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Geographical Routing Algorithms In Asynchronous Wireless Sensor Network

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Abstract- **In wireless sensor network, the network lifetime depends upon the battery of the sensor nodes. As the Sensor nodes are small in physical size the battery power is also limited .To conserve the energy, sensor nodes operate in sleep wake mode, when a sensor node is in idle state it is in sleep mode, due to this we can save the battery power. We are considering asynchronous network in which the sensor nodes are waking at different time. Routing to such network is difficult, delay occur in the network because each node has to wait for the next node to wake up , one of the routing algorithm is Any casting (AC) , data is delivered to the node which wake up first ,the disadvantage of AC algorithm is that the route can be long adding more delay to network. Second algorithm is maximum forward (MF), data is delivered to the node which is nearer to the sink and farther from source node, the disadvantage of MF is the source node have to wait and check each node distance which falls in its vicinity, due to this additional delay has been introduced in the network, next algorithm is based on thresholding, thresholding in terms of distance of the communication range, source node will forward the data to the node which is greater than threshold and nearer to sink due to this the source node does not have to wait each node to wake up and data is forwarded with shorter routes.**

Keywords: Asynchronous Wireless Sensors Network (WSN), Node, Transferring nodes, threshold distance algorithm (TC), any casting algorithm (AC), maximum forward algorithm (MF).

I. INTRODUCTION

Wireless sensor network has been considered as one of the most important technology. Tiny, cheap, and smart sensors are deployed in a physical area and networked through wireless links to perform some operation, like environmental monitoring, battlefield surveillance and industry process control. In the past few years, Wireless sensor network has received attention from industry as well as from academic.

In a WSN sensor nodes are deployed in an interested area, due to short transmission ranges large number of nodes are deployed, these nodes are equipped with sensors ,microprocessor and radio transceivers thus these nodes not only has sensing capability but also has data processing and communication capability, these nodes will collect the data and route the data to sink. In WSN, sensor nodes has dual functionality ie data originator and data router. [7]There are some issues that have to be considered in a WSN, Sensor nodes are powered by battery and in most situations it is very difficult to change or recharge the batteries so power conservation is important in WSN. Sensor nodes have limited processing and storage capacities and therefore nodes performed with limited computation functionalities.

[6]Routing play an important role in power conservation, the main task of wireless sensor nodes is to sense and collect data from a target

domain, process the data, and transmit the information back to specific sites where the underlying application resides. To achieve this task efficiently, it is required to develop an energy-efficient routing protocol to set up paths between sensor nodes and the sink. [1]One specific, ad hog routing appears to be more accessible to algorithmic analysis is geographical routing. Geographical routing also called as location based or position based routing. In this there are two assumption, first, it is assumed that every node know its own and its neighbor location. Second, the source node knows the destination position where the message has to deliver. This has an advantage that topology can be changes independently and whenever node want to transmit the data it will simply addresses the message with the position of destination. The algorithm which we are using is based on thresholding; known as threshold distance algorithm (TD), by transmission power we will get the communication range, and as we know the position of the nodes we can calculate the distance of nodes from the source node. We will transfer the data to a node which is greater than threshold and nearer to the sink.

II. RELATED WORK:

Joohwan Kim, Xiaojun Lin, and Ness B.Shroff has introduced "An optimal anycast technique for delay sensitive energy constrained asynchronous sensor network", the scheme anycast means that each sensor node forward the packet to the first node that wakes up among its neighbor. This pattern will have smallest delay.[2]

K.P.Naveen and Anurag Kumar has considered a WSN in "Tunable Locally-Optical Geographical Forwarding in WSN with sleep wake cycle", in which geographical forwarding and asynchronous nodes are used. If the nodes know their locations and that of sink then it is possible to select the node which is nearer to the sink .A node needs to forward a packet to the sink. There is set of neighbors of the node that are nearer to the sink than the node, the forwarding set. The relay node is selected such that the delay should be minimized. Each node has at least one neighbor that is strictly closer to the sink than itself so that greedy forwarding will always find a path to sink. This will eliminate the one hop delay.[3]

