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Lifetime Energy Efficient Optimization for WSN

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ABSTRACT *A wireless sensor network with a large number of tiny sensor nodes can be used as an effective tool for gathering data in various situation. Sensor networking is challenging because of signal processing, networking & protocols, databases & information management, distributed algorithms, embedded system & Quality of Service (QoS). Many routing protocols have been designed & evaluated for wireless sensor network using simulation tools. In this paper we put our attention into node energy for data aggregation & gradient-based routing in wireless sensor network.*

I. Introduction

A wireless sensor network is a collection of sensor nodes interconnected by wireless communication channel. Each sensor node is a small device that can collect data from its surrounding area, carry out simple computations, and communicate with other sensors or with base station (BS). Developing a wireless platform is less expensive and has several uses in environment monitoring, home/building security, disaster management etc.

Recent advances in MicroElectroMechanical Systems (MEMS)-based sensor technology low-power analog and digital electronics and low-power RF design have enabled the development of inexpensive and low-power wireless micro sensors. Micro-sensors network can contains hundreds or thousands of sensing nodes. It is desirable to make these nodes as cheap and energy-efficient as possible and reply on their large numbers to obtain high quality results. Network protocol must be designed to achieve fault tolerance in the presence of individual node failure while minimizing energy consumption. The main goal of data aggregation algorithms is to gather and aggregate data in an energy-efficient manner so that network lifetime is enhanced. An energy-efficient routing protocol can reduce control packet. It supports in-network data processing which can reduce data packets greatly and only transmit processed & necessary data.

WSNs life is extended by clustering based routing methods. Self organization and energy efficiency are two most important characteristics of a largely deployed sensor network. These characteristic control the operation and lifetime of the network. Data aggregation techniques increases lifetime of sensor network by decreasing the number of packet to be sent to sink or base station. Energy-efficiency is one of core challenges in WSN because energy is few and hard to find out and valuable. Several clustering algorithms have been proposed for purpose of reducing energy consumption and extending lifetime of sensor network.

In this paper we propose new energy and cost aware, multihop routing protocol. The proposed protocol combines an energy efficient clustering mechanism with gradient based data routing techniques.

II. technique

We consider a network of homogeneous sensor nodes. Each node has perform the basic task of sensing the field parameters, form data packets and communication them with the cluster head. The cluster head is forward this data to the sink. The cluster head elected whose node has remaining powers which employ energy aware clustering strategy.

The cluster heads then generate a report based on the received data and forward this to a neighbor node that has minimum cost towards the sink. We define cost of node by considering its energy level and its link cost towards the sink. In this way the report reaches the sink through the most optimal path.

III. Cost Field Establishment:

The cost-field setup is initialized by the sink and is expanded further by its neighbors. During the cost-field setup each node gets several packets from its neighbors containing different communication cost with the sink along different paths. Every node chooses the least costly path to the sink and only stores that least cost value. Cost of each node is computed by considering the following two parameters;

- Energy of each node
- Link cost between two nodes

Energy of node: Life time maximization of a network can be achieved by using high energy nodes for routing. Energy of a particular node is calculated by considering its initial battery power and remaining battery power. Each node stores the following attribute E; as the energy constraint parameter.

$E_i = P_o/P_i$

where

E_i = Energy of node

P_0= Initial battery power

P_i = Remaining batter power

Link cost between two nodes: Link cost between two nodes 's' and 'v' can be defined using following equation.

$L_{s, v} = P_{t, s}/P_{r, s}$

where

$L_{s,v}$ = Link cost between s and v

$P_{t, s}$= Transmission power of s.

$P_{r, s}$= Receiving power of v.

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Cost field: Cost field is defined with following parameters. Initially each node sets its cost to ∞.

$Cost_{init} = \infty$ And $Cost_{sink} = 0$

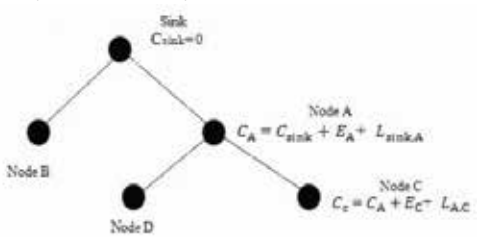

Figure 1. Cost Calculation for Different Node

The sink broadcasts an advertisement message 'ADV' containing its own cost (0 initially). Upon receiving this ADV message from sink, node A sets its path cost as:

$C_A = C_{Sink} + E_A + L_{sink,A}$

Once node A sets its path cost, it further creates a new ADV packet containing its own cost value and sends it to its neighbors. Upon receiving the ADV from node A, node C set its link cost as:

$C_c = C_A + E_c + L_{A,c}$

When a node receives multiple ADV packets from its neighbors as shown in figure 2, then it adds minimum received cost to its energy and link cost. For example if node C receives ADV from node A and node B then to calculate its own cost it selects $C_{min} = (C_A, C_B)$

Node C selects its minimum cost path and further propagates it in its own ADV packets to other neighbors.

$C_c = C_A + E_c + L_{A,c}$ if $C_A < C_B$

$C_c = C_B + E_c + L_{B,c}$ if $C_A > C_B$

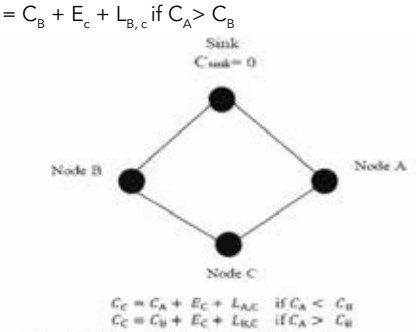

Figure 2. Cost calculation with multiple neighbors

IV. Cluster formation

Groups of nodes are organized into clusters where each group of nodes has an elected cluster head CH. Sensed data is sent to CH rather than the sink. The proposed technique has two main phases

1. Energy Aware Clustering phase
2. Routing Phase

Energy aware clustering phase: Many energy aware WSN routing protocols have been proposed [6]. We perform energy aware clustering in rounds and each round result in election of different cluster heads. In LEACH protocol, nodes are periodically elected as cluster-heads with a certain probability. We propose a new cluster head election mechanism. Each node calculates T (i) in every round as shown. T (i) gives threshold value of each node which considers remaining battery power of each node before selecting it as a cluster head. In (3), p is a predetermined cluster-head proportion, r is the current round of cluster heads selection, i is node ID, and G is the set of nodes that have not been elected as cluster-heads in last lip rounds. E (i) represents the ratio of remaining energy and initial energy of node.

$$T(i) = \frac{p}{1 - p(r \bmod (\frac{1}{p}))} + \sqrt{E(i)}$$

Where i ε G and

$$E(i) = K * \frac{E_{avg} + E_{residual}}{E_{avg}}$$

Where

E (i) = the ratio of remaining energy & initial energy of node

K= Random number between(0.9,1)

E_{avg} = Average energy of node.

$E_{residual}$ = Residual energy of node.

By using above equation nodes with higher energy have an increased probability of becoming cluster heads in each round.

Routing Phase: Each node decides to which cluster head it becomes a member of. If a node receives multiple cluster head advertisement, it becomes the member of the cluster head with the larger signal strength. The cluster head then assigns TDMA communication slots to all members. Once the clusters are created and TDMA schedule is fixed, data transmission can begin. All nodes send their sensed data to their respective cluster heads. Cluster head will choose the path with lowest cost and forward the aggregated report towards the sink.

V. conclusion

To the limitations of wireless sensor network many algorithms have been proposed with different goals. To increase the network lifetime is very important to consider nodes with low energy. The technique performs data aggregation to reduce the load on network.

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