NETWORK LIFETIME ENRICHMENT PROTOCOL FOR WIRELESS SENSOR NETWORKS USING EESEP PROTOCOL

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***Abstract*— The impact of heterogeneity of nodes, in terms of their energy, in wireless sensor networks that are hierarchically clustered are considered. This sensor are randomly distributed and are not mobile, the coordinates of the sink and the dimensions of the sensor field are known. Behavior of such sensor networks becomes unstable once the first node dies (FND), especially in the presence of node heterogeneity. Energy Efficient stable election routing protocol (EESEP), is based on weighted election probabilities of each node to act as a cluster head according to remaining energy in each node. Simulation that EESEP always prolongs the stability period compared to that LEACH is obtained using current clustering protocols.**

Keywords: *Energy Efficient, Routing Protocol, Wireless Sensor Networks, Energy Efficient Stable Election Routing Protocol (EESEP)*

1. INTRODUCTION

Wireless sensor network has appeared as an important area for research and development. The key constraints in the development of wireless sensor networks (WSN) are cost, limited energy and memory, limited computational capability, and the memory size of the sensor nodes. WSN are working as long as they can communicate sensed data to manage particular node. Sensing and communication are essential activities and they consume energy so power executive and coverage preservation can effectively network lifetime increase. In some protocols sensor nodes transmit their data directly to a BS. The most important feature of a routing protocol is reduced energy consumption and extension of the network's lifetime. During the recent years, more energy efficient routing protocols have been proposed for WSNs.

The technology for sensing and manage includes electric and magnetic field sensors, radio-wave frequency sensors. Sensor is typically deployed in a high-density manner and in large quantities. One of the component of wireless sensor network an assembly of calculated or localized sensors, an interconnecting network, a central point of information clustering and a set of computing sources at the central point to handle data correlation, event trending, status querying, and data mining.

2. LITERATURE REVIEW

Low-energy adaptive clustering hierarchy (LEACH)

One of the hierarchical network routing protocols is low-energy adaptive clustering hierarchy (LEACH), which has been broadly accepted for its energy efficiency. LEACH as a hieratical protocol to randomly select a few sensor nodes as cluster heads and rotates this role to evenly share the energy load among the sensors in the network. If the cluster heads were chosen a priori and stable throughout the system lifetime, these nodes would fast use up their limited energy. Once the cluster head (CHs) runs out of energy, it is no longer operational.

Thus, low-energy adaptive clustering hierarchy (LEACH) incorporates randomized revolution of the high energy cluster head location among the sensors to avoid draining the battery of special one sensor in the network. In this way, the cluster head is evenly share the energy to all the nodes. The operation of low – energy adaptive clustering hierarchy (LEACH) is divided into rounds.

2.1. Self-configuring cluster formation phase

Low-Energy Adaptive Clustering Hierarchy (LEACH) forms clusters by using a distributed algorithm where nodes make autonomous decisions without any centralized control. In this approach are that no long distance communication with the BS is required and distributed cluster formation can be done without knowing the correct location of any of the nodes in the network. In addition, no global communication is essential to set up the clusters and nothing is assumed about the current state of any other node during cluster formation. The goal is to accomplish the global result of forming good clusters out of the nodes purely, via local decisions made autonomously by each node.

2.1.1. Cluster Head Selection Algorithm

At the creation of the setup phase, a round of cluster head (CH) selection start. The cluster-head election process ensures that this role among sensor nodes, thereby distributing energy consumption evenly across all network nodes. Each and every Sensor node chooses a random number, r, between 0 and 1. The node becomes a cluster head for the current round if the number is less than the following threshold

$$T(n_i) = \begin{cases} \dfrac{p}{1 - p\left(r \bmod \frac{1}{p}\right)} & \text{if } n_i \in G \\ 0 & \text{otherwise} \end{cases}$$

Where p is the desired percentage of cluster heads (e.g. 0.1), r is the current round (time interval for all nodes to send data to their respective cluster-heads), and G is the set of nodes that have not been cluster heads in the last 1/ rounds. Then all the non CH nodes, decide on the cluster to which they want to belong.

2.1.2. Cluster Formation Algorithm

Once the nodes have elected themselves to be cluster heads, the cluster head nodes must let all the other nodes in the network know that they have chosen this role for the current round. To do this, each cluster head node broadcasts an advertisement message (ADV) using a non-persistent carrier-sense multiple access (CSMA) MAC protocol.

This message is a small message containing the node's ID and a header that distinguishes this message as an announcement message. Each non cluster nead node determines its cluster for this round by choosing the cluster head that requires the minimum communication energy, based on the received signal strength of the advertisement from each CH. After each node has decided to which cluster it belongs, it must inform the Cluster head (CH) that it will be a member of the cluster.

