensors networks which having cognitive radio MAC protocol is improves throughputs and also minimizes the end to end delay.

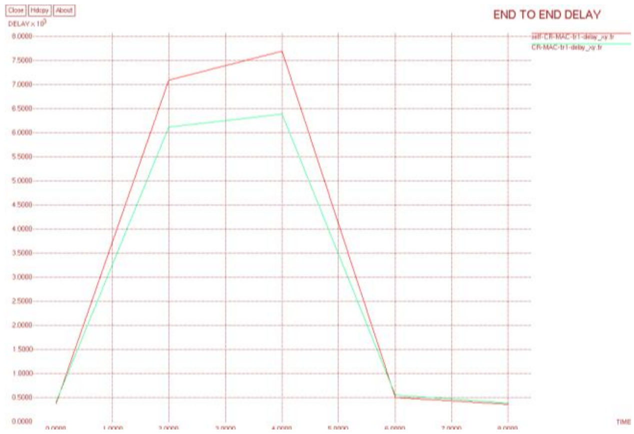

Figure.5 Delay in CR-MAC and Self CR-MAC

Figure 5 and figure 6 showing the reponse for throughputs and end to end delay in two different environment of CRMAC i.e. in simple CRMAC and in self CRMAC.The improved values we get in self CRMAC than that of CRMAC. The ability of CR-MAC to finding spectrum for sending and receiving the data informations for the neibour sensor node with highest energy.

Figure.6 Throughputs in CR-MAC and Self CR-MAC

CONCLUSIONS

Cognitive Radio-based MAC CR-MAC protocol which having the highest throughputs and the lowest delay when the traffic increases these having improved values as compared with the existing protocols. Therefore, a maximum limit of number of allowed packets transmission needs to be provisioned for a minimum non critical packet traffic throughput and maximum non-critical packet rejection rate can be obtained. The geographical greedy packet forwarding algorithm is having algorithm that it calculating the distance between the coordinator and the destination sensor node and find out idle node for forwarding packet, which maintain the information alive to reach to destination. The message loss is avoided by this protocol. The strongest node forward the data information that means improves the basic parameters.

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