



Energy efficient routing protocol LPCH and UDLPCH in WSN

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ABSTRACT

Remote sensor nodes alongside Base Station (BS) constitute a Wireless Sensor Network (WSN). Nodes comprise of tiny power battery. Nodes sense the information and send it to BS. WSNs require protocol for efficient energy consumption of the network. In direct transmission and minimum transmission energy routing protocols, energy consumption is not well disseminated. Be that as it may, LEACH (Low-Energy Adaptive Clustering Hierarchy) is a clustering protocol; arbitrarily chooses the Cluster Heads (CHs) in each round. However, random selection of CHs does not guarantee efficient energy consumption of the network. Therefore, we proposed new clustering methods in routing protocols, Location-aware Permanent CH (LPCH) and User Defined Location-aware Permanent CH (UDLPCH). In LPCH, numbers of CHs are chosen by LEACH algorithm in first round. However in UDLPCH, ideal numbers of CHs are chosen, throughout the network life time number of CHs are remain same. Simulation results show that energy consumption and number of packets dropped of UDLPCH is less than LPCH.

Keywords-Location-aware,Permanent,Cluster,LPCH,UDLPCH.

I. INTRODUCTION

WSNs connect end users through BS or sink directly to sensor network and to provide information, according to the user need or demand. WSN can be composed of hundreds or more sensor nodes. Which are randomly deployed inside the area of interest or very close to it and a BS or sink. Nodes sense the data and send their report toward sink. Stability period of WSN are limited. In order to prolong the stability period of WSN many routing protocols [4],[8] are proposed and many new energy-efficient routing protocols must be designed. Classical approaches like direct transmission and minimum transmission energy do not guarantee well balance distribution of the energy load among nodes of sensors network. In direct transmission, every node directly sends their data to BS, Therefore far away nodes consume greater energy in sending data to BS and hence die quickly. However in minimum transmission energy,

far away nodes send the data to BS through intermediate nodes. Therefore nodes that are near to BS die quickly. A solution proposed is of adaptive clustering algorithm called LEACH. In LEACH, routing operation is divided in to rounds. In each round, CHs are selected, CHs then form clusters, and in each cluster there are cluster members and a CH. Each cluster member node sense the data and send to CH. CHs receive the data, aggregate it and sends to BS. However in LEACH there is no optimum number of CHs in each round, also randomly selecting CHs makes different size of cluster; number of nodes in each cluster are vary. CH of large size cluster consumes greater energy and vice versa. Therefore a sensor node of network does not consume balance energy.

In this work, the sink is not energy limited and the system operation is separated into rounds. To improve efficiency of WSN, we proposed two new location based [5],[6],[7] routing protocols:

LPCH (Location-aware Permanent Cluster Head) and UDLPCH (User Defined Location-aware Permanent Cluster Head). These proposed protocols are clustering based strategies [1]. In LPCH, network operation is divided into number of rounds. In first round, CHs are chosen by LEACH calculation. From second round to last round, number of CHs stay same as in first round. This prolongs energy consumption and furthermore greater throughput is obtained. UDLPCH follow the same thoughts to LPCH except, first round. In first round user define optimal of CHs. In case of UDLPCH energy consumption and number of packets dropped are less than that of LPCH..

II. RELATED WORK

As a new information acquisition and processing technology, wireless sensor network WSN has a wide range of applications in military, environmental monitoring, smart furniture and space exploration and so on. Wireless Sensor Network can be described as an autonomy system consisting of lots of sensor nodes designed to intercommunicate by wireless radio and it can collaborate in real time monitoring, perceiving and collecting information of various environmental or monitoring objects and transfer this information to the base station. It does not need a fixed network support and it has rapid employment, survivability and other characteristics so it has a good application prospect. Until now the research on sensor network generally has gone through two stages, the first stage is primarily intended for node, the second one is for network-level issues, the main research works in this stage involve the network layer and MAC layer protocol based on energy optimization, node localization technology, clock synchronization technology and data fusion technology. Study of routing protocols in wireless sensor networks is one of the hot topics at this stage. LEACH Protocol is the first protocol of hierarchical routings which proposed data fusion, it is of milestone significance in clustering [2] routing protocols. Many hierarchical routing protocols are improved ones based on LEACH protocol.

So, when wireless sensor networks gradually go into our lives, it is of great significance to research on LEACH [3] protocol.

III. MOTIVATION

In current research body of WSN, many routing protocols are proposed. LEACH is one of the very first routing protocols. In LEACH, BS selects CHs randomly. However it can be improved in many aspects. Firstly, LEACH does not guarantee optimum number of CHs (n/p) in each round of epoch, where n is total number of nodes and p is probability of optimal number of CHs. Secondly, CHs are selected randomly, so clusters formed are of different sizes. Therefore CH in a large size cluster (greater number of member nodes) consumes greater energy. Thirdly, member node sends data to CH, even if its distance from BS is less than its distance from CH, as can be seen in the Fig.1.