Each node transmits a join-request message (Join-REQ) back to the chosen cluster head using a non-persistent a non-persistent carrier-sense multiple access CSMA MAC protocol. This message is again a short message, consisting of the node's ID and the cluster head's ID. The cluster head node sets up a Time Division Multiple Access (TDMA) schedule and transmits this schedule to the nodes in the cluster.

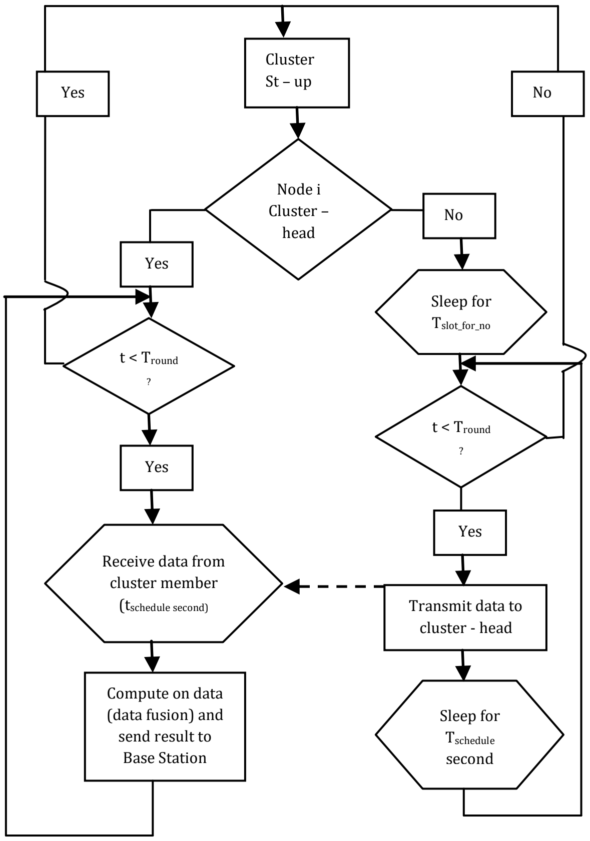

Fig - 1: Flow-chart of the distributed cluster formation algorithm for LEACH.

This ensures that there are no collisions among data messages and also allows the radio components of each non CH node to be turned off at all times except during their transmit time, thus reducing the energy consumed by the individual sensors. After the TDMA schedule is known by all nodes in the cluster, the set-up phase is complete and the steady-state operation (data transmission) can begin. LEACH flowchart and architecture are depicted figure 1 and 2, respectively.

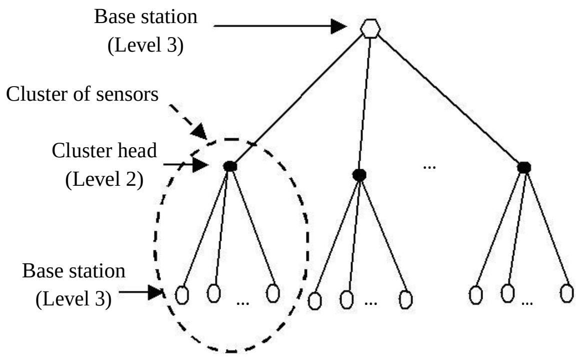

Fig - 2: LEACH architecture organized into three levels: BS level, CH level and Sensor node level.

2.2. Steady-state phase

This phase is broken into frames, as depicted in figure 3,

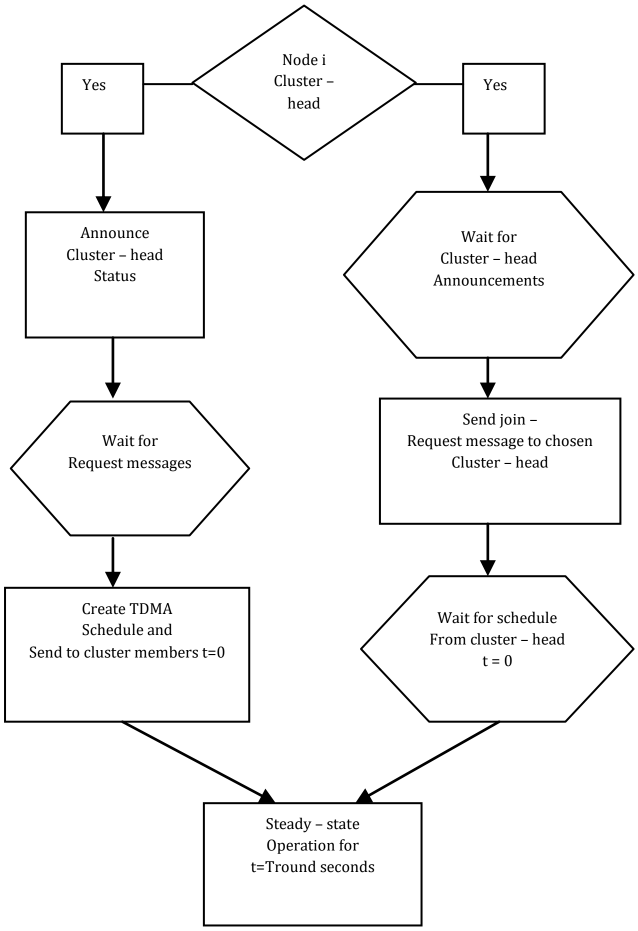

Fig - 3: Flow graph of the steady-state operation for LEACH.

