CLUSTER HEAD ELECTION USING WIRELESS SENSOR NETWORK

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ABSTRACT

In Wireless Sensor Network, sensor nodes life time is the most critical parameter. Many researches on these life time extensions are motivated by LEACH scheme, which by allowing rotation of cluster head role among the sensor nodes tries to distribute the energy consumption over all nodes in the network. Selection of cluster head for such rotation greatly affects the energy efficiency of the network. In this paper a new protocol called Final Cluster Head Election Routing Protocol (FCHERP) which is inspired with lower energy stability election, and lower energy conservation through stable clustering is proposed. FCHERP models the network as a linear system which calculates the mixtures of the nodes that can be selected as cluster heads in order to extend the network lifetime. Both mobility classes have obvious and important influence to sensor networks operation. In our mobility model, there are hard limitations in both sensors mobility pattern and distance. Such boundaries are natural due to limitations on sensors' form-factor and energy.

Keywords: Cluster-head (CH), Energy efficiency, LEACH protocol, Mobility, Wireless Sensor Network.

I. INTRODUCTION

WSN is a collection of sensor nodes organized into a cooperative network. It consists of hundreds to thousands of low-power multi functioning sensor nodes, operating in an unattended environment with limited computational and sensing capabilities. In addition to one or more sensors, each transceiver or other wireless communication device, a small microcontroller and an energy source, usually a battery. These inexpensive and power –efficient sensor nodes works together to form a network for monitoring the target region.The nature of wireless sensor network necessitates specific design requirement, of which energy efficiency is paramount. One of the important parameter in ensuring a good WSN system is the routing protocol. The energy source in WSN is implacable and their lifetime is limited. The development of wireless sensor networks was originally motivated by military applications such as battlefield surveillance[2].recent developments in this technology have made these sensor nodes available in a wide range of applications in military and national security and many other feilds.

Wireless sensor networks have the following characteristics:

- *Sensor nodes* with limited energy which can sense their own residual energy .
- *One base Station (BS)* without energy restriction is far away from the area of sensor nodes.

In this paper present the development of an energy efficient routing protocol which consumes significantly less power compared to existing protocol for Wireless Sensor Network. The design was developed based on Low Energy Adaptive Clustering Hierarchy (LEACH) routing protocol, intended to reduce the overall energy consumption. Clustering is an energy efficient and scalable way to organise the WSN [4]. The main objective is to elect Final Cluster Head which minimize the energy dissipation and increase node stability which maintain stable clusters.

II. RELATED WORK

Wireless sensor networks are made up of small microelectronic devices which are adept of sensing, calculating and transmitting data from harsh physical settings like a study field. These sensor nodes majorly be contingent on batteries for distance base energy, which get down at a faster rate because of the addition and statement acts which have to make. Communication protocols can be designed to make efficient operation of energy resources of a sensor node and to obtain real time functionality. In our research, a new protocol called (FCHERP) inspired with lower energy and stability election, and lower energy consumption through stable clustering, is proposed. FCHERP models the network as a linear system and calculates the mixture of nodes that can be selected as cluster heads in order to extend the network lifetime. However being an developing topic, a clear sympathetic of chances and challenges of sensor network mobility is missing today, and hence is an important need of the hour. In this paper, we make donations to sensor network mobility. First, we study we subject of how sensors can use their mobility to improve quality of network positioning. In our mobility model, there are hard limitations in both sensors mobility pattern and distance. We identify serious challenges arising in deployment under such hard mobility limitations and what kind of trade-off they show for final cluster for lower energy assumption in mobility environment.

