A Survey on Leach -Protocols for Wireless Sensor Networks

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Abstract: Recent development in network area of micro-sensor devices have accelerated the advances in the sensor networks field leading to many new protocols specifically designed for wireless sensors networks(WSNs).wireless sensors networks with hundreds to thousands of sensor nodes can gather information from an unattended location and transmit the gathered data to a particular users, depending on the applications. These sensor nodes have some constraints due to their limited energy, storage capacity and computing power. Data are routing from one node to other using different routing protocols. There .this paper gives brief idea about different protocols in wireless sensor networks (like LEACH, SEP, HRC etc.) also included comparison of these protocols. Most of the research in energy efficient data gathering in data centric applications of wireless sensor networks is motivated by LEACH (Low Energy Adaptive Clustering Hierarchy) scheme. It allows the rotation of cluster head role among the sensor nodes and tries to distribute the energy consumption over the network. Selection of sensor node for such role rotations greatly affects the energy efficiency of the network.

I. INTRODUCTION

Wireless sensors networks are networks of tiny, battery powered sensor nodes with limited on - board processing storage and radio capabilities. Nodes sense and send their reports towards a processing centre which is called “sink”. The design of protocols and applications for such network has to be energy aware in order to prolong the lifetime of other network, because the replacement of the embedded batteries is a very difficult process once these nodes have been deployed. As shown in figure 1 the regular node sense the field, generate the data, and send them to associated nodes.[2,3] Then the after performing some processes transmit them to the BS in a multi-hop approach. Eventually the user receives the data from the.

II. PROTOCOL PROPOSED FOR WIRELESS NETWORKS

Wireless sensor networks (WSNs)[1] are composed of a hug number of sensor nodes. There are many applications for WSNs and depending on the application, different types of sensors are used, such sensors measuring moisture, temperature, pressure and movements. WSNs have themselves characteristics that make them different from other types of networks. One for example is that the applicability of the networks is related to energy supply of the nodes, so energy conservation is one of the most important challenges in these networks .Different types of protocols for WSN are following:

A. Direct Transmission Protocols

Using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes, direct communication will require a large amount of transmit power from each node. This will quickly drain the battery of the nodes and reduce the system lifetime. How-ever, the only receptions in this protocol occur at the base station, so if either the base station is close to the nodes, or the energy required receiving data is large, this may be an acceptable method of communication.

B. Minimum Transfer Energy Protocols

In these protocols, nodes act as routers for other nodes’ data in addition to sensing the environment. These protocols differ in the way the routes are
chosen. Some of these protocols only consider the energy of the transmitter and neglect the energy dissipation of the receivers in determining the routes. Depending on the real time costs of the transmit amplifier and the radio electronics, the total energy expended in the system might actually be greater using MTE routing than direct transmission to the base station.

It is clear that in MTE routing, the nodes closest to the base station will be used to route a large number of data messages to the base station. Thus these nodes will die out quickly, causing the energy required to get the remaining data to the base station to increase and more nodes to die. This will create a cascading effect that will shorten system lifetime. In addition, as nodes close to the base station die, that area of the environment is no longer being monitored.

Nodes closest to the base station are the ones to die out first for MTE routing, whereas nodes furthest from the base station are the ones to die out first for direct transmission. This is as expected, since the nodes close to the base station are the ones most used as “routers” for other sensors’ data in MTE routing, and the nodes furthest from the base station have the largest transmit energy in direct communication.

C. Clustering Protocol[6]

A final conventional protocol for wireless networks is clustering, where nodes are organized into clusters that communicate with a local base station, and these local base stations transmit the data to the global base station, where it is accessed by the end-user. This greatly reduces the distance nodes need to transmit their data, as typically the local base station is close to all the nodes in the cluster. Thus,[5] clustering appears to be an energy-efficient communication protocol. However, the local base station is assumed to be a high-energy node; if the base station is an energy-constrained node, it would die quickly, as it is being heavily utilized. Thus, conventional clustering would perform poorly for our model of micro sensor networks.

D. LEACH:

Low-Energy Adaptive Clustering Hierarchy

LEACH is called “Energy efficient Adaptive protocol for clustered Wireless sensor networks”. This protocol facilitates the nodes with more residual energy have more chances to be selected as cluster head.[11] In order to extend the lifetime of the whole sensor network, energy load must be evenly distributed among all sensor nodes so that the energy at a single sensor node or a small set of sensor nodes will not be drained out very soon.

Low Energy Adaptive Clustering Hierarchy (LEACH) is the first energy efficient routing protocol for hierarchical clustering. It reduces the energy significantly.[12] LEACH is a self-organizing, adaptive clustering protocol that uses randomization to distribute the energy load evenly among the sensors in the network. In LEACH, the nodes organize themselves into local clusters, with one node acting as the local base station or cluster head.

LEACH[13] includes randomized rotation of the high-energy cluster-head position such that it rotates among the various sensors in order to not drain the battery of a single sensor. LEACH performs local data fusion to “compress” the amount of data being sent from the clusters to the base station, further reducing energy dissipation and enhancing system lifetime.

