

Algorithm for Optimizing First Node Die (FND) Time in LEACH Protocol

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Abstract

Optimizing lifetime and efficiency is the most critical requirement in WSN. Due to remote deployable nature frequent access is not possible for nodes in WSN. Data Collection, processing and transmission are key function of WSN node. The whole functionality of the node depends upon the battery lifetime and replacement of the battery is not possible. User can't access these nodes once they are deployed. So there is a requirement of energy efficient protocol in order to improve the lifetime of the network. The most common protocol used to enhance the lifetime of the network is clustering based protocol still there is a need for optimizing the communication protocol in which different nodes communicates with the Cluster Head and Base Station. In this paper an improved LEACH Protocol for heterogeneous network is proposed. In the proposed method algorithm is optimized for increasing first node die (FND) time. The protocol also focuses on lifetime enhancement and maintaining Quality of the Service (QoS) of the network.

Keywords: WSN, Cluster Head, Heterogeneous, Lifetime, FND, QoS

1. Introduction

Protocol selection and Implementation in communication solely depends upon parameters like energy requirement, coverage area and quality of service. In WSN, lifetime and efficiency are the parameters that can be optimized. Lots of research has been done in this field to enhance network parameters by designing different protocols. A fixed distance based threshold is used for the bifurcation of direct communication and cluster based communication. Tyagi Sudhanshu (2013). In wireless sensor network (WSN), a large number of low power sensor nodes jointly gather information from their surrounding environments and transmit them towards the Base Station Akyildiz,W (2002), D. J. Cook (2004).

In standard protocols with every round the energy of nodes decays until the node dies. In some protocols nodes directly transmit the data to the base station and the energy consumed by nodes is larger because larger transmission power is required to transmit the data to base station. The nodes which are farthest will die earlier because of larger transmission distance. Several Protocols have been designed to make the network efficient. One of the most common protocol used to make the network efficient is based on clustering. W. Heinzelman(2000) proposed a clustering algorithm. In this method sensors are divided into clusters and each sensor node sends data to its clustering head and the cluster head forwards it to the Base Station Mao Ye (2005). The nodes closer to the Base Station consumes less Energy since the energy consumption for data transmission is proportional to square of transmission distance.

General architecture of WSN based on clustering is shown in figure-1. In which Clusters are created and a cluster head (CH) is assigned to each cluster. These Cluster heads are also known as Master Nodes. Cluster Heads are responsible for collecting and processing the data from their respective clusters, and transmitting this data to the BS.

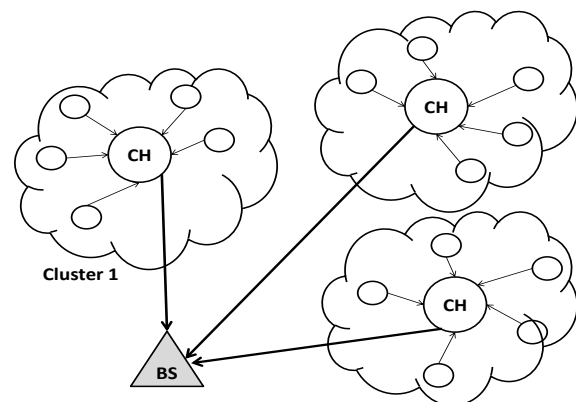


Figure:1 Heterogeneous Network Structure of WSN (Clustering)

In data processing the power consumption is larger than in data transmission. The aggregation of data at CHs greatly reduces the energy consumption in the network by minimizing the total data messages to be transmitted to the BS. Also, the CHs act as local sinks for the data, so that data are transmitted over a shorter transmission distance J. N. Al-Karaki (2004). The process of cluster formation consists of two phases, cluster-head election and assignment of nodes to cluster-heads. The cluster-head

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needs to coordinate all transmissions within the cluster, so also it handles the inter-cluster traffic, delivers the packets destined for the cluster, etc. Wong, D.S(2007), I. S. Misra (2005). Hence these cluster-heads experience high-energy consumption and thereby exhaust their energy resources more quickly than the ordinary nodes.

