



A Review Paper on Energy Efficient Routing Protocol for Wireless Sensor Networks

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Abstract: Designing Energy Efficient Routing protocol for Wireless Sensor Network is the basic need of the WSNs to increase the efficiency of the WSNs. In WSNs sensors are extremely sensitive to energy consumption. Saving energy is the fundamental requirement in designing routing protocol for WSNs. To increase the life of sensor and battery, it is necessary to design energy efficient routing protocol which can overcome all the issues that decreases the efficiency of WSNs. This paper introduces some issues related to energy efficient routing protocol for WSNs.

Keywords: WSNs, Energy efficient routing protocol, sensor, battery life, network efficiency.

I. INTRODUCTION

WSNs consist of small and less complex devices called sensor node. The characteristics of sensor node are:

- Sensing the environment or surrounding and collect the information from the surrounding and communicate through wireless links.
 - collected information is forwarded using multiple hope relaying on controller that is used to connect to the alternative networks[1]
- Elements of sensor node are shown below.

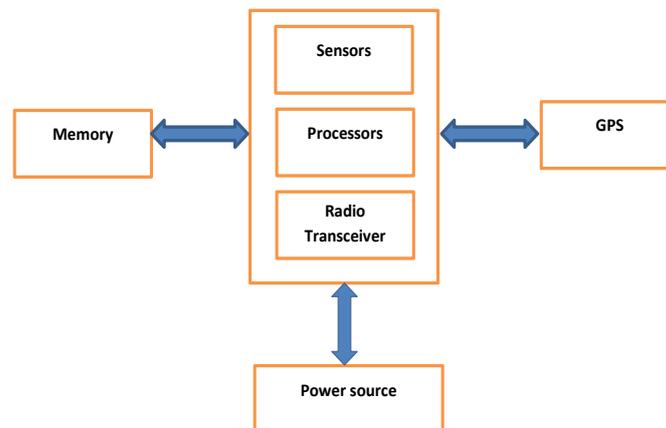


Fig 1: Elements of Sensor Node

A wireless network is made up of many entities which are: Scattered sensor nodes, Controller, Network (internet or alternative) and User. The sensor nodes are scattered in the sensor fields as shown in below figure

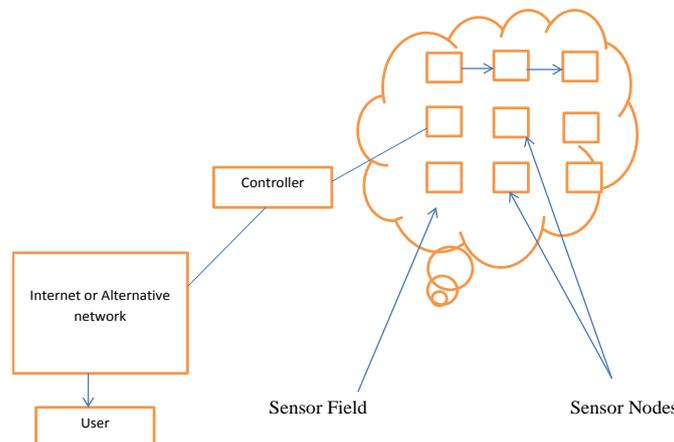


Fig: 2 Sensor Nodes spreaded in a sensor field[1]

Replacement of sensor nodes carrying very less power sources is difficult and life time of sensor depends upon power supply. To minimize energy consumption, energy efficient routing protocol is required. So, designing energy efficient routing protocol is a necessity. Many routing protocol are designed for WSNs. Routing in WSNs is a very tedious task due to the inherent property of the WSNs [7].

II. FREQUENT PROBLEMS OCCUR IN WSNs

Some frequent occurred problems [8] are:

1. **Coverage problem:** It shows how well a sensor monitored or tracked in a wireless network.
2. **Position estimation problem:** Determining the actual position of nodes in the wireless network is the real problem.
3. **Energy Consumption:** In WSNs most of the energy is consumed in transferring and receiving of data as compared to sensing and processing of data.

III. ROUTING PROTOCOL

Routing algorithm is used by the routing protocol to determine optimal network data transfer and communication paths between network nodes. There are number of parameters to classify and compare different routing protocol.

