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Review on Energy Efficient LEACH Protocol in Wireless Sensor Network

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Abstract— In Wireless Sensor network (WSN) the energy consumed by the sensor network determines the wireless sensor network lifetime and battery backup which effect lifetime of sensor node and nodes are alive more time. LEACH is a hierarchical routing protocol special for wireless network .LEACH due to randomness property CH selection and any sensor node become cluster head. More number of cluster in sensing reduce cluster size and energy consumption of nodes and cluster also data transfer between cluster head and base station. Stability is fail to maintain in system. The purpose is to increase the alive time of nodes for more data transfer among BS and CH without failure of any node. In improved LEACH protocol, after clusters are established, each cluster head decides whether to select a new cluster head, based on their energy consumption. The new cluster head will be the node having more residual energy. Thus, those clusters with less load can avoid the energy consumption resulted in selecting cluster head frequently. A homogeneous sensor network consists of identical nodes, while a heterogeneous sensor network consists of two or more types of nodes organized into hierarchical clusters

Index Terms- Wireless Sensor Network (WSN), LEACH, Cluster, Homogenous, Heterogeneous,

1 INTRODUCTION

Wireless sensor network is emerged as an important new area in wireless technology and collection of sensor nodes having limited resources. These networks are essentially data-gathering networks where the data are highly correlated and the end-user requires a high-level description of the environment the nodes are sensing. In addition, these networks require ease of deployment, long system lifetime, and low-latency data transfers. The limited battery capacity of micro-sensor nodes and the large amount of data that each node may produce translates to the need for high application-perceived performance at a minimum cost, in terms of energy and latency [1]. In this paper Leach- heterogeneous system in the individual clustering of the whole network, which is energy efficient routing method for WSNs and compared it with the normal Leach-Homogeneous system. Results from our simulations using MATLAB shows that Leach Heterogeneous System provides better performance in energy efficiency and increasing level in lifetime of the wireless sensor networks. Thus we conclude that the heterogeneous wireless sensor networks are more suitable for real life applications as compared to the homogeneous counterpart. WSN is widely used to collect reliable and accurate information in the distance and hazardous environments, and can be used in National Defense, Military Affairs, Industrial Control, Environmental Monitor, Traffic Management, Medical Care, Smart Home [2]-[3]. Also, the network protocol should take care of other issues such as self-configuration, fault tolerance, delay, etc. [4]. In heterogeneous networks more than one and different types of nodes with different battery functionality are used. In heterogeneous network different topologies are used and this makes the network a very complex network. Thus in short, we can say that in case of heterogeneous sensor network there are two or more various types of network nodes along with different functionality and battery energy is used. The real motivation behind the heterogeneous networks is the need of extra battery energy and more complex hardware is embedded in some cluster heads, hence this reducing the overall cost of hardware for the remaining sensor network. But the fixing of cluster head nodes is nothing but the role rotation which is not possible longer [5]. In homogeneous networks all the sensor nodes are identical in terms of battery energy and hardware complexity. With purely static clustering (cluster heads once elected, serve for the entire lifetime of the network) in a homogeneous network, it is evident that the cluster head nodes will be over-loaded with the long range transmissions to the re-mote base station, and the extra processing necessary for data aggregation and protocol co-ordination. As a result the cluster head nodes expire before other nodes. However it is desirable to ensure that all the nodes run out of their battery at about the same time, so that very little residual energy is wasted when the system expires. One way to ensure this is to rotate the role of a cluster head randomly and periodically over all the nodes as proposed in LEACH [6]. However the downside of using a homogeneous network and role rotation is that all the nodes should be capable of acting as cluster heads, and therefore should possess the necessary hardware capabilities. On the other hand, in a heterogeneous sensor network, two or more different types of nodes with deferent battery energy and functionality are used. The motivation being that the more complex hardware and the extra battery energy can be embedded in few cluster head nodes, thereby reducing the hardware cost of the rest of the network. How-ever fixing the cluster head nodes means that role rotation is no longer possible. When the sensor nodes use single hop-ping to reach the cluster head, the nodes that are farthest from the cluster heads always spend more energy than the nodes that are closer to the cluster heads. On the other hand when nodes use rotation which is not possible longer [5]. In homogeneous networks all the sensor nodes are identical in terms of battery energy and hardware complexity. With purely static clustering (cluster heads once elected, serve for the entire lifetime of the network) in a homogeneous network, it is evident that the cluster head nodes will be over-loaded with the long range transmissions to the remote base station, and the extra processing necessary for data aggregation and protocol co-ordination. As a result the cluster head nodes expire before other nodes. However it is