III. CLUSTER FORMATION

Senor nodes use irreplaceable power with the limited capacity, the nodes capacity of computing and storage is very limited which requires WSN protocols need to conserve energy as the main objective of maximizing the network lifetime [6]. An energy –efficient communication protocol LEACH along with different parameter are used which employs clustering based on information received by the Base Station (BS). The BS periodically changes both the cluster formation nodes and Cluster Head (CH) to conserve energy. Each node transmits data to the closest cluster head and the cluster heads performs data aggregation. We proceed to our indicator function of chosen a cluster head[1]. In each round of the cluster formation , network needs to follow the two steps to select cluster head and transfer the aggregated data(i) set-up phase, which is again subdivided into Advertisement , cluster set-up phases (ii) Steady-state phase, which provides data transmission using Time Division Multiple Access.

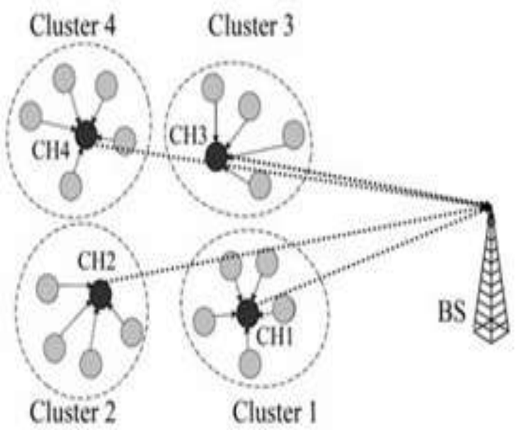

Fig1. The LEACH Clustering Communication Hierarchy for WSNs.

IV. LEACH (LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY)

The application field of sensor network is the environment observation and location tracing. In such an environment, the end user does not need any repeated data as each node of the data is not related to each other [5]. The role of LEACH (Low Energy Adaptive Clustering Hierarchy) is to merge repeated data by cluster head and sent to sink. Hence any repeated data is not sent to the sink.

The LEACH assumptions are as follows:

(i) All nodes have enough energy to send data to the sink and can adjust transmission energy.

(ii) All nodes have data to send at any time and close nodes have data associated with each other.

LEACH makes even energy consumption between the nodes in the network. And to do so, the cluster head (CH) is randomly replaced on the probability based. At the start of each round, probability value of P_i (t) decides whether to work as cluster head[3]. The no. of cluster head k of P_i (t) value on each round, in other words, when N is the other number of total nodes in network based on the number of clusters, (1) is given as below. On average, each node should be set as the cluster head once every N/K in order to guarantee the same number of cluster head in every node:

$$B_{[CH]} = \sum_{i=1}^{N} Pi\ (t) \times 1 = k. \qquad (1)$$

From the selection process of the cluster in LEACH protocol each node follows (2) to obtain the selected probability of the cluster head, where C_i (t) is a control function, and when during recent mod (N/K) round has cluster head in relevant node is then, 0, if not 1. In consequence, if it had been head for at least once, there is no chance to be selected again during the recent r mod (N/K) round :

$$P_i(t) = \begin{cases} \frac{K}{N-k*(r \bmod (\frac{N}{k}))}, & C_i(t) = 1 \\ 0, & C_i(t) = 0, \end{cases} \qquad (2)$$

And according to (2), stands for the node identifier, t is the time, N is the total number of nodes, is the number of clusters, and r represents the round. the node selection gives equal probability from random nodes during one round as it excludes the nodes that have been selected in the previous round. Therefore in the increase of rounds the value of P_i (t) simply rises. And since this pattern is iterated every N/K, all nodes have equal probability of being selected to be the head node.

The probability function of (2) allows selecting more often nodes that have not been chosen as the cluster node in latest time. Where the node which has been selected in the recent time it comprises more energy. All nodes are assumed to transmit data at any time. Due to the probability function of (3), this additional probability function in which a node a greater energy is to be selected more frequently as the cluster head:

$$P_i(t) = \min\left\{ \frac{E_i(t)}{E_{total}(t)} k, 1\right\} \qquad (3)$$

Where E_{total} (t) represents the sum of the current energy on all nodes and E_i (t) represents the current energy of node I. By applying this probability function, node with greater energy is to be selected as the cluster.