Classification of Routing Protocols

A WSNs might be have classified in four ways, **routing path establishment, network structure, protocol operation based, initiator of communication and application design of networks** as shown in below figure

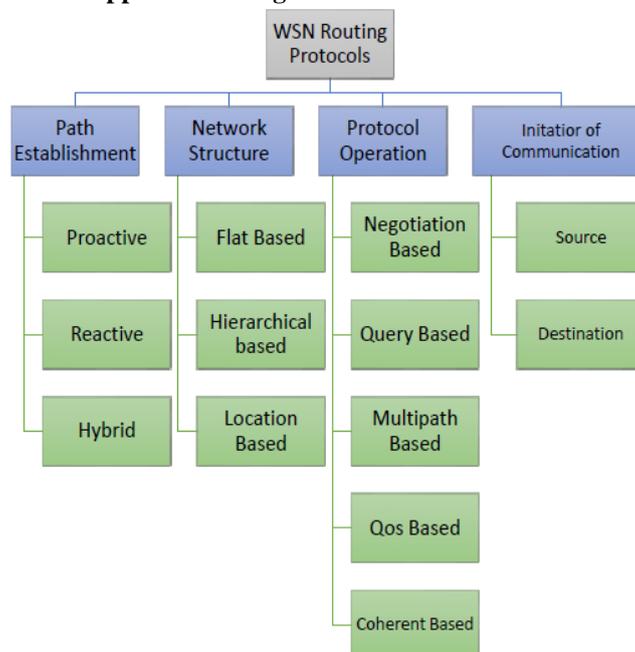


Fig:3 Classification of Routing Protocol

3.1 LEACH

(Low Energy Adaptive Clustering Hierarchy): In the network, for distributing energy load among the sensor nodes this adaptive clustering protocol is used. It uses single hop routing mechanism where information is transmitted directly to the cluster head or the sink [5]. It works in two phase

- 1) The setup phase: Organization of clusters, selection of cluster head is done and to determine whether a node can become a cluster head or not, an algorithm is used in each round.
- 2) The steady state phase: In order to minimize overhead the data is sent to the base station, the duration of the steady state phase is longer than the duration of the setup phase in order to minimize overhead. Cluster head creates a TDMA (Time Division Multiple Access) schedule based on the number of nodes in the group. CDMA (Code Division Multiple Access) code is used for random communication inside the cluster. LEACH is not suitable for large network areas.

Advantages of LEACH protocol

1. It mostly uses hierarchical routing algorithms in sensor networks.
2. The total wireless sensor network is divided into many clusters in leach protocol. The Node that is served as a CH in present round cannot be selected as the CH again; therefore each node can share the load equally which is imposed on Cluster heads.
3. Selection of CH node is random so there are equal chances of each node to which energy consumption of whole network is averaged. Thus LEACH will prolong the network life cycle [2].

Disadvantages of LEACH protocol

Due to the dependence on cluster heads rather than the cluster members for communicating with the sink, it is because of change of CH in each iteration of the communication of information. There is no inter-cluster communication in the

networks because the CHs can directly communicate with the sink. This process requires high range of the transmission power in the network. In LEACH CHs are not at all uniformly distributed within the cluster that means the CHs can be located at the edges of the clusters. In LEACH, CH selection is a random process, which does not take into considerations the energy consumption of the different nodes within the cluster along with the CH into account and this leads to the reselection of CH as the same node in many simultaneous iteration of data processing in the network. It does not work well with the application that requires large area of coverage along with the multi-hop inter-cluster communication [4] [5].

3.2 IB LEACH Protocol:

This protocol is the improved version of LEACH protocol. The advantages and disadvantages of IB LEACH protocol are:

Advantages of IB LEACH protocol:

1. High cluster stability.
2. Scalability of the network is easy.
3. Most efficient protocol to balance the load in wireless network.
4. Energy efficiency is very high in comparison to other routing protocol.

Disadvantages of LEACH protocol

1. High delivery delay
2. Complexity of the algorithm of this protocol is little bit high.

3.3 HEED

Hybrid Energy Efficient Distributed clustering Protocol: HEED extended the fundamental scheme of LEACH by using residual energy and node degree as a main parameter for cluster election to achieve power balancing. By using an adaptive transmission power in the inter-clustering communication, it works in multi-hop networks. In HEED, the proposed algorithm periodically chooses CHs depending upon the combination of two clustering parameters. Residual energy of each sensor node is the first parameter and the second parameter is the intra-cluster communication cost act as the node degree (i.e. number of neighbors). The first parameter is used to select an initial set of CHs and the second parameter is used for breaking ties [6].

Advantages of HEED Protocol are:

1. Networks lifetime improvement as compared to the LEACH clustering because LEACH randomly selects CHs, which may result in quicker death of some nodes.
2. The nodes only require local (neighborhood) information to form the clusters.
3. In HEED due to distribution of energy, the lifetime of the nodes is enhanced within the network which results in stabilizing the neighboring node.

Disadvantage of HEED protocol are: 1. Due to very large workload some Cluster heads, which are near to the sink, might die.

2. Likely LEACH protocol, the clustering in each round appoints significant burden in the network. This burden causes remarkable energy dissipation which results in decline of the networks lifetime. 3.

HEED suffers from a consecutive burden as it needs several iterations to form the clusters. Therefore due to several iterations lots of packets are broadcasted.