Martin Mauve and Jorg Widmer in "A survey on Position based routing in Mobile Ad Hog Networks" has presented an overview of different routing protocols that makes routing decision based on destination position. According to this paper ad hog network is divided into static and mobile network. In static network, position of the nodes are fixed ie once it is deployed it does not change. Whereas in mobile network the position of the nodes changes frequently. Routing is difficult in such situation they had distinguish two different approaches topology based and position based routing. Position based is more advantageous than the topology based because position based routing does not require establishing or maintaining the routes and the nodes do not have to maintain the routing table.[5]

III. NETWORK:

1. Node Deployment:

The nodes n are deployed in a square region (0.m), as it is Geographical routing, the node location is very important because the main objective of geographical routing is to use location information to find an efficient route towards the destination.[3]

Let xi be the location of the nodes where i= 1 to n-1. The source and sink has the fixed location ie x_0 (0, 0) and

Xn (m, m). R_c will be communication range the nodes will call neighbor only when the will be in communication area, the distance between two

nodes will be less than R_c, and the distance between from any node to the sink will be

$L_{i=} x_n - x_i$.

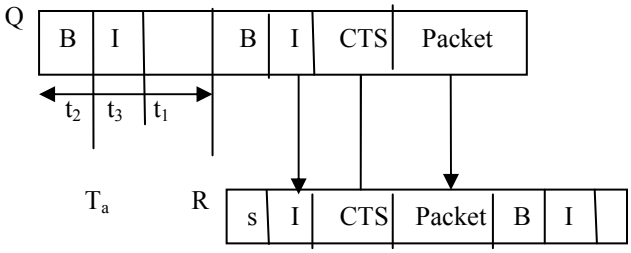
2. MAC protocol:

The wireless channel has a broadcast nature where the transmission of a sensor node can be received by multiple sensor nodes surrounding it. Each sensor node share the wireless channel with all the nodes in its transmission range, so designing of medium access control (MAC) protocol is very important. The MAC protocol ensure that the communication links between the nodes are established and connectivity is provided throughout the network and the collision which occurs due to the nodes which transmit at the same time and located closely should be eliminated.

MAC protocols are classified as contention based, reservation based, and hybrid and so on. Most of the MAC protocols proposed for WSN rely on convention medium access scheme, the scheme is carrier sense multiple access (CSMA) mechanism. In contention based protocol CSMA is used for basic data communication. CSMA relies on carrier sense. Carrier sense refers to nodes listening to the channel for a specific amount of time to assess the activity on the particular channel. CSMA is listen before transmit method. If the channel is ideal the node may transmit immediately or if the channel is busy the node defers the transmission and monitors the channel until the transmission get over. For Example if node A is sending some data to node B and node C which is nearer to node A want to transmit some data to node A, then C will hear the A's transmission and differ it's transmission ,this will avoid collision. [6]

3. Scheduling:

By using sleep wake cycle, the energy consumption in the WSN can be reduced significantly. There are two types of network depending on sleep wake pattern, synchronous sensor network and asynchronous sensor network. In synchronous all the nodes in the network wake up and sleep at the same time, while in asynchronous all the nodes in the network has different sleep wake pattern. In asynchronous network, the clock synchronization which is used in sleep wake scheduling can be avoided due to this considerably amount of energy consumption can be reduced



. *Figure 1.1 Scheduling*

B-Beacon

I-Sender ID

CTS-clear to send

t_1- listen for acknowledgment CTS

t_2- duration of beacon

t_3- duration of ID signal

s- Sensing the channel

Refer Fig 3.2, node Q sense an event and want to transmit the packet, as it is asynchronous network node Q has to wait for node R to wake up. It sends beacon signal of duration t_2 and the Id signal of duration t_3 and listens for the duration of t_1 for acknowledgement; it will repeat the sequence till R wakes up and sense the beacon, it will stay awake to decode the Id signal contains the identity of sending node. R wants that packet it will send CTS then Q will transmit the packet to R. if R does not want the data it will go back to sleep. [2]

Since we want the delay occurred in routing due to sleep wake cycle we will neglect propagation delay, transmission delay and other delays.