Where nodes send their data to the CH at most once per frame during their distributed transmission slot. Every slot is constant, so the time for a frame of data transfer depends on the number of nodes in the cluster.

3. DESCRIPTION OF THE PROPOSED ALGORITHM

EESEP is based on weighted election probabilities of each node to become cluster head (CHs) unity of the remaining energy in each node. Simulation that EESEP always prolongs the stability period evaluate to the one obtained using current clustering protocols. We conclude by studying the sensitivity of our EESEP protocol to heterogeneity parameters capturing energy imbalance in the network. These nodes will be equipped with extra energy than the nodes that are already in use, which creates heterogeneity in terms of node energy.

3.1. *Contribution*

The sink is not energy partial and that the direct of the sink and the dimensions of the field are known. Assume that the nodes are uniformly allocated over the field and they are not mobile. This model, we propose a new protocol, we call EESEP, for selected cluster heads in a distributed fashion in 2-level hierarchical wireless sensor networks, EESEP is heterogeneous-aware, in the sense that selection probabilities are weighted by the initial energy of a node relative to that of other nodes in the network.

3.2. *EESEP Protocol*

Energy efficient Stable Election routing Protocol (EESEP), which is based on the initial energy of the nodes. This solution is more applicable compared to any other solution which assumes that each node knows the total energy of the network and then adapts its election possibility to become a cluster head according to its remaining energy.

3.3. Energy model analysis

Analyzing two protocols –LEACH, EESEP-based on the energy dissipation model shown in the following figure

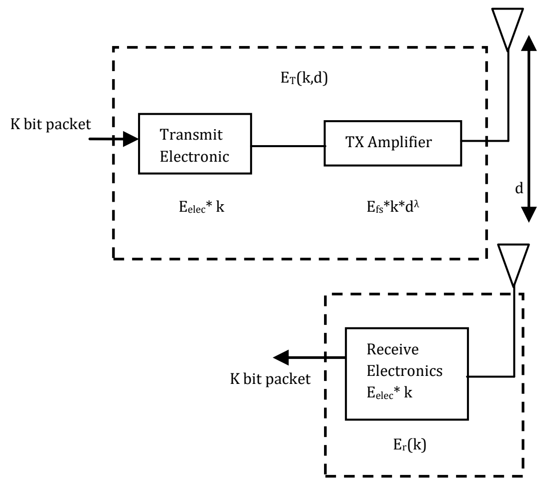

Fig - 4: Energy dissipation diagram

For a particular node, dissipate the receiving and transmitting energy. The energy expanded in transmitter to transmit k-bit message is given by

$$E_T(k,d) = (E_{elec} * k) + (E_{fs}*k*d^2) \quad \text{if } d<=d0$$

$$(E_{elec} * k) + (E_{mp}*k*d^4) \quad \text{if } d>d0$$

Energy dissipation to receive a k-bit message is given by

$$E_R(k) = E_{elec}* k$$

4. SIMULATION RESULTS

As a performance metric, we compare the efficiency of energy consumption of the networks. The comparison is done between the LEACH and EESEP protocol with the new technique under the same simulation condition and values. In the first scheme, LEACH, the selection of CHs is based on a predetermined probability. The proposed EESEP with typical distributed clustering protocols LEACH by using performance metrics including the variance of energy level, the number of nodes alive over simulation time, number of data received at the sink, and the average lifetime.

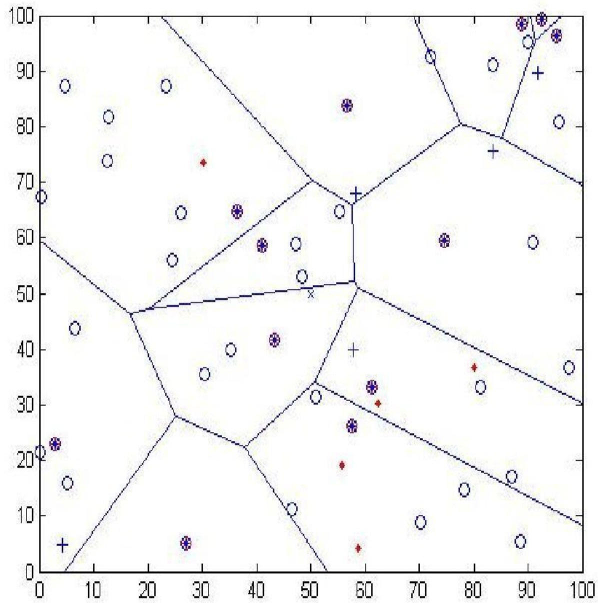

Fig - 5: Node coverage area of LEACH

Simulate a clustered wireless sensor network in a field with dimensions 200m × 200m. The total number of sensors n = 100. The nodes, both normal and advanced, are randomly circulated over the field. This means that the horizontal and vertical coordinates of each sensor are accidentally selected between value 0 and the maximum value of the dimension.