3.4 TEEN (Threshold sensitive energy efficient sensor network protocol)

For reactive network the first developed protocol was TEEN. The reduction of number of transmission is the purpose of hard threshold, which is done by allowing the nodes to transmit only when the sensed attribute is in the range of interest. The soft threshold further reduces the number of transmissions by eliminating all the transmissions which might have otherwise occurred when there is little or no change in the sensed attribute once the hard threshold. TEEN is well suited for time critical applications and is also quite efficient in terms of energy consumption and response time. It also allows the user to control the energy consumption and accuracy to suit the application. The main drawback of this scheme is if the thresholds are not achieved, the nodes will never communicate, the user will not get any data packet from the network and will not come to know about the nodes if they die. Thus, this scheme is not well suitable for applications where the user wants to get data regularly. Another problem is that a practical implementation would have to ensure that there collision-free cluster [2].

3.5 ZECR (Zone-Divided and Energy -Balanced Clustering Routing)

ZECR protocol is a one of the efficient protocol for WSN and adapts to the energy heterogeneous network. The main advantage of ZECR is that it can balance the energy consumption of the network and prolong the network life time obviously. In this section the details of ZECR protocol will be illustrated by the five parts in sequence: Zone division, Size of cluster radius, Cluster set-up phase, Inter-cluster multi-hop routing phase and Data transmission phase [8]

Comparison between different Clustering Based Routing Protocols

Clustering minimize interferences and collision in the WSNs and increases the throughput [12]. Now we compare several clustering routing protocol by different parameters.

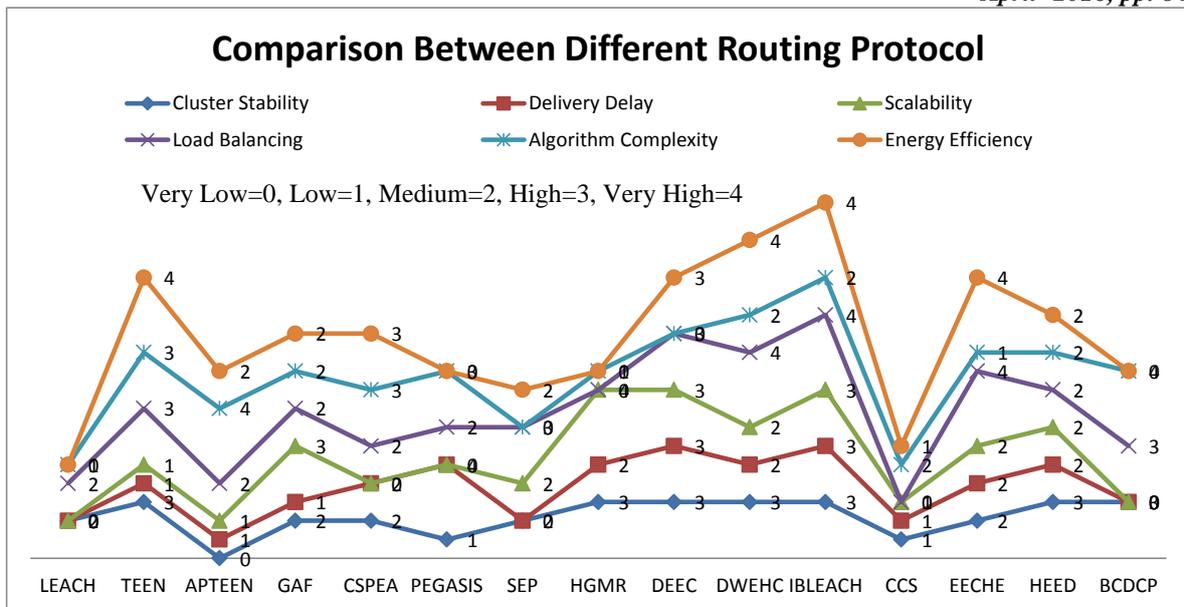


Fig 3: Comparison of Different Energy Efficient Routing Protocols

IV. CONCLUSION AND FUTURE RESEARCH

Designing Efficient Energy Routing Protocol is the fundamental requirement for WSNs, because after some round sensor nodes are dead. The Number of rounds depends upon the power of individual sensor which is measured in joule/node. The value of these rounds is different for every routing protocol which may be around 300 or 500 if we give power of 0.25 or 0.5 joule to node respectively. So, now we have a necessity to design energy efficient routing protocol which helps to keep sensor alive for a long time or for long rounds. In this paper, we have reviewed many research papers which mainly focused on Energy Efficient Routing Protocol for WSNs. We have compared many Routing protocol in several aspects. These papers covered many Energy Efficient Routing Protocols for WSNs but still improvement is required. Further research would be based on many issues which are not covered in existing protocol.

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