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# Enhanced Approach of Making Mobile Base Station in LEACH

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***Abstract*— Wireless Sensor Network is a new branch of networking which has been widely used in multiple applications like area monitoring, agriculture, environmental monitoring etc. Different applications require different parameters like network topology, energy constraint, number of nodes, location of base station etc. Based on the features of nodes with limited battery life, people have done deep research in order to prolong the network life time. With the assumption putted in LEACH, a new Protocol has been proposed in this paper in which base station is kept mobile. The base station is moving in a to and fro motion, initially the node is kept far away from nodes then for each 100 round the base station increments from its position and reaches in between sensor nodes. For next 100 rounds it starts positioning to its original position. The simulation is done in MATLAB and found that the lifetime is improved in comparison with original LEACH.**

***Index Terms*— Wireless Sensor Network, base station, nodes, aggregation.**

## I. INTRODUCTION

There has been unfathomable development in the field of technology to which computer network is no exception. Wireless sensor network is also one of the branches of networking which has been widely used in vast data gathering applications including variety of commercial and industrial areas like environmental monitoring, habitat monitoring, area surveillance, process monitoring etc. These sensors monitor the different physical conditions like temperature, pressure, humidity, seismic signals etc and pass it to the base station from which user can extract the information. Wireless sensing network is composed of number of nodes that are communicating with the help of wireless medium. Fig 1 is showing typical wireless sensor network environment.

The major components of wireless sensing node include-

- Sensing unit and actuation unit
- Processing unit
- Communication unit
- Power unit
- Other application dependent unit.

The sensing units sense the analog signals and convert it in to digital signals with the help of analog to digital converter.

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The digital signals are then passed in to the processing unit where task processing, data and controlling functionality with other sensor nodes are governed. The processed signals are then passed to transceiver which acts both as a transmitter and receiver. It is the communication unit. Then in power unit either a rechargeable (an embedded form of energy harvesting like solar energy, wind energy) or non rechargeable power supply can be used but in general batteries are used which is a limited resource of energy and with the increase in computation and communication process the draining of batteries is also increased. Therefore the application requires a protocol which should be energy aware, compos able and should be fit in the given network.

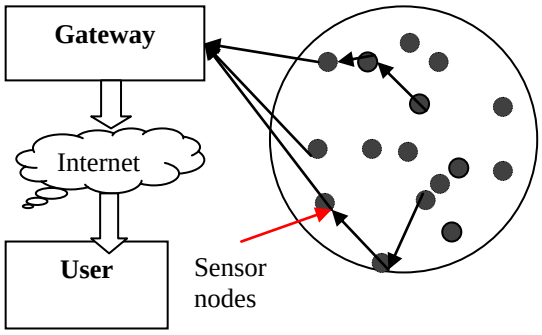


**Figure 1: Sensor Network Environment**

WSNs require novel routing techniques that take into consideration the immense scalability and inaccessibility of sensor devices with limited resources deployed in a harsh environment. Now days with every new step a new protocol is coming in to market giving different functionality and fitting in different type of application.

## II. RELATED WORK

The main aim of sensor nodes is to transfer their data to the user through base station so that proper decision making may takes place. In the conventional models like direct data transmission each sensor nodes transmit its data to the base station directly. In [1] it is observed that if the base station is located far away from sensor nodes than it will drain off the battery quickly and reduces the network lifetime because each node will require large transmit power separately. So it is mainly suitable for the applications where base station is located close to the nodes or when energy required to receive the data is large. Similarly, in minimum energy routing protocol where data is transferred to the base station with the help of intermediate nodes. Thus nodes close to the base

station are the ones to die out quickly because these routers have to transmit large amount of data.

W. R. Heinzelman, A. P. Chandrakasan and H. Balakrishnan [1] in 2000 proposed a protocol called Low Energy Adaptive Clustering Hierarchy (LEACH) which later turned to be the most popular algorithm in the hierarchal routing for sensor nodes. It is a dense network of sensor nodes grouped in to clusters and utilizes randomized rotation of clusters. These local cluster heads act as a router to send information or knowledge to the base station. Since only the cluster head are sending data to the base station this algorithm saves a lot of energy than conventional algorithms. The cluster head is also responsible for processing tasks like data aggregation and fusion. This protocol is also adaptive in nature that is the cluster head changes randomly after small interval of time in order to balance the energy dissipation of the network.