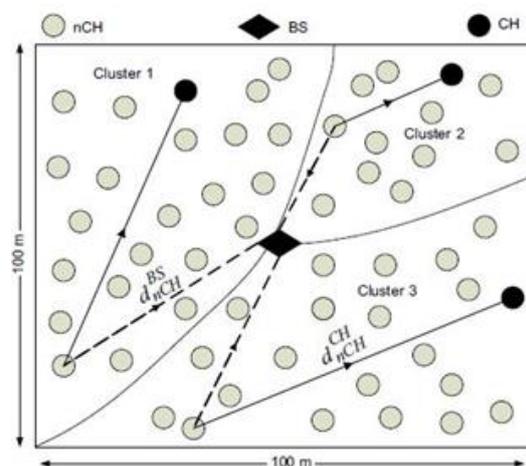


Fig.1. Comparison [1]

In LPCH, we select CHs according to LEACH algorithm where in UDLPCH, we select optimum number of CHs in given network field in first round. Our proposed protocols LPCH and UDLPCH focus on controlling: cluster size, maintain number of CHs same in all rounds, distance between member nodes and CHs. which results in efficient energy consumption. Hence stability period and throughput of WSN is improved.

IV. IMPLEMENTATION: PROPOSED PROTOCOL

In this section we discuss the network model for proposed protocols: LPCH and UDLPCH. We also discuss these protocols in detail.

A. Network Model: We deployed the 100 nodes into network as shown in Fig 2. All nodes in the network are homogeneous (same energy nodes). The BS is not energy limited. This model uses a location-aware clustering scheme. In location-aware scheme, BS is location aware of all nodes in the

field. Each cluster has a CH which collects data from cluster member, aggregate it and send it to BS. The main features of such architecture are: Each node has a unique ID and fixed position.

Only CH node performs additional computation on the data to conserve energy of the network the sending node can adjust the transmit power to save energy depending on the distance to the receiver.

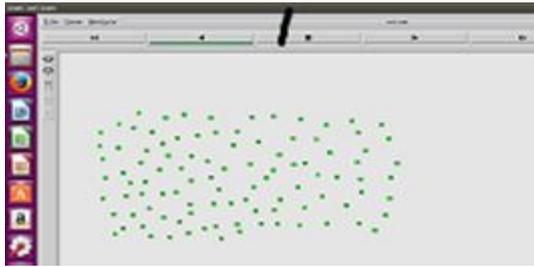


Fig. 2. Sensor Network model

The energy consumption of the CH (E_{CH}) and cluster member node (E_{NCH}) can be calculated by following equation[1].

$$E_{CH} = E_{rec} + E_{tra} + E_{agg} + E_{amp}^n$$

Here " d_{BS} " is the distance between CH and BS, " d_{CH} " is the distance between CH node and member node.

" E_{rec} " is the energy consumption by CH in receiving data from member nodes. " E_{agg} " is the energy consumption by CH in aggregating the data. " E_{amp}^n " is the net energy consumption of the transceiver amplification circuit. " E_{tra} " is the net energy consumption in transmitting the data.

B. LPCH

In this section we explain our proposed protocol known as LPCH. In LPCH, we remove the deficiencies of LEACH protocol. We use the network model given in fig 2. According to the network model 100 nodes are randomly deployed into the network. So in our proposed protocol we change the criteria of CH selection, to select optimum number of clusters in the network area. Cluster forms are of lower size. So that energy of the network is conserved. Operation of LPCH is divided into rounds. In first round, in each region CHs select according to LEACH algorithm with little modification. Because in first round all the nodes are eligible to be CH.

First round: CHs are selected by LEACH algorithm. From second round: CHs, same in number to round one, are selected. Number of CHs is same

throughout the network lifetime. Proposed network operation is show in Fig.3.

Algorithm for LPCH:

- 1) Each node has fixed location and unique ID.
- 2) In first round CHs select according to LEACH algorithm.
- 3) From second round CHs selects according to previous CH nodes. A node selects as CH if its y-coordinate is less than y-coordinate of CH and its y-coordinate is closest to y-coordinate of CH.
- 4) If more than one node y-coordinates are closed to CH node, then with lowest ID become CH.

If distance of a node from BS is less than its distance from CH, it send data directly to BS.

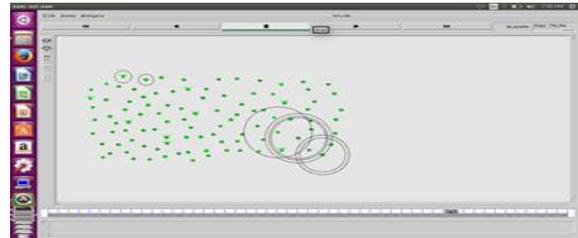


Fig. 3 Network operation for LPCH

C. UDLPCH

In first round of LPCH; CHs are selected by LEACH algorithm in given network and that number of CHs remain same for all rounds. According to network model 100 nodes are randomly deployed in the network. So in UDLPCH there is guarantee of selecting optimum number of CHs in the network. However, there is no guarantee of optimum number of CHs in LPCH. We can increase efficiency of the network by selecting optimum number of CHs and that number of CHs could be remain same for all rounds. UDLPCH improves the energy efficiency of LPCH algorithm. In first round, user selects optimum number of CH. From second round, CHs selection is according to LPCH algorithm. Network operation for UDLPCH is show in Fig.4.

