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# Endurance of Lifetime in Wireless Sensor Networks Using LEACH Protocol

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ABSTRACT

Energy efficient operation is a critical issue that has to be addressed with Large scale wireless sensor networks deployments. Cluster based protocols are developed to tackle this problem, and the Low Energy Adaptive Clustering Hierarchy (LEACH) is one of the best known protocols of this type. However, certain aspects of LEACH offer room for improvement, one such aspect is the arrangement of wireless sensor network with the fixed base station location. We propose an algorithm that is based on LEACH protocol but uses a sleep mode of cluster head. This algorithm produces reasonable improvement over LEACH in a network area 500m x 500m. We also compare the proposed algorithm to other protocols that use DTx, LEACH, EEE-LEACH and SRDC-LEACH in term increase the lifetime. For calculation, MATLAB environment is used, simulation results are provided to show the comparative effectiveness of different clustering algorithm on network lifetime, cluster head selection, and normal nodes in the network.

## 1.1 INTRODUCTION

Remote sensing platforms are typically characterized by reduced processing capabilities, limited memory capacities, and fixed battery supplies (Brownfield, 2006). The wireless sensor network energy consumption falls into three categories: sensing, computing, and communicating (Sohrabi.2000). Demonstrates that the communications costs dominate a wireless sensor network, sensor platform's power budget. The wireless sensor network must also be scalable to support extremely dense sensor fields.

There has been a long history for remote sensing as a means for humans to observe the physical world. For example, the telescope invented in the 16th century is simply a device for viewing distant objects. As with many technologies, the development of sensor networks has been largely driven by defense applications. Applications for energy efficient wireless sensor network include homeland defense, sensing, military surveillance, and environmental sensing (Mainwaring, A2002). Due to large numbers of nodes the management of network becomes difficult, and complex structure is required. The structured wireless sensor network has planned deployment of sensor nodes, and this means that fewer nodes are required to cover the area compared to an unstructured network.

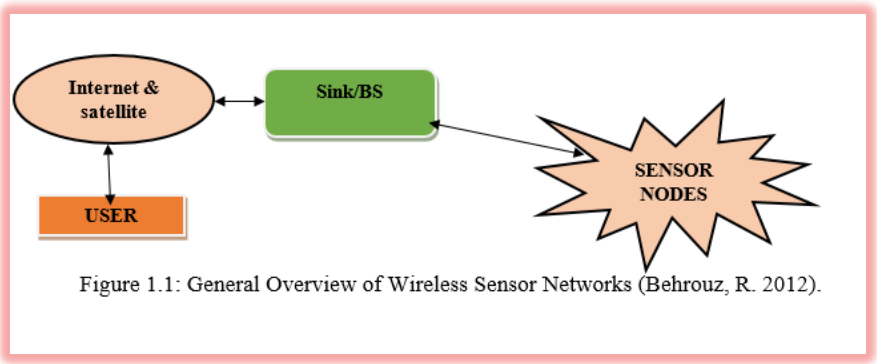


Figure 1.1: General Overview of Wireless Sensor Networks (Behrouz, R. 2012).

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### 1.2 LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY (LEACH)

LEACH is the first network protocol that uses hierarchical routing for wireless sensor networks to increase the life time of network (as shown in figure 1.4). The entire node in a network organizes them into local cluster, with one node acting as the cluster head. All non-cluster head node transmits their data to the cluster head, while the CH node receive data from the entire cluster member, perform signal processing functions on the data aggregation and transmit data to the remote base station. LEACH minimize the communication energy that is dissipated by the cluster heads and the cluster members as much as 8 times when compared with direct transmission and minimum transmission energy routing.

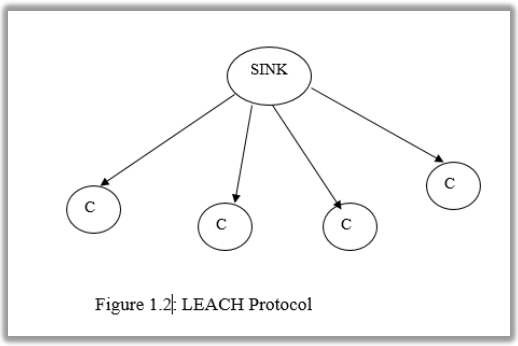

Figure 1.2: LEACH Protocol

### 1.3 THE PROBLEM STATEMENT

All sensors will collect information and send to the base station which leads the energy consumption in the network. Especially when the entire cluster heads effective, adjacent, collect the same information and send to base station, the problem would be to cluster heads died quickly and which lead to energy consumption for wireless sensor networks.

