

A Literature Survey on Different Type of Energy Efficient Routing Protocol in Wireless Sensor Network

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Abstract— The increasing advances in low-power electronics, sensor technology, and wireless communications, wireless sensor networks (WSNs) have developed into a platform for several important surveillance and control applications[1][2]. WSNs consists of hundreds and thousands of minute sensor nodes equipped with sensing, data processing, and communication units to perform distributed sensing tasks. Sensor nodes usually are operated on battery and hence they have to function without any attendance for a extensive period.. In most of the cases it's impossible or very difficult alter or recharge the batteries in sensor nodes[4].In general, since they are powered by limited energy source, energy maintenance is commonly considered the most key challenge to guarantee the connectivity of the network and extend the operating period of the sensor nodes, especially when the deployment field is inaccessible and battery cannot be replaced[3].Here we will compare different routing protocols for the energy efficiency of a WSN.

Index Terms—WSN, Clustering, Base Station.

I. INTRODUCTION

The vast development in wireless communication has given an opportunity to manufacture tiny, durable, easy to handle, economic sensors that can supervise the surrounding , calculate the required data and transmit signal to the end user from a remote location. WSNs are made of sensor nodes in large number deployed over a region which are typically, capable with small computational capacity processors, short range wireless transceivers, and restricted energy resources (i.e.,batteries) to monitor physical phenomena like acoustic vibrations, temperature, humidity, and light intensity[5]. These very small nodes link with one other over RF communication in ISM band to makeup a WSN [7].Note that there are WSNs which consists of mobile nodes[6].The sensor nodes used in WSN need energy to correspond and forward data to another sensor node and the base station. They are powered by battery. The substitution or recharging of this battery is difficult as they are placed in isolated and hostile environment. Providing an energy potent routing protocol will be the actual challenge of this technology. The idea of the routing protocol is to reduce the energy dissipation and maximizing sensor nodes capacity, to improve the network's lifetime[4].

II. WSN PROTOCOLS

Based on the application (Protocol-Operation-based) and network architecture (Network-Structure-based),

the routing protocols in WSNs would differ. Based upon the protocol operation, WSN can be classified into,

A. Negotiation-based routing

It is done to remove redundant information transmissions. Here, considering the resources offered by the network, decisions on communication are also made.

B. Query-based routing

A inquiry for the data from node will be in the network which it is propagated by the destination nodes. A node which has this data sends back the data which matches the query, to the node which initiated it.

C. Multipath-based routing

To upgrade network performance, it uses multiple paths instead of a single path. For instance, by maintaining different paths between source and destination the fault tolerance can be increased but at the same time increasing energy usage and traffic generation.

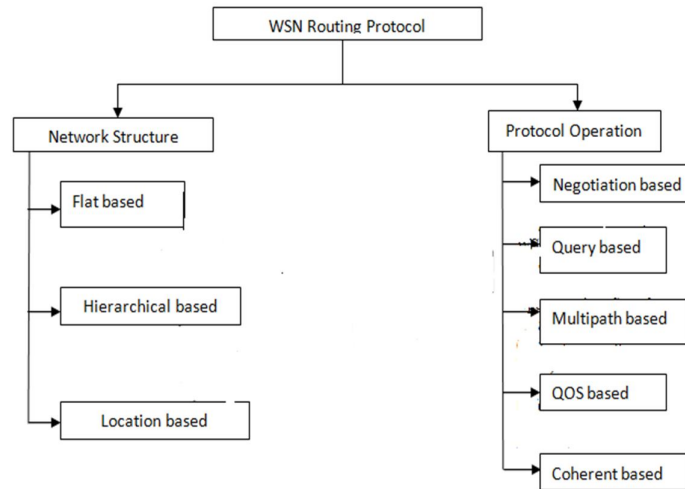


Fig. 1 Different types of WSN routing protocols

D. QOS-based routing

During data delivery process, this routing balances the network between quality and energy consumption through few of the QOS metrics like delay, energy, bandwidth etc.,

E. Coherent-based routing

The limited data processing over the nodes is distinguished into coherent (minimum processing) and non-coherent (full processing) routing protocols.