The algorithm is divided in to two phases i.e. a set up phase and a steady phase. The operation is broken down into rounds. Each round begins with set up phase. It mainly involves formation of clusters and selection of cluster head while in steady phase mainly data transmission is carried out. The steady phase is long compared to set up phase.

The set up phase is again consists of two operations. First is the decision operation where the decision is made that whether the node will become cluster head or not. This decision is based on the suggested percentage of cluster head for the network determined in priori, number of times the node became cluster head, and the residual energy left in the node. The node n makes this decision by choosing a random number between 0 and 1. The node becomes a cluster head for the current round if the number is less than the following threshold:

$$T(n) = \begin{cases} \frac{p}{1-p*\left(r \bmod \frac{1}{p}\right)} & \text{If } n \in G, \\ 0 & \text{Otherwise,} \end{cases}$$

Where, p is the desired percentage of cluster head, r is the current round, G is the set of nodes that has not become cluster heads in the last 1/p rounds. Nodes that are cluster-heads in round 0 can't be again for next 1/P rounds; thus the probability of left nodes to become CH increases.

Each node that elect them self as a cluster head broadcast its message to the rest of the nodes using CSMA MAC protocol. This is the advertisement operation and it takes place with the same transmit energy. All the non cluster head nodes keep their receivers on to hear the advertisement. Once all advertisement is heard by the node, the decision is taken by the nodes to which cluster head to belong for the current round on the basis of minimum energy consumption. In case of ties random cluster head is chosen. After the cluster selection this information is advertise to cluster head using same CSMA MAC protocol. Next comes the Steady phase where the cluster head now knows its members and their identifiers after setup. The cluster head schedules the nodes using TDMA which tells when to transmit its data to cluster head so that proper synchronization may takes place. When cluster head receives data from node then all other non cluster head node turns off their radio component so that energy dissipation of individual sensors may be reduced. Cluster head then collects all data from all individual nodes, aggregates it, fuse it and pass this data to the base station. LEACH centralized (LEACH-C) [2] also uses the same steady state phase but during set up phase each node send its location id and energy level to the base station. The base station then decides the cluster head according to the average node energy. LEACH is a protocol which turned out to be the base of designing several other routing protocol [3][4].

## III. SIMULATION SCENARIO

The consideration in the conventional models is that the base station and the sensor nodes are kept as fixed, base station is located far away from sensors and all nodes in the network are homogenous and energy constrained [1]. This paper assumes that 100 sensor nodes are static and densely deployed in a two dimensional geographic space. The energy of sensor nodes cannot be recharged. Base station is initially kept far away from sensor nodes and is not fixed but is movable in a to and fro motion. The base station for each 100 rounds increment from its location and reaches to the center in between the nodes and again after next 100 rounds starts locating to its initial position. The energy dissipation model is shown in Figure 2 and network parameters [1] are shown in Table 1.