#### 1.3.1 EXISTING SYSTEM

Many energy efficient techniques were employed. In Handy et al. focus on reduction in power consumption of wireless sensor networks with the help of the LEACH protocol. LEACH's stochastic cluster head selects an algorithm by a deterministic component to define the lifetime of a sensor network. It presents the three metrics – First Node Dies (FND), half of the Nodes Alive (HNA), and the Last Node Dies (LND) that determines the lifetime of a sensor network. However, it is assumed that all nodes in the network are homogenous and energy constrained and are able to reach the base station, nodes have no location information, and cluster heads perform data compression. In, multi-hop routing with the LEACH protocol to prolong lifetime of WSN is implemented based on Received Signal Strength Indicator (RSSI). Each sensor node has to send that packet to the distant base station. The LEACH protocol forms clusters to fuse the data before transmitting it to the base station. The PEGASIS protocol is put forth to reduce the amount of energy sent per round, to overcome the drawback of the LEACH protocol. PEGASIS eliminates the overhead dynamic cluster formation, minimizes the transmission distance for non-leader nodes, and limits the number of transmissions and receptions among all nodes. In the existing PEGASIS protocol has a chain of sensor nodes that is formed, and for the data gathering round leader for each round is selected at random. The head of each cluster collects the data, fuses it, and sends to the base station. Here, the first node is selected for a particular number of rounds from those nodes in the

network. Another approach is to pick the node with highest energy as the head of the data gathering process. The protocol is implemented in square, circular and rectangular topologies successfully. However, the PEGASIS is based on assumption that sensor nodes are static in behavior, and all nodes have global knowledge of the network. General Self-Organized Tree Based Energy Balance Routing Protocol (GSTEB) has been put forth in as a substitute to LEACH, PEGASIS and HEED Protocols. Based on network structure the routing techniques are classified as hierarchical, location based, or cluster based routings. These are evaluated for design, energy and communication overhead savings, and drawbacks. Based on this analysis the challenges and pinpoint future research guidelines are posed.

### 1.3.2 DRAWBACKS

- Follows static cluster approach
- Inefficient power management
- High Traffic load

### 1.3.3 PROPOSED SYSTEM

LEACH and PEGASIS are the most well-known energy efficient protocols for wireless sensor networks. LEACH considers dynamic cluster approach and energy efficiency during wireless transmission, while PEGASIS considers the power consumption, reduced traffic overload, increased network lifetime and cost efficiency, but doesn't take into account dynamicity. The combination of the two protocols is to design an ideal routing protocol for wireless transmission and networking. The cluster head set is responsible for data forwarding in LEACH, while in PEGASIS, hierarchical chain formation is implemented. We propose the new protocol P-LEACH that combines the chain formation technique within the clusters for data forwarding. The nodes in a cluster select an active cluster head having the highest energy amongst them. Each cluster head communicates with other cluster heads in the network and thus form a chain to the base station. The cluster head having the nearest distance to the base station is selected as a leader of the chains, who is responsible for sending the data to the base station directly.

## 1.4 SWIT-CH-LEACH Expanded

This section is introducing a new algorithm called (SWIT-CHLEACH) to achieve the equitable distribution energy consumption of wireless sensor networks. It have many of steps as shown in The SWIT-CH Algorithm is starting be called the initial parameters, power of normal node 2J, Special Node 3J, environment size 500m x500m, number of node 100, number of cluster head 20, active cluster head 5, sleep cluster head 15, Special Node Ratio 20%, the first job fix the location node randomly, then select the most powerful node as a working cluster head after that will select the active cluster heads and put the rest special node in sleep mode. For each round will be calculate the modem power, by find firstly power used in its round then update the all node of power, all the previous operations will repeat until the most of the cluster heads are died.

## 1.5 METHODOLOGY

### 1.5.1 HARD WARE DETAILS

**Operating system:**

Windows 7 Service Pack 1

**Processors:**

Any Intel or AMD x86-64 processor with four logical cores and AVX2 instruction set support

**Disk:**

2.6 GB of HDD space for MATLAB only, 4-6 GB for a typical installation

**RAM**: 4GB

**Graphics**: Hardware accelerated graphics card supporting OpenGL 3.3 with 1GB GPU memory is recommended.

### 1.5.2 SOFTWARE DETAILS

We use MATLAB for the implementation of algorithm, MATLAB version 12 is a powerful language for technical computing, the name MATLAB stands for MATrix Laboratory, because its basic data elements is a matrix (Array), MATLAB can be used for math computations, modeling and simulations, data analysis and processing, visualization and graphics, and algorithm development.

