International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 3, Issue 11, November 2014

ENERGY EFICIENT METHOD USING ENERGY BALANCED ROUTING PROTOCOL FOR WSN

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***Abstract*— Wireless sensor network is a wireless network consisting of widely distributer autonomous devices using sensors to monitor physical or environmental conditions. In WSN large number of node organized into a cooperative network. In WSN nodes are battery powered devices, they have limited transmission power, communication ability storage capacity. For effective transmission of data to receiver we go for design of routing protocol. Since energy conservation is a key issue in WSN, data aggregation is exploited to save the energy. This paper proposes energy efficient method using energy balanced routing protocol. This method is based on forward aware factor technique. In FAF, next hop node is selected based on forward energy density and link weight. Simulation results shows that the proposed method balances the energy consumption, increase the network lifetime and provide QoS .**

***Index Terms*— Energy balanced routing, Energy consumption, Forward aware factor, Wireless sensor networks**

I. INTRODUCTION

It is well known that wireless sensor network consist of large number of sensor nodes.in industrial application. WSNs is an active research area over past few years. WSN used as a effective medium to integrate physical world and information world of industrial application. Each sensor node act as both sensor and router . It has limited energy and communication ability. so the design of routing protocol and network topology are required. Energy consumption is important factor in the design of WSN, there are two approaches to accomplish the data collection. They are direct communication and multi hop forwarding.

In direct communication, the sensor node directly transmits the data to the sink, this method increase the communication distance and degrade the energy efficiency of the sensor nodes. In multi hop forwarding sensor node transmit the data to the sink through multiple relays and thus communication distance is reduced[1]. However the energy of sensor node closer to the sink is decreased rapidly thus reduce the network performance.

In recent years, to balances the energy consumption, increase the communication and connectivity, several mechanism are designed for wireless sensor networks. Some mechanism deals with complex networks such as SCN and airport network. In [2] BBV weighted network model is based on the strength of connections, it also consider the strength of connections. BBV model widely used to analyze the scientist collaboration network and airport network [3]-[5].

Traffic load of the node is depends on several factor. One important factor is the relative distance between node to sink. Generally the node closer to the sink has high traffic load, this is due to the node closer to the sink has to forward the packets all other farthest node. Traffic load also depends on the type of routing protocol. Because routing protocol determine the next hop node for forwarding the data to sink. Lastly traffic load depends on the characteristic of environment which affects the radio communication behavior of the sensor node. Based on the detailed analysis of data transmission mechanism, we define the forward transmission area .forward energy density. Based on these we propose a energy balanced routing method that balances the energy consumption and increase the network life time.

II. RELATED WORK

A. Ad-hoc On Demand Vector routing

ADOV routing protocol use neighborhood information to route the packets to sink[6]. In AODV, the network remains idle until a connection is needed. If the network node requires the connection then it broadcast the request for connection. Each node maintains the routing table with only one entry to destination. Each table entry stores the next hop to that destination and the destination generate sequence number, which is used to identify whether the information is current or dated. Each entry node also stores the address of the active neighbor node through which packets are routed to the

ISSN: 2278 – 909X

destination. Whenever link failure occurs, the upstream node immediately identifies the active neighbor of the link. This is repeated until the source node reaches the link. Then route recovery process is initiated.

The major difference between AODV and DSR is that the DSR uses the source routing in which data packet carries the complete path to be traversed but in AODV, the source node and intermediate node stores the information of the next hop node through which the data can be transmitted. Another difference is that the AODV uses the destination sequence number which is used to determine the current path to destination.

B. Low Energy Adaptive Clustering Hierarchy (LEACH) protocol

LEACH protocol is based on hierarchical routing algorithm. In LEACH the nodes are grouped to form local cluster. The cluster has cluster head and cluster member, the protocol can be divide into two phases setup phase and steady state phase. In setup phase the nodes are organized and the cluster head(CH) is elected based on threshold value. In steady state phase data are transferred from the cluster member to CH and from CH to the sink. In clustering algorithm, the CH node has high energy when compared to cluster member.

If the CH node fails in cluster means, all cluster member inside the cluster lost its communication ability. LEACH is based on TDMA scheme, it allocates time to each node. So node can transmits the data at their allocated time.

In setup phase the sensor node choose the random (r) number between 0 and 1.if this random number is less than the threshold value means that node act as the CH for current round. the non-cluster head node choose the CH with strong signal strength and form the cluster. Then the CH collects the data from all nodes and transmit to the sink [7].The threshold value T(n) can be calculated by

$$T(n) = p/(1-p\times r \bmod(1/p)) \text{ , } n \in G$$
$$0, \quad \text{else} \qquad (1)$$

Where p is the percentage of cluster head account for all sensor nodes , r is the current number of round and G is the set of non-cluster head nodes.