Depending on the network structure, Routing Protocols can also be distinguished into,

A. Flat-based routing

Here each node plays the similar role. The sensor nodes perform together the sensing task. Example- SPIN, Directed diffusion. [8][9]

B. Hierarchical-based routing

Here, processing and transmission of information is done by the nodes which have higher-energy nodes while the nodes which have the low-energy perform sensing near the target. The system lifetime, energy efficiency and scalability can be efficiently increased by using the process of creating clusters and allocating special responsibilities to cluster heads. This routing is an effective way to lower the energy consumption within the cluster. This is done by data aggregation within the different clusters so as to cut down the number of information bits sent to the sink node. Example- LEACH, TEEN, APTEEN

C. Location-based routing

Here sensor node is addressed by the means of locations of the nodes. Depending upon received signal strength from the source nodes, the distance among the neighbouring node can be estimated. By trading such data between neighbours or by communicating with satellite using GPS, respective coordinates of the adjacent nodes could be obtained. In order to save energy, some location-based schemes also suggest that nodes should go to sleep if there is no activity to perform in a definite time. Example- GEAR.

Clustering mechanisms are followed in hierarchical routing. Clustering techniques are efficient with respect to energy and scalability. By using clustering technique the energy utilization is minimized to a great extent in collecting and distribute data [10]. By dividing nodes to different clusters, hierarchical routing protocols minimize the energy consumption. In each cluster, the cluster head (CHs) which are the higher energy nodes, would be utilised to process and send the information to the base station while the cluster members which are low energy nodes can be used to perform the sensing in the proximity of the target and send to its cluster head. In the hierarchical model based on cluster, data is aggregated in the cluster and sent to a higher-level cluster-head or to the base station. Only the cluster-heads have to perform the data aggregation process in this model.

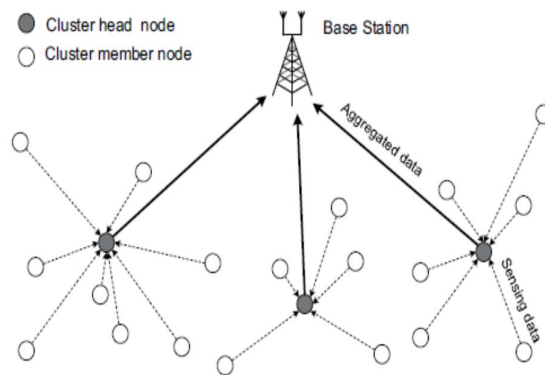


Fig.2 A WSN model with clustering hierarchy

Advantages of clustering over various classes of algorithms are [12]

- Decrease in the energy consumption of intra cluster and as well as inter cluster network.
- Network scalability.
- Network life time extension.
- Decrease in the information packet delay.
- Managing heterogeneity of network.

Few of the hierarchical routing techniques based on clustering are:

- LEACH (Low energy adaptive clustering hierarchy)
- PEGASIS (Power efficient gathering in sensor information system)
- TEEN (Threshold sensitive energy efficient sensor network protocol)
- APTEEN(Adaptive threshold sensitive energy efficient sensor network protocol)

III. HIERARCHICAL ROUTING

- LEACH (Low energy adaptive clustering hierarchy) - is majorly used for energy efficient routing. It performs well for an homogeneous networks, where in every node have the same energy as in the beginning. The LEACH working is mainly divided into 2 major phases – The Set-up phase and The Steady-state phase. In Set-up phase, if a arbitrary number (between 0 and 1) selected by node A is lesser than a threshold value then it is selected as a CH. In Steady-state, each non-CH node sends data to CH at its stipulated timeslot which aggregates and transmits the data to base station.
- Even if it has not sensed data, non-CH node will send data at timeslot stipulated to it, which is not energy efficient. Besides, sensor nodes motility is not supported by it.

- PEGASIS (Power efficient gathering in sensor information system) –This is an improvised version of LEACH protocol. In this protocol, cluster formation does not happen. Instead, every node will communicate with the nearest node to transmit and receive the data. And among these nodes one node will be selected to talk with the base station. This chain formation is achieved by reducing overhead energy dissipation and bandwidth usage in a greedy way to improve the network life span.[13]
- TEEN (Threshold sensitive energy efficient Sensor network protocol) – It is also a hierarchical clustering protocol in which hierarchy of the sensor nodes is present. In this protocol data from sensor nodes is accumulated and then transmitted from the cluster head of first level to cluster head of next level and so on until the base station is reached.
- TEEN executes its function based on a threshold value. As it implies a constraint on when the sensor should transmit the data thus reducing number of transmission it can be called as the most excellent energy efficient protocol.[13]
- APTEEN (Adaptive threshold sensitive energy efficient sensor network protocol)- It is an enhancement of TEEN protocol so as to overcome its drawbacks. It uses a concept similar to TEEN to decrease energy dissipation. This protocol provides a time critical information along with continuous transmission of data that is sensed to the user. It works on the rule which is a combination from both the LEACH and TEEN protocol. Its efficiency is between the two protocols as it performs the function of both the protocol.[13]