Let T_i be any random number which is uniform on (0, T), i=1,2……n.

T is period of the sleep wake cycle.

The node i wake up at the periodic instances,

$kT+T_i, k \geq 0$.

The waiting time for a node to wake up at time t will be,

$W_i(t) = \inf \{kT+T_i \geq t, k \geq 0\} - t$ [1]

4. Routing:

In this network node can take decision by observing the neighborhood activities, some assumption are made ie only single packet is transmitted at a time, events are separated with respect to time so that two events will not intersect. Each node knows its location and location of sink

Forwarding set is the set of nodes which are neighbors to sender node but nearer to sink. Each node knows their forwarding set nodes by the routing table.

Suppose a node i want to transmit the packet, at some instant, let p_i be the set of nodes which are in communication range of node i and closer to sink ie

$x_p - x_i \leq Rc$ and $x_n - x_p < L_i$

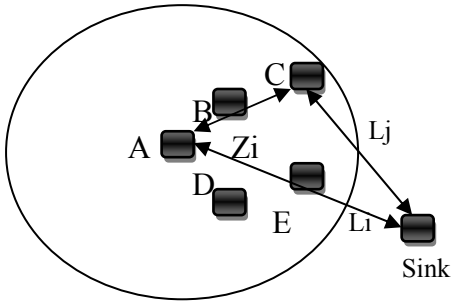


Figure 1.2 Transmission within forwarding set

Refer to fig 1.2 with respect to node A the forwarding set are B, C, D, and E. A want to send the packet it will wait till any node in the forwarding set wake ups, until then A will send continuously the beacon signal with its ID and L_i. First node C wakes up listen to the channel it will check $L_j < L_i$. L_j=the distance of nodes from sink individually. If yes then it will respond to A otherwise go to sleep.

Here the L_1 (Distance from sink) is smaller than L_i so the progress made will be $Z_1 = L_i - L_j$.

Now we will consider 3 algorithms:

A. Maximum forward Algorithm:

In this the node A will forward the packet to that node which is closer to sink ie, it will wait all the nodes which are in forwarding set to wake up and then transmit to the node which make the maximum progress. Refer to fig 1.2 node E will make maximum progress so A will transmit to E. This will give maximum delay and maximum progress.

B. Any cast Algorithm:

In this policy node A will transmit to any node whichever wake up first, refer to fig 1.2; if node C wakes up first then A will transmit C immediately. This will give minimum delay and minimum progress.

C. Threshold distance Algorithm:

Transferring set is the set of nodes which are neighbors to sender node but nearer to sink. Each node knows their transferring set nodes by the routing table. Thresholding distance can be decided by,

T = (1/6) X C

T = Thresholding

C = Communication Range

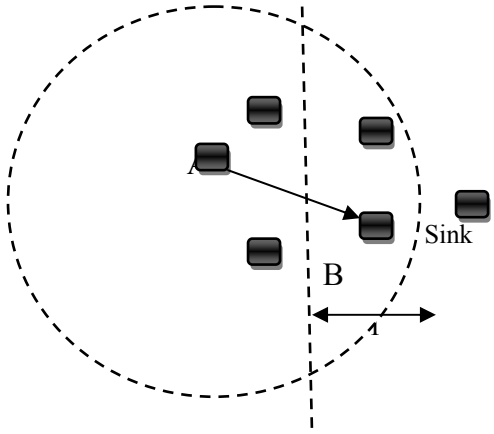


Fig 1.3 TC Routing

I= Interested area.