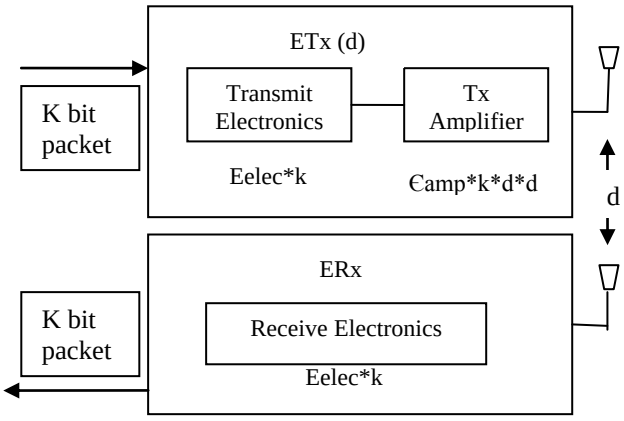


**Figure 2: Radio Energy Dissipation Model**

**Table1. Network Parameters used in the simulation**

| | |
|---|---|
| Network Size | 100*100 meter |
| Location Of sink | (150,50),(140,50),(120,50), (100,50) |
| No. of nodes | 100 |
| Data packet length | 4000 bit |
| Initial energy of nodes | 0.5 joule |
| Transmitter/Receiver Electronic | 50 nj / bit |
| Aggregation energy, $E_{DA}$ | 5 nj/bit |
| Transmit amplifier, $\epsilon_{fs}$ , if $d_{to\ BS} \leq d_0$ | 10 pj/bit/m$^2$ |
| Transmit amplifier,$\epsilon_{mp}$ , if $d_{to\ BS} \geq d_0$ | 0.0013 pj/bit/m$^2$ |

## IV. SIMULATION RESULTS

The base station here in this paper is kept mobile so for each 100 rounds the Base station comes towards the nodes and for next 100 rounds it moves outwards the nodes. It can

be seen from Figure 3 that if we compare the number of alive nodes for static and mobile base station then mobile base station outperforms the static base station when base station are located far from sensors. This experiment is performed for total 1000 rounds. The data is given in Table 2.This is because to transmit the data from node to node will consume much more energy than processing it and here we have reduced the communication degree by reducing the distance through making the base station mobile. Mobile agents help to reduce funneling effect [5] as they can visit different regions in the network and spread energy consumption uniformly even in case of large WSN architecture [6] [7]. We have tried to show the simulation scenario of proposed approach through Figure 4. The example is taken when base station is initially kept at (150, 50) and is moving in a to and fro motion in every round.

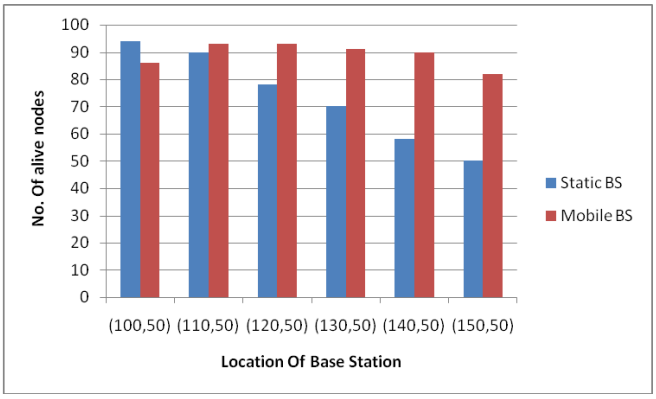


**Figure 3: Location of base station v/s number of alive nodes.**

Table2

| | No. of alive nodes in 1000 round | |
|---|---|---|
| Location of BS | Static BS | Mobile BS |
| (100,50) | 94 | 86 |
| (110,50) | 90 | 93 |
| (120,50) | 78 | 93 |
| (130,50) | 70 | 91 |
| (140,50) | 58 | 90 |
| (150,50) | 50 | 82 |

## V. CONCLUSION

Wireless Sensor Network can be implemented for various architectures and for variety of applications. Different applications require different parameters like network topology, energy constraint, number of nodes, location of base station etc. With the same assumption between this approach put forward in this paper and the LEACH algorithm, the new approach can send more data. So it is easy to see that the new clustering approach is better than the traditional algorithm such as the LEACH.

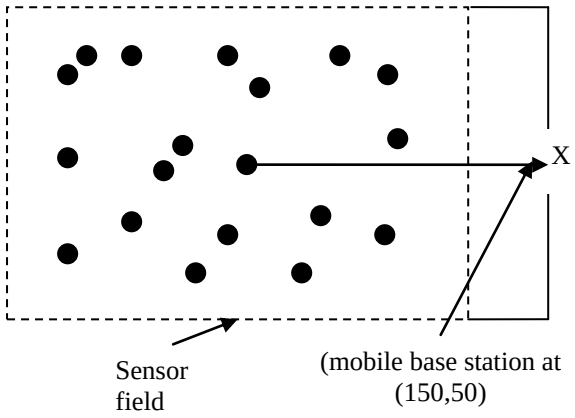


**Figure 4: Scenario of Proposed approach**

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