desirable to ensure that all the nodes run out of their battery at about the same time, so that very little residual energy is wasted when the system expires. One way to ensure this is to rotate the role of a cluster head randomly and periodically over all the nodes as proposed in LEACH [6]. However the downside of using a homogeneous network and role rotation is that all the nodes should be capable of acting as cluster heads, and therefore should possess the necessary hardware capabilities. On the other hand, in a heterogeneous sensor network, two or more different types of nodes with deferent battery energy and functionality are used. The motivation being that the more complex hardware and the extra battery energy can be embedded in few cluster head nodes, thereby reducing the hardware cost of the rest of the network. How-ever fixing the cluster head nodes means that role rotation is no longer possible. When the sensor nodes use single hop- ping to reach the cluster head, the nodes that are farthest from the cluster heads always spend more energy than the nodes that are closer to the cluster heads. On the other hand when nodes use multi-hopping to reach the cluster head, the nodes that are closest to the cluster head have the highest energy burden due to relaying . Consequently there always exists a non-uniform energy drainage pattern in the network. LEACH divides the network into several clusters of sensors, which are constructed by using localized coordination and control not only to reduce the amount of data that are transmitted to the sink, but also to make routing and data dissemination more scalable and robust.

Related Work

The WSN is used the two types of networks homogeneous and heterogeneous. The homogeneous mixture is a mixture where the components that make up the mixture are uniformly distributed throughout the mixture. The heterogeneous mixture is a mixture where the components of the mixture are not uniform or have localized regions with different properties, but heterogeneous networks are more efficient than the homogeneous network in WSN. LEACH (Low-Energy Adaptive Clustering Hierarchy) [5] is a clustering-based protocol and one of the first hierarchical routing approaches for sensor networks that utilizes the randomized rotation of local cluster base stations to evenly distribute the energy load within the network of sensors. In LEACH, the cluster head (CH) nodes reduce the data arriving from nodes that belong to the particular cluster, and send an aggregated data to the base station in order to reduce the amount of information that must be transmitted to the base station. WSN is considered to be a dynamic clustering method. There are two types of clustering techniques. The clustering technique applied in homogeneous sensor networks is called homogeneous clustering schemes, and the clustering technique applied in the heterogeneous sensor networks is referred to as heterogeneous clustering schemes. Many existing clustering techniques such as LEACH consider homogeneous sensor networks where all sensor nodes are designed with the same battery energy. The energy saving schemes for homogeneous wireless sensor networks do not perform efficiently when applied to heterogeneous wireless sensor network. Thus, Energy efficient clustering protocols should be designed for the characteristic of heterogeneous wireless sensor networks [7]. The dynamic is changing the network parameters. In LEACH, a data collection model is described as shown in fig 1. One hundred of homogeneous nodes are uniformly distributed in a 100m * 100m square region. This model is based on the military object tracking and hazards environment monitoring application background, where the base is often far from application area. Some assumptions are made that node can selected its transmission range and every node knows the positions of other nodes and itself. The selectable range assumption is closely based on the function of current sensor devices. The network includes some of the initial setting of energy parameters and the initialization of the sensor nodes. So it is necessary to generate a random distribution of these nodes in the 100 *100 m^2 of the region (X=100, Y=100). Sink is located at (bs_x=50, bs_y=50). o indicates Normal nodes and dark o indicates CHs For homogeneous wireless sensor network system initialization all the available wireless sensor network nodes are having equal amount of initial energy E_o = 0.5J. In the LEACH, the CH is always on receiving data from cluster members; CH dies earlier than the other nodes in the cluster because of its operation of receiving, sending and overhearing. When the CH die, the cluster will become useless because the data gathered by cluster nodes will never reach the base station. In our protocol, besides transmitting data directly from CH to base station, CH sends data to the other cluster head which is inside a pre-defined radius, so that transmitting energy is less dissipated. LEACH is completely distributed and requires no global knowledge of network. It reduces energy consumption by (a) minimizing the communication cost between sensors and their cluster heads and (b) turning off non-head nodes as much as possible [8]. LEACH uses single-hop routing where each node can transmit directly to the cluster-head and the sink. Therefore, it is not applicable to networks deployed in large regions. Furthermore, the idea of dynamic clustering brings extra overhead, e.g. head changes, advertisements etc., which may diminish the gain in energy consumption. While LEACH helps the sensors within their cluster dissipate their energy slowly, the CHs consume a larger amount of energy when they are located farther away from the sink. Also, LEACH clustering terminates in a finite number of iterations, but does not guarantee good CH distribution and assumes uniform energy consumption for CHs. The operation of LEACH is divided into rounds having two phases each namely (i) a setup phase to organize the network into clusters, CH advertisement, and transmission schedule creation and (ii) a steady-state phase for data aggregation, compression, and transmission to the sink.