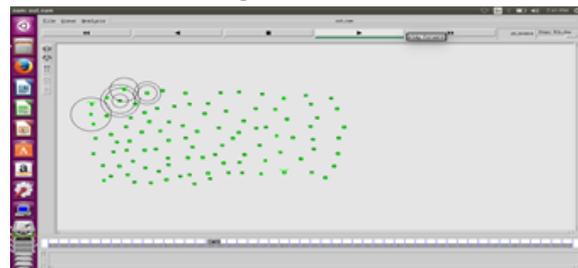


Fig 4 Network operation for UDLPCH

D. EXPERIMENTATION PLATFORM - SAMPLE RESULTS

We proposed two types of clustering based protocols: LPCH and UDLPCH. For simulation of LPCH and UDLPCH we use network model given in fig 2 with N=100 nodes and 100m x 3312mm field. Our goals in conducting the simulation are: Compare the performance of LPCH, UDLPCH on the basis of network lifetime. Study the effect making number of CHs constant.

We run the simulations for 500 rounds, average results of simulations are shown in figures given below. Fig.5 shows the total energy consumption per round. It is obvious from the fig 5 that, total energy consumed by UDLCH is 18% less than LPCH. LPCH does not guarantee of selecting optimum number of CHs in each round. Where in UDLPCH, there is guarantee of optimum number of CH selection.

Fig.6 shows number of packets dropped per round,also show that network lifetime of UDLPCH is greater than LPCH. If all the nodes become CH once in first rounds of the epoch than in the remaining rounds nodes do not select as a CH in the same epoch. All nodes directly send data to BS therefore, nodes consume more energy. In LPCH there is constant number of CHs in each round. So, there are always CHs to send data of cluster members to BS, therefore energy of the network is conserved. That is why network life time of UDLPCH is greater than LPCH.

Fig. 7 shows that an average energy consumption of UDLPCH is 18% less than LPCH. Hence, number of CHs select in network region may be different. The region which has more number of CHs die first. However, in UDLPCH optimum number of CHs are selected and that number of CHs remain same throughout the network.

V. SIMULATION RESULTS

Total energy consumed by UDLPCH is 18% less than LPCH.

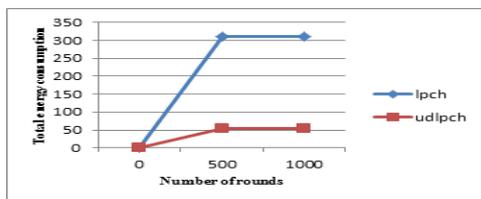


Fig. 5 Total energy consumption for lpch & udlpch

In LPCH number of CHs selected in first round of network region is maintained till the end of the network lifetime. In UDLPCH, number of packets dropped in UDLPCH is 40% less than that of LPCH.

In LPCH distance (node to CH) greater than distance (node to sink) packet is directly sent to BS. In UDLPCH extended network lifetime increases the throughput.

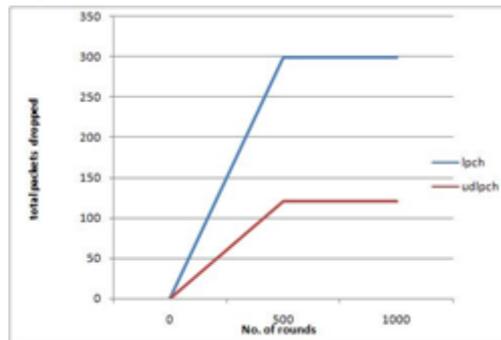


Fig. 6 Total dropped Packets

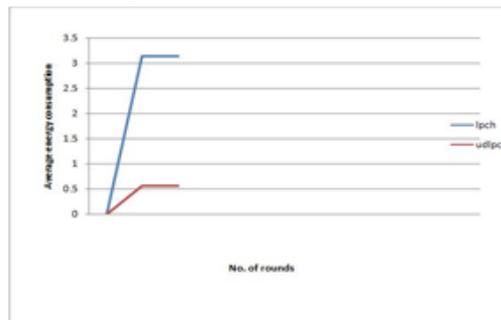


Fig.7. Avg. energy consumption for LPCH & UDLPCH

VI. CONCLUSION AND FUTURE WORK

Numerous analysts presented directing systems as talked above for development in various parameters identified with system hub for instance Energy, Delay, Throughput, Transmission time. No. of dropped packets in UDLPCH is 40% less than LPCH routing protocol. It means throughput of UDLPCH is more than LPCH. Energy consumed by UDLPCH is 18% less than energy consumed by LPCH routing protocol. In this way network life time is increases. As WSN are being used in location monitoring, military applications. In this case the information transmitted must be encrypted. This requires generation of secure keys between sensor nodes.

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