E. Stable Election Protocol

Stable Election Protocol (SEP) is proposed based on weighted election probabilities of each node to become cluster-head (CHs) according to their respective energy. This approach ensures that the cluster head election is randomly selected and distributed based on the fraction of energy of each node assuring a uniform use of the nodes energy.

SEP also considered two types of nodes and two level hierarchies.

We have analyzed a three level hierarchical clustered heterogeneous sensor network and considered three types of sensor nodes having different initial energy namely advanced, moderate and normal nodes.[5] Advanced and moderate nodes have more energy supply, longer transmission range, higher data rate than the normal nodes. So, the advanced and moderate nodes have higher chances to become cluster heads at a particular round compare to a normal node which extensively prolong the sensor network to operate.

F. Hierarchical Cluster-Based Routing (HCR) Protocol

In HCR nodes self organize into clusters and each cluster is managed by a set of associates called head-set. Using round-robin technique, each associate acts as a cluster head (CH). [3] The sensor nodes transmit data to their cluster heads, which transmit the aggregated data to the base station. Moreover, the energy-efficient clusters are retained for a longer period of time; the energy-efficient clusters are identified using heuristics-based approach.

G. Genetic Algorithm

A genetic algorithm (GA) is used to create energy efficient clusters for data dissemination in wireless sensor networks. A GA is used at the base station,
which provides energy efficient solutions to the optimizer. This provides the base station with the ability to determine the best cluster formation that will give minimum energy consumption during run time. The base station analyses the current network condition and applies the GA after every iteration. The optimizer at the base station selects the best solution based on the acquired knowledge through the GA fitness function. [9]The proposed fitness function is based on parameters such as energy consumption, number of clusters, cluster size, direct distance to sink, and cluster distance. Upon completion of iteration, the optimizer improves its decisions by receiving feedback, which is then used to adjust the weights of the parameters of the fitness function for the next iteration. The BS uses a GA to create energy-efficient clusters for a given number of transmissions. The node is represented as a bit of a chromosome. The head and member nodes are represented as 1s and 0s, respectively. A population consists of several chromosomes and the best chromosome is used to generate the next population. The simulation results indicate that using GA-based hierarchical clusters increase the network lifetime. In future, the cross layer optimization using query and routing strategies can be investigated.

### TABLE I

**COMPARISON OF PROTOCOLS**

| Sr. No. | Protocols       | Comparisons                                                                 |
|--------|-----------------|------------------------------------------------------------------------------|
| 1      | Direct Transmission | 1. In this protocol sensor node transmit data directly to sink.  
2. Nodes far from sink die quickly.  
3. Not energy efficient protocol.          |
| 2      | MTE             | 1. In these protocols, nodes act as routers for other nodes.  
2. Nodes near to sink die first.  
3. Require more energy than DT.          |
| 3      | Clustering      | 1. One head for some nodes.  
2. Transmission through cluster head.  
3. Work poorly because head die quickly. |
| 4      | LEACH           | 1. The nodes organize themselves into local clusters.  
2. Includes randomized rotation of the high- |

| Sr. No. | Protocols | Comparisons                                                                 |
|--------|-----------|------------------------------------------------------------------------------|
| 5      | SEP       | 1. Increase system lifetime with increase stability.  
2. Transmission energy heterogeneous.          |
| 6      | HCR       | Based on hierarchy of cluster head and sink.                              |
| 7      | GA        | A genetic algorithm (GA) is used to create energy efficient clusters for data dissemination in wireless sensor networks. |

### IV. ADVANTAGES

1. Network setups can be carried out without fixed infrastructure.  
2. Suitable for the non-reachable places such as over the sea, mountains, rural areas or deep forests.  
3. Flexible if there is random situation when additional workstation is needed.  
4. Implementation pricing is cheap.  
5. It avoids plenty of wiring.  
6. It might accommodate new devices at any time.  
7. It's flexible to undergo physical partitions.  
8. It can be accessed by using a centralized monitor.

### V. DISADVANTAGES

1. Less secure because hackers can enter the access point and obtain all the information.  
2. Lower speed as compared to a wired network.  
3. More complicated to configure compared to a wired network.  
4. Easily troubled by surroundings (walls, microwave, large distances due to signal attenuation, etc).  
5. It is easy for hackers to hack it we couldn’t control propagation of waves.  
6. Comparatively low speed of communication.  
7. Gets distracted by various elements like Bluetooth.  
8. Still Costly (most importantly).

### VI. Applications of WSN

A wireless sensor network is designed to measure sense a set of information of the processing task such as detection, tracking or classification. Some existing real life applications are given below:

1. Military Applications  
2. Environment Observation  
3. Precision Agriculture
4. Medical Applications
5. Habitat Monitoring
6. Home Automation
7. Other Commercial Applications
8. Disaster Management

VII. CONCLUSION

In this paper we presented a comprehensive survey on the different approaches. First, we explained the problem in wireless sensor networks and its applications, objectives and characteristics. Then we reviewed and classified the most important approaches and their extensions. All methods generally try to improve the lifespan of the network the main design challenge in these methods is basically different. Energy Efficiency for prolonging the WSN has received much focused energy efficient in wireless network.

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