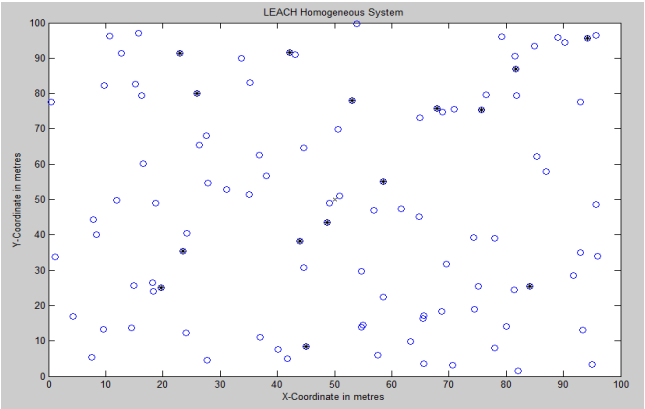


Fig.1: Initialization of the wireless sensor network

Table 1: Simulation Parameters

PARAMETER NAME	VALUES
Network area	$100m * 100\ m$
Number of nodes	100
Initial Energy (E_o)	0.5J

BS position	$50\ m * 50\ m$
E_{elec}	50nJ/bit
$E_{tx}=E_{rx}$	50nJ/bit
ε_{fs}	10pJ/bits/m2
ε_{mp}	0.0013pJ/bit/m^4
D_o	$sqrt(\varepsilon fs\ /\ \varepsilon mp)$
E_{DA}	5nJ/bit
Packet size	4000bits
Total nodes	100

3. SIMULATION RESULT

In the homogeneous LEACH when the number of rounds is 400 then all nodes are in live state. Similarly as round leads to 700 all nodes are still alive. As the rounds proceeds up to 900, nodes start going into dead states, but if the rounds goes up to 2000 rounds then the almost all the nodes are dead. In the heterogeneous LEACH, when the number of rounds are 500 then all nodes are in live state. As the rounds proceeds up to 1000, nodes start going into dead states .After 3400 rounds all the active nodes are dead. Thus the overall simulation of parameters over the code analyzed shows that heterogeneous protocol performs better than homogeneous type.

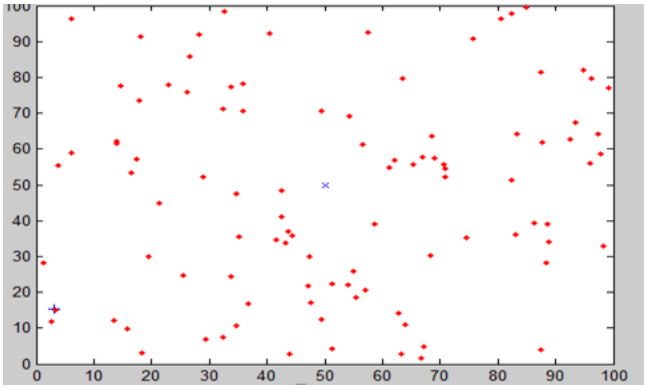
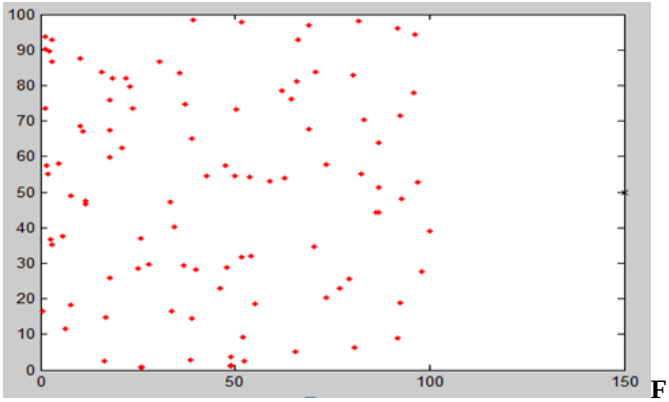


Fig.2. Simulation result after 3200 rounds in LEACH-Heterogeneous System. (All Nodes dead)



F ig.3. Simulation result after 2000 rounds in LEACH-Homogeneous System. (All Nodes dead)

We have the area for the X and Y in meters but number of nodes is same in Heterogeneous and Homogeneous LEACH. In this if we have an area of 100*100 then the total numbers of nodes are 100.

4. CONCLUSIONS

In Wireless sensor networks energy efficiency is the most important factor. The major problem for wireless sensor networks is the limited energy supply so that we can save energy for future purpose. The life time and reliability of the network can be improved by heterogeneity in wireless sensor networks. Clustering is a good technique to reduce energy consumption and to provide stability in wireless sensor networks. To operate under heterogeneous wireless sensor networks, several protocols are proposed. Finally, We conclude that the heterogeneous wireless sensor networks are more suitable for real life applications as compared to the homogeneous counterpart. For future work, a model with high density of heterogeneous wireless sensor nodes with its topology is proportionately increased according to the application to have good energy efficient and increasing lifetime network may be investigated. This may try to implement in ns2 and MATLAB with stable and mobile mode of the system. We will increase network lifetime and fault-tolerance with putting high power sensors as a gateway between cluster head and sink.

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