In steady state phase, the operation is broken into frames where node can transmit their frame at most once per frame during their scheduled transmission time slot. Based on the received signal strength of the advertisement, CM sets the transmission power using power control. This is used to reduce the energy dissipation. The cluster head receives the data from all nodes by keeping the receiver on and then transmits the data from CH to the base station.

III. PROPOSED METHOD

A. Energy balanced routing protocol based on FAF:

Based on the position of the sink and cluster node, the forward transmission area can be calculated in this method. Forward transmission area (FTA) [8] defines the forward energy density which constitutes forward aware factor with link weight. This proposed communication protocol sense of balance the energy consumption and increase the network life time.

1). Network model

Sensor nodes are randomly dispersed in the rectangular sensing field. Data are sent to the cluster head and then from cluster head to sink node. Fig.2 shows the distribution of node in the rectangular W×H field.

In this network model, all nodes are similar i.e isomorphic; they have restricted energy and communication ability. Consider the N total number of nodes and it can be defined as $V=(v_1,v_2,\ldots v_N)$.

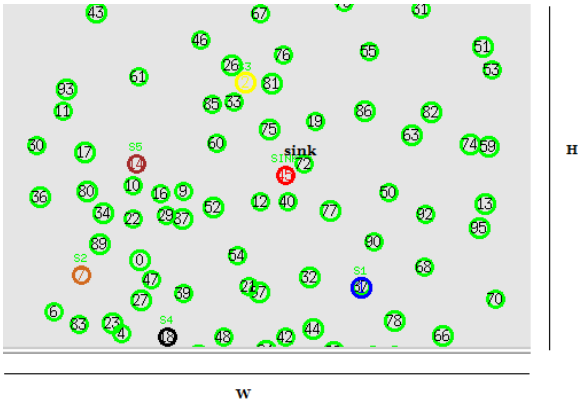

Fig .1 Distribution map of sink and nodes

The original energy of the node can be considered as E_0. When this energy is drained means node dies, however energy of the sink node can be added. The location of the sink and sensor node can be fixed.

The sink node broadcast the message to all sensor nodes in the sensing field. Received signal strength is used to compute the distance between source and sink node. Central node cannot be nominated initially. It can be selected after the topology development [8].

The communication range of the sensor node is set to d_0. The threshold d_0 can be defined as

$$d_0=\sqrt{(\varepsilon_{fs}^2/\varepsilon_{mp})}$$

where ε_{fs}, ε_{mp} are energy coefficients.

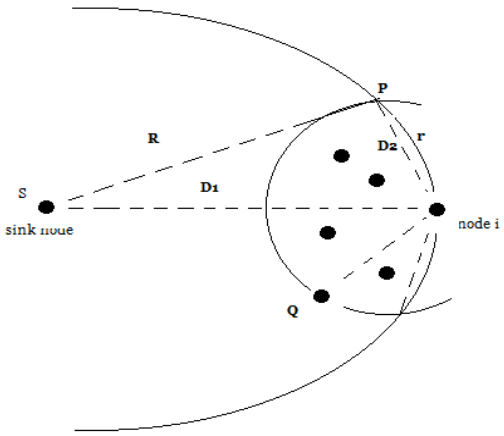

Fig 2. Forward transmission area

From fig.2 d(i, sink) is the distance between the node i and sink node. d(i ,sink) can be defined as

$$R=(X \text{ , } \sqrt{((H/2)^2+ (X+W)^2)})$$

ISSN: 2278 – 909X

When i is the cluster head, the communication radius of the cluster head $R_{opt}(i)$ is given by

$$R_{opt}(i) \sim f_1(R).$$

Where $f_1(d(i, sink)$ is the function of $d(i, sink)$. And its ranges is between 0 and d_0

Fig 3.shows two circle, circle 1 has sink as the center and d(i ,sink) as the radius. Circle 2 has node as center and d_{ip} as radius. Forward transmission area of node I can be denoted as FTA(i)

$$FTA(i) = \odot S \cap \odot i$$
$$r = \max(d_{ij}),\ j \in N'(i)$$

where d_{ij} is the distance between node i and node j, N(i) is the set of nodes that has the communication link with node i and N′(i) is the set of nodes of N(i) that have an edge with node i[8].

In this routing method, each time the node finishes the transmission, the strength of the next hop node is checked. If the next hop node energy is less than the average value of all sensor node strength in forward transmission area then topology reconfiguration is launched. New node is selected for next round of transmission.

