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A Survey on Routing Protocols in Wireless Sensor Networks

Komal Kirola[1], Kavita Rawat[1], Juhi Bhatt[1] and Anurag Bhatt[2]

[1]M.Tech Scholar, Dept. of CSE, Graphic Era Hill University, Bhimtal, (Uttarakhand), INDIA
[2]Assistant Professor, Dept. of CSE, Amrapali