V. MOBILITY- ADAPTIVE CLUSTERING

In MAC we do not assume that during the clustering process the nodes of the network need not to move. This makes the algorithm suitable for both the clustering set up and its maintenance. In the MAC algorithm , we still assume that a message sent by a node is received correctly within a finite time by all its neighbour[4]. We can also assume that each node knows its own ID, its weight , its role (if it has decided to be a cluster head or an ordinary node) and the ID , the weight and the role of all its neighbours. When a node has not yet decided what its role going to be, it is considered as an ordinary node.

5.1 Algorithm

Each node executes as as soon as it starts the clustering operations, the algorithm is message driven. Here we use the two types of messages

- CH(v)
- JOIN(v,u)

On receiving CH(u) . when a neighbour u becomes a cluster head, on receiving the corresponding CH message , node v checks if it has to affiliates with u i.e , it checks if whether w_u is bigger than the weight of v's cluster head or not. In this case, independently of its current role, v joins u's cluster.

```
begin
      if(w_u > w_clusterhead) then begin
            send Join(v,u);
             Clusterhead :=u;
             if CH(v)then CH(v):=false
             end
end;
```

On receiving JOIN(u,v). On receiving the message Join(u,z) the behaviour of node v depends on wheather it is clusterhead or not. In the affirmative , v has to chechk if either u is joining its cluster(z=v : in this case u is added to Cluster(v)) or if u belonged to its cluster and is now joining another cluster. If v is nota clusterhead, it has to check if u was its clusterhead. Only if this is the case , v has to decide its role: it will join the biggest clusterhead x in its neighbourhood such that $w_x > w_v$ if such a node exists.otherwise it will be a clusterhead.

```
begin
  if CH(v)
     then if z=v then clusterhead(v) :=Cluster(v)U {u}
        else if u € Cluster(v) then Cluster(v):=Cluster(v)\{u}
else if Clusterhead= u then
if { z €(v): w_z >w_v ∧ CH(v) } ≠Ø
          then begin
                x:= max w_z > w_v {z:CH(z)};
                send JOIN(v,x);
                Clusterhead:=x;
                end
```

```
else begin
     sendCH(v)
     CH(v):=true;
      Clusterhead:=v;
      Cluster(v):={v}
      end
end;
```

VI. RESULTS AND DISCUSSIONS

Based on the original cluster routing protocol, the paper sets a certain energy threshold for cluster heads. When the remaining energy detected by the cluster head sensor reaches a given threshold, its members will select the minimum cost cluster head by the dynamic routing mechanism.

The simulation results show that LEAFCH can greatly prolong sensor network's lifetime when the transmission range is limited. Sensor node is the lowest energy consumption as evaluate to other protocols. The throughput is high in sensor node and LEAFCH protocols than other two protocols. The average delay of the proposed MWSN, LEAFCH protocol is the lowest delay. Then the routing overhead is increases the number of created control packets in LEAFCH.