2).Design

Energy balanced routing method based on FAF is used for the large scale WSN for static data collection and event detection[9]. This algorithm divided into several stages

1. Decide the FTA(i) and the probable next hop nodes of node i. The node that adjacent to sink than node i constitute set of all possible next hop node and furthest node determine the FTA(i).
2. Next evaluate FTA(j) and $S_{FTA}(j)$ for all possible next hop node. It can be designed as that of FTA(i) and $S_{FTA}(i)$

$$S_{\mathrm{FTA}}(i) = \frac{1}{2}\pi d_2^2 - d_2\sqrt{d_1^2 - \frac{1}{4}d_2^2} + \left(d_1^2 - \frac{1}{2}d_2^2\right) \times \arccos\left[1 - \frac{1}{2}\left(\frac{d_2}{d_1}\right)^2\right]. \quad (2)$$

IV. SIMULATION

At present agent based modeling and simulation is the only pattern which allows the simulation of complex behavior in the environment of wireless sensor networks. Agent based simulation of WSN is new paradigm. It is based on social simulation. Network simulator like OPNET, netsim, and NS2 can be used to simulate wireless sensor networks. This project was done using NS2. Basically NS2 program contain four steps. They are 1). Create an event scheduler 2). Turn on tracing 3). Create a network 4). Monitor using network animator. Creating network contains computing the setup routing, creating transport connection, creating traffic.

A).SIMULATION RESULTS

Simulation shows the comparison between energy balanced routing protocol with LEACH by five parameters: packet delivery ratio, throughput, energy consumption, end to end latency, packet drop. Packet delivery ratio can be defined as the ratio of number of packets received to the number of packets sent. Throughput can be defined as rate of successful message delivered over a communication channel. End to end latency refers to the time taken for a packet to reach source to destination over a network. Packet drop means difference between packets sent and packets received. Energy consumption can be defined as average energy consumed on ideal sleep transmits and received to total energy consumed. Simulation results shows that the performance of energy balanced routing protocol can be much better than the LEACH protocol in terms of above parameters.