### 1.6: IMPLEMENTATIONS DETAILS

The SWIT-CH-LEACH has been simulated accurately in MATLAB. These have been made assuming a network having dimensions 500m x 500m, the nodes are generated and placed randomly, the parameters that are used to calculate the energy of nodes are given below:

1. Distance between the normal nodes and CHs.
2. Distance between the CHs and BS.

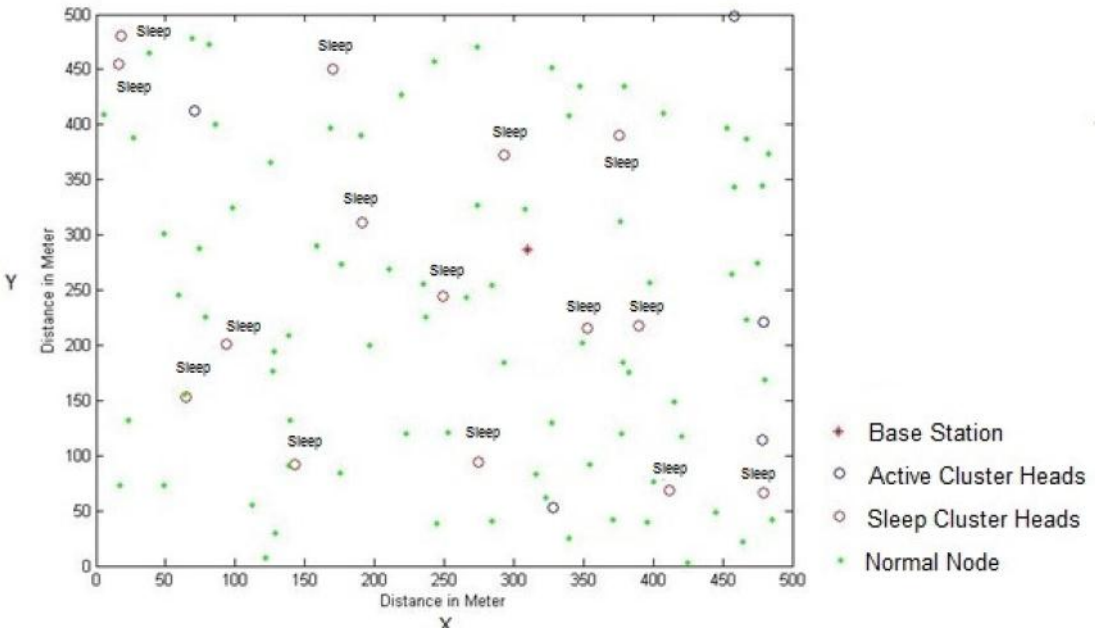


**Figure 5.1** Initial Node


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| MODIFIED LEACH | SRDC-LEACH | EEE-LEACH | LEACH | DTx | Protocol |
|---|---|---|---|---|---|
| Yes | Yes | Yes | Yes | No | CH |
| No | No | Yes | No | No | Master CH |
| Yes | No | No | No | No | Special CH |
| Yes | Yes | No | No | No | Sleep Node |
| Yes | No | No | No | No | Sleep CH Only |
| Fixed BS | Fixed BS | Fixed BS | Fixed BS | Fixed BS | Mobility |
| TDMA | TDMA | TDMA | TDMA | TDMA | Scheduling |
| Excellent | Very Good | Very Good | Good | Average | Lifetime |
| Very Good | Good | Good | Least | No | Energy Efficient CH |
| Single-hop | Single-hop | Multi-hop | Single-hop | Single-hop | Communication |

Comparison for Different Properties LEACH Protocols

### 1.7 CONCLUSIONS

Wireless sensor networks pose interesting challenges for networking research. Foremost among these is the development of long lived sensor networks in spite of the energy constraints of individual nodes. Introduces a brief background of sensor nodes covering structured and limitation. In this thesis we proposed a new algorithm SWIT-CH-LEACH to increase the lifetime of the wireless sensor networks. This algorithm improves the results of the traditional LEACH protocol. We selected 20% of the total deployment nodes to be cluster heads. In each round the highest energy of five cluster heads has been chosen and the rest of cluster heads will be in sleep mode. The SWIT-CH-LEACH algorithm will continue to process until the cluster heads will lose all energy

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