The reason is that after the death of a considerable number of nodes, the cluster head selection process becomes unstable and as a result fewer nodes become cluster heads (CHs). Even worse, during the final rounds, there are only few rounds where more than one cluster head is elected.

Our simulation results are shown in Fig 5. Although the length of the stability region is pretty secure, LEACH takes more benefit of the presence of heterogeneity manifested in a higher number of advanced nodes. First node dies (FND) at 750 rounds.

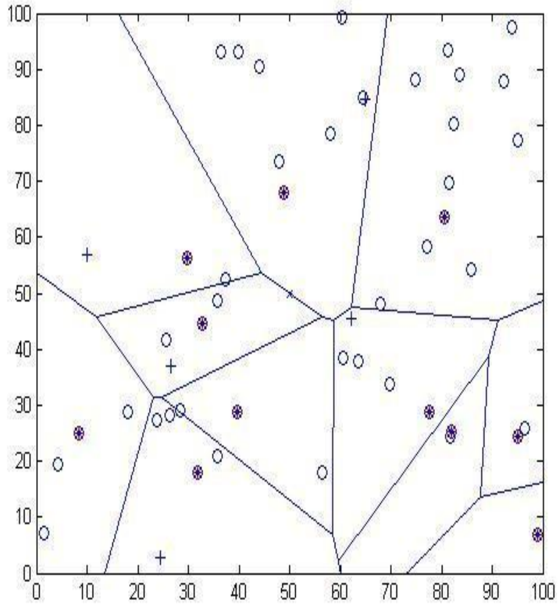

Fig - 6: Node coverage area of EESEP

Simulation results are shown in Fig 6. Although the length of the stability region is pretty secure, EESEP takes more advantage of the presence of heterogeneity manifested in a higher number of advanced nodes. First Node Dies at 816 rounds.

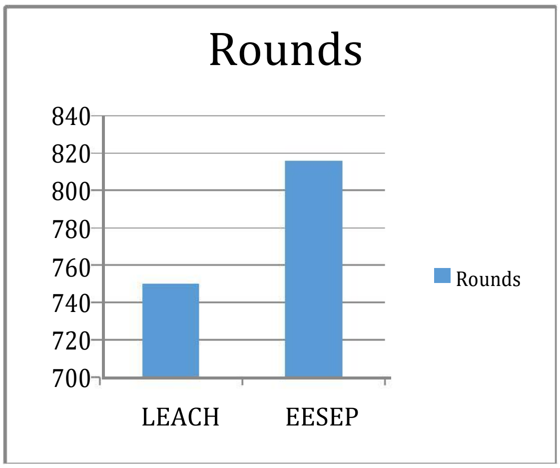

Fig - 7: Network Lifetime (stability) of LEACH and EESEP

They consider nodes that are fewer but more influential that belong to an overlay. All the other nodes have to statement to these overlay nodes, and the overlay nodes aggregate the data and send it to the sink. In this EESEP simulation result n=100, total number of rounds depends on life of network. The energy consumption comparison graph of LEACH and EESEP schemes are as shown in Figure 7.

The table represented below depicts the various parameters considered for simulation in MATLAB.

Table - 1: Design Parameters and Values

PARAMETERS	VALUES
N(No of nodes)	100 nodes
Routing Protocol	EESEP
Transmission Protocol	UDP
Antenna	Omni-Directional Antenna
Simulation Time	150ms
Channel	Wireless Channel
Network Size	200*200m
Deployment Model	Random

5. CONCLUSION

Energy Efficient stable election routing protocol architecture, reduce energy consumption by using clustering technique, therefore increase system lifetime. Energy Efficient stable election routing protocol (EESEP) so every sensor node in a heterogeneous two-level hierarchical network independently selected itself as a cluster head based on its initial energy relative to that other nodes. The performance evaluation in terms of network lifetime and coverage was conducted using MATLAB. EESEP is more stable because FND at 816 rounds is more than as compare to LEACH values of which are 750 rounds. The future work includes providing security integration of EESEP with MAC protocol that can provide low cost information about the distribution of energy in the vicinity of each node.

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