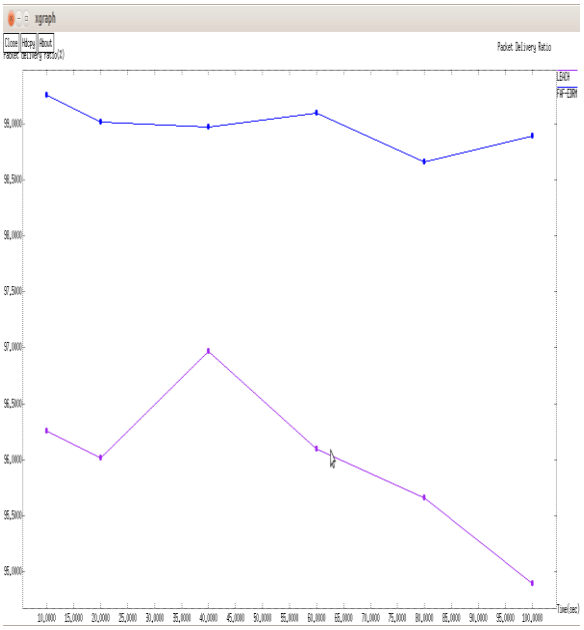

Fig 3.Comparison of Packet delivery ratio

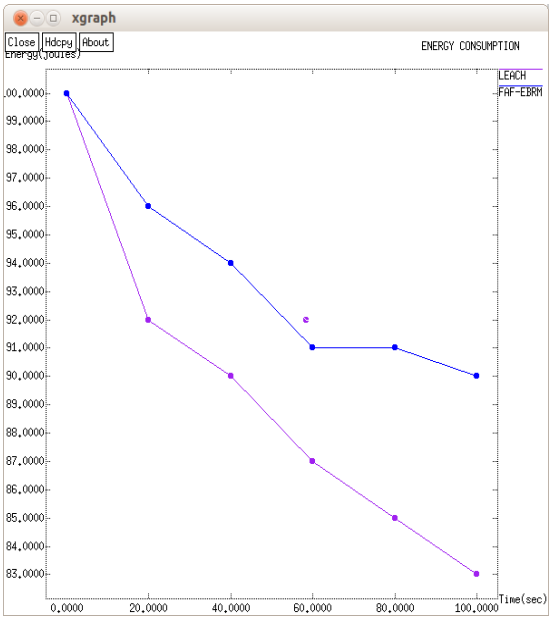

Fig 4.Comparison of energy consumption

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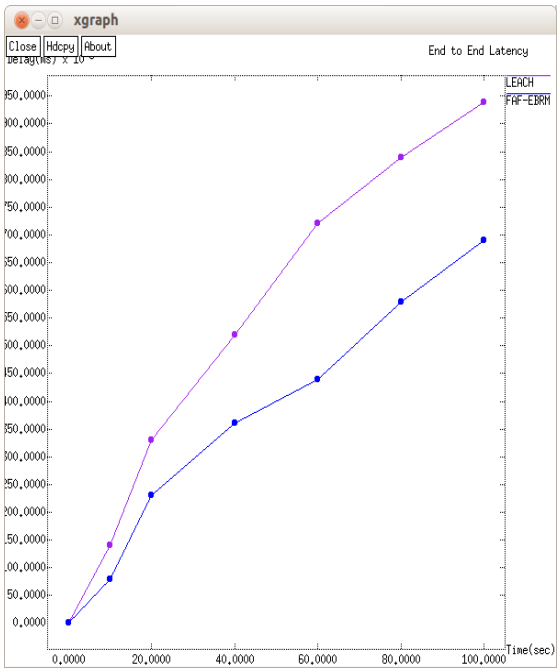

Fig 5. Comparison of end to end latency

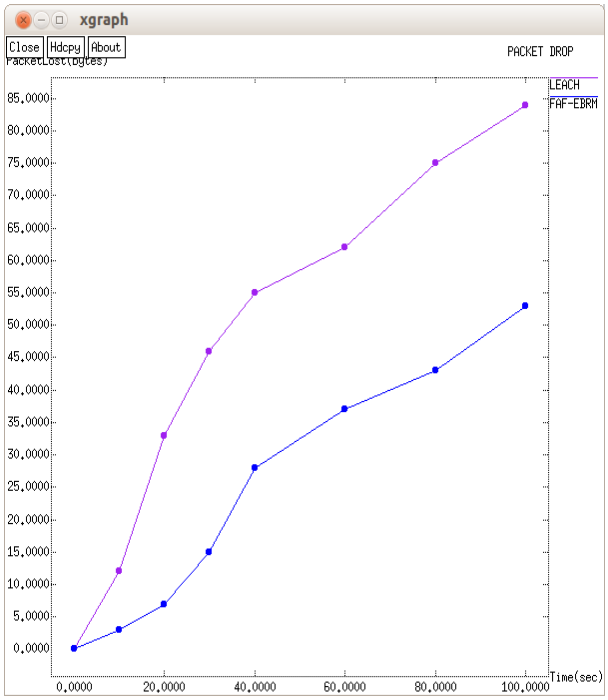

Fig 6. Comparison of packet drop

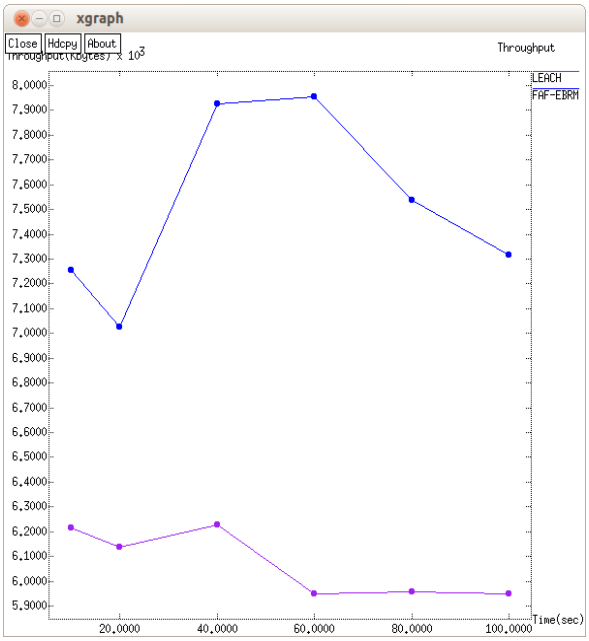

Fig.7. Comparison of throughput

V. CONCLUSION

This paper proposed energy efficient method using energy balanced routing protocol. This method uses a forward aware factor technique. Simulation results show that the proposed method balances the energy consumption, increase the network life time. Enhancement work includes studying the issues and overcome those issues.

ACKNOWLEDGMENT

First of all we sincerely thank the almighty who is most beneficent and merciful for giving us knowledge and courage to complete the project work successfully. We also express our gratitude to all the teaching and non-teaching staff of the college especially to our department for their encouragement and help done during our work. Finally, we appreciate the patience and solid support of our parents and enthusiastic friends for their encouragement and moral support for this effort.

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ISSN: 2278 – 909X