IV. CHALLENGES IN CLUSTER BASED HIERARCHICAL ALGORITHM

We have to face various challenges while transmitting of sensed information within the network or outside the network while using routing protocols based on cluster. Some of the challenges are as follows [12],

- Some of the cluster based routing algorithms are only efficient to small region or less number of nodes (LEACH) only.
- Some of the routing is suitable only for deployment of the nodes in a static manner and it degrades its performance in the case of mobile nodes.
- In some algorithm the cluster heads distribution is concentrated to only one area.
- Some routing algorithms are not effective for time critical application.
- All available algorithms are of top down approach, which intern requires re-clustering when we see deployment in some mission critical application.
- Some routing algorithms let all the CHs to send the aggregated information to base station, leading to further energy dissipation in the network.
- Few of the routing algorithms use probabilistic approach during processing and communicating of information in the network which does not consider residual energy in network nodes and that results in early dying of CHs.

V. AD-HOC WSN ALGORITHMS

Various algorithms have been proposed in WSNs.

A. Ad – Hoc On Demand Distance Vector (AODV)

It is another routing algorithm used in ad hoc networks. AODV stands for Ad-Hoc On-Demand Distance Vector. It is a reactive protocol, even though it uses characteristics of a proactive protocol. It takes the fascinating concepts of DSR and DSDV, i.e. the route detection and route maintenance of DSR and also the concept of series numbers and sending of cyclic hello messages from DSDV are used. Routing path in AODV are discovered, established, and stored only when and as long as needed. To ensure loop freedom, sequence numbers, which are created and updated by each node itself, are used. These also let the nodes to select the most newest route to a given destination node. AODV takes benefit of route tables. In these, the routing information is saved as destination and next hop addresses is stored as the sequence number of a destination. After that, a list of the predecessor nodes which direct through it is saved by the nodes, to form route maintenance easier when link breakage. Each routing table entry will have lifetime so as to prevent the storing of data and maintenance of routes that are not used anymore. If the route was not used during this time, the entry is discarded.

B. Destination Sequence distance vector (DSDV)

It is a table-driven routing pattern used for ad hoc mobile networks which is based on the Bellman-Ford algorithm. Solving of the Routing Loop issue that exists in Bellman-Ford algorithm is the main role of the algorithm. To do this, DSDV uses sequence numbers. Every entry in this routing table consists of a sequence number. If the link is present, the sequence numbers are usually even; else, an odd number is used. And the destination generates the number, and the emitter sends out the next update with this number. Distribution of routing information between the nodes is done by sending full information in frequently and small incremental updates more repeatedly.

C. Dynamic Source Routing (DSR)

It is a very well-known routing algorithm for ad hoc wireless networks. Maltz, and Broch originally developed it. DSR is on demand, as it lowers the bandwidth usage particularly in situations wherein the mobility is low. It is a simple and capable routing protocol used for ad-hoc networks. It has two important phases, route discovery, and the route maintenance. The key algorithm works in the follows the routine given below. A node that wishes for communication with another node, first checks its own route cache and see if there already exists a route to the particular destination. If it has had no route, it then initialises a route discovery mechanism. This is done by sending a Route Request message. As soon as the node gets this route request message, it searches its collection to see if it has a way to the end node. If it does not has any, it then affixes its own ID to the packet and then the packet is forwarded to the next node. This continues until a node having a route to the end node is discovered or the packet is received by the destination. In this case, a route reply packet is sent by the node this will have a list of all of the nodes which forwarded the packets to arrive at the destination. This forms routing information necessary for source, it will then transmit its data packets to the intended destination by means of this newly revealed route. Comparatively swift rates of mobility can be supported by the DSR.

VI. CONCLUSION

In this paper, various energy efficient approaches available in literature are surveyed and described. Many challenges and limitation of WSNs are discussed. In addition to it, different clustering energy efficient protocols and data collection protocols which are frequently been used in WSNs are explained in brief. It is observed that every abbreviation has their own advantages over others in with respect to networks lifetime, battery life, data transmission and sensing techniques etc. It is tough to single out any one that will be suitable in all environments.

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