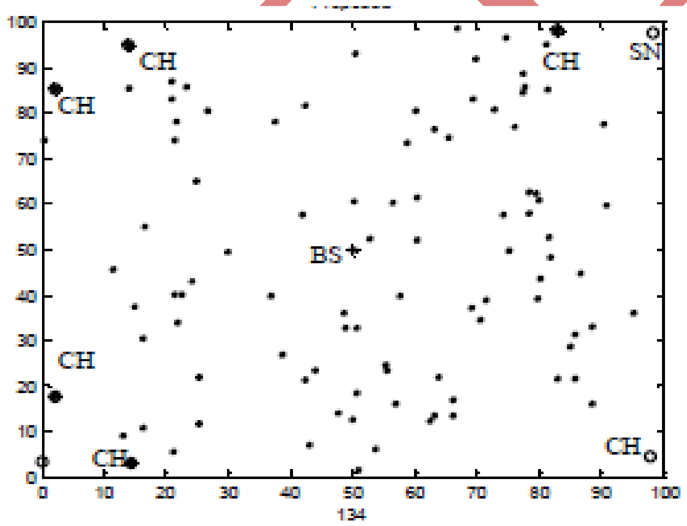

Fig1: Elected cluster heads using leach

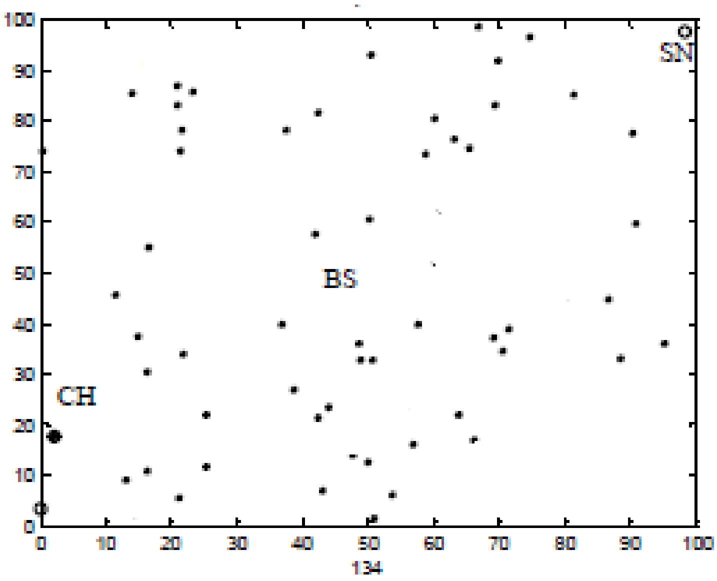

Fig2: Final cluster head elected (FCHE)

Simulation results show that, compared with the existing routing protocols, the dynamic routing protocol has significantly improvement on the overall network lifetime and data collection to evaluate the energy dissipation achieved by using Leach and mobility as its parameters in routing protocol using random probability to evaluate the energy dissipation. As the rounds increase reaffiliation increase tremendously because the movement of the nodes become more erratic and they leave their clusters very frequently to join other clusters.

Parameters	**LEACH**	**LEAFCH**
End to End delay	Long delay	Less delay
Network Lifetime	Short	Long
Energy Consumption	High	Low

VII. PERFORMANCE METRICS

The evaluation of performance of routing protocols can be considered under the below matrices:

7.1 End To End Delay

This metric measure the average time it takes to route a data packet from the source node to the destination node.

7.2 Energy Consumption

The energy metric is taken as the average energy consumption per node calculated through simulation time.

7.3 Network Lifetime

The time of first node failure due to the exhaustion of battery power charge during the simulation with a particular routing protocol.

VIII. CONCLUSION

In this paper, we studied the issue of how sensors capable of limited mobility can relocate themselves to attain desired deployment. Based on the original cluster routing protocol, the paper sets a certain energy threshold for cluster heads. When the remaining energy detected by the cluster head sensor reaches a given threshold, its members will select the minimum cost cluster head by the dynamic routing mechanism. Simulation results show that, compared with the existing routing protocols, the dynamic routing protocol has significantly improvement on the overall network lifetime and data collection.

To the best of our knowledge, our work highlight security impacts under the presence of external mobile agents and to address the topic of physical attacks, both of which we believe will be critical components of sensor networks security in the future.

With the emergence of mobility in wireless sensor networks, coupled with its patent significances, we hope that our work can provide strong foundations and further motivations for researchers to explore this topic. Some critical open issues in this realm understand impacts of internal mobility to issues like channel contention, connectivity/ topology corruption, security etc. Also in some applications of today, it may happen that even if the sensors are static and cannot make (or control) movement decisions, they can still be relocated from one location to another by third-party forces beyond the control of sensors themselves.

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