Depending upon the application and network architecture routing protocols are chosen J. N. Al-Karaki (2004). Heinzelman et al discussed various communication protocols for optimization of WSN. A protocol named LEACH (low energy adaptive clustering hierarchy) is based on distributed clustering. Each cluster consist of CH which collects data from it neighboring nodes and transmits toward the base station J. Ibrqi (2004), G. Zheng. New cluster head will be formed on the basis of threshold number $T(n)$, assigned to each node in the network. Its value lies between 0 and 1, which changes after every round.

$$T(n) = \begin{cases} \frac{p}{1-p \times (r \times \text{mod} \frac{1}{p})} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Here,

- P - Cluster head probability,
- r - Current round number and
- G - Group of nodes that have not been cluster head in the last $1/P$ rounds.

2. Methodology

Generally for Cluster head selection the strategy followed depends upon maximum energy of the node in the same cluster after each round. A new approach using LEACH is proposed which focuses on lifetime maximization as well as on Quality of Service. In this proposed method parameters FND (first node die) is targeted and optimized.

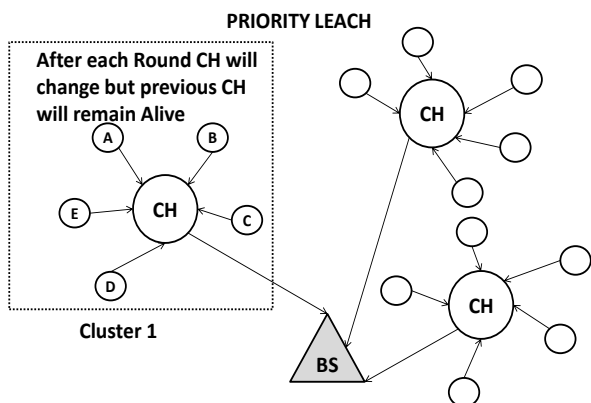


Figure: 2 Concept of Priority Leach

After every round of transmission the energy level of each node will be different and the cluster head will be changed accordingly. The node in cluster with maximum energy is selected as new cluster head. The node previously working as CH will now become an ordinary node. Thus it will remain alive for longer duration. The quality of service of the network will also improve as the large number of node will remain alive till end.

Cluster head is selected randomly in the beginning. Base station is continuously monitoring the energy level of all the nodes. After every epoch, the energy level of nodes will change.

The node with highest energy level in that particular cluster will automatically become Cluster Head. With this approach the energy level of nodes will not decay rapidly ultimately increasing the first node die time which will enhance the lifetime as well as Quality of Service. Here priority is given to node with highest residual energy after each epoch. Figure -2 shows the concept of priority leach protocol proposed.

The Flow chart of Priority LEACH is shown in Figure-3. After the first round of transmission, the energy of Cluster Head is compared with the energy of remaining nodes in the cluster. If the energy is greater than other nodes, the same cluster head will carry on the operation otherwise new cluster head will be formed having the highest energy in cluster.

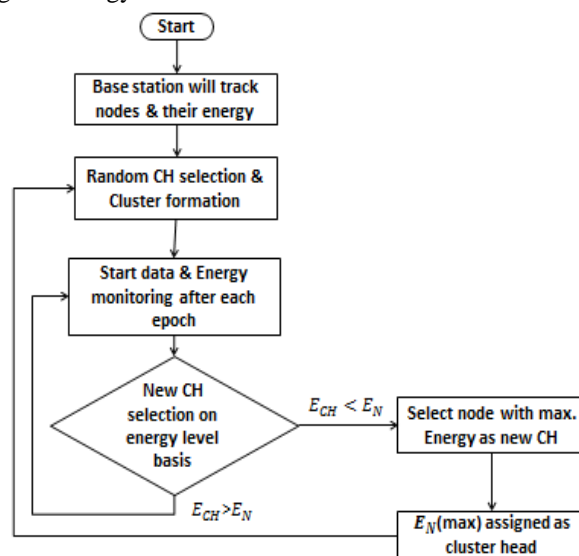


Figure: 3 Flow Chart of Priority LEACH

Result & Conclusion

Cluster head selection method in proposed technique allows all nodes remain alive for longer periods. The new cluster head is formed as the current cluster head loses its energy. The previous cluster head become an ordinary node and contributes in network. With fixed clustering scheme the algorithm anticipates considerable increase in network lifetime by increasing the first node die (FND) time.

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