Refer to Fig no.1.3, the nodes which falls in I area is our transferring nodes; among them the node which responded first, is the node to which the data will get transferred. As in figure the source node A will transmit the data to node B as the node B has responded first. This process will go on until sink get the data.

IV. IMPLEMENTATION:

We had implemented the network in OMNeT++, for designing wireless sensor network a new software MiXiM should be imported in OMNeT++, The result is an event log file which contains detailed information of the simulation, and later can be used for various purposes, such as visualizing message exchanges among modules on a sequence chart. Two network is simulated in this simulator, the network consist nodes deployed randomly in 300 m sq feet playground area. Its network type is base network layer using CSMA MAC protocol. The header length is 24 bits, bit rate is 15360 bps, and maximum transmission power is 100mW. First network is designed with no sleep wake cycle the first event take place at 389 msec. Referred to Fig no.1.4.

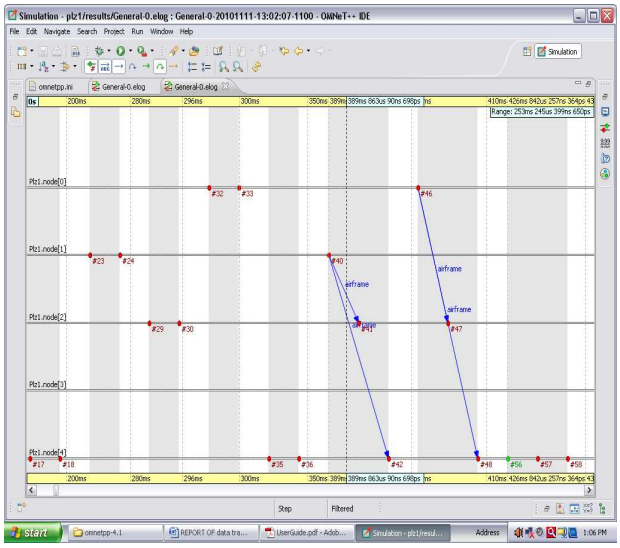


Fig no. 1.4 simulation of first network

Second network is designed by putting sleep wake pattern as 0.5 ms the first event take place at 394 msec. that means delay has been introduced in the network. Referred to Fig no.1.5. For the second network we had designed the TC algorithm.

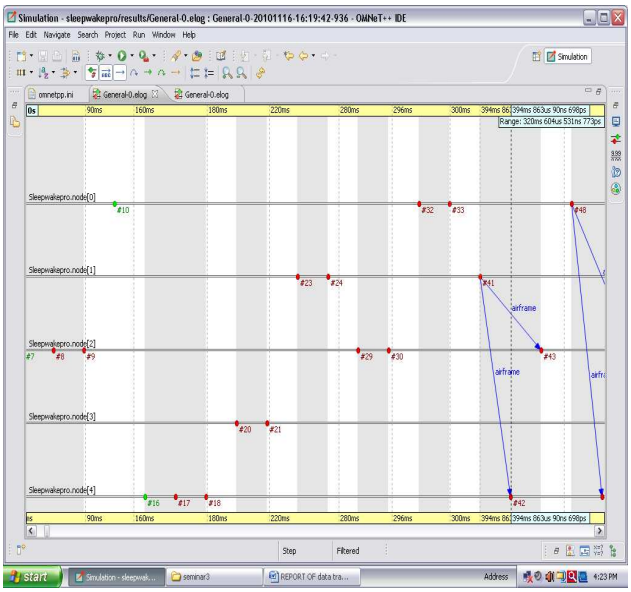


Fig no.1.5 simulation of second network

V. CONCLUSION:

The results which we had derived from OMNeT ++ shows that delay has been introduced in the network and to reduce the delay we can apply all stated algorithm, MF will give maximum delay and maximum progress, AC will give minimum delay and minimum progress, TC will give us minimum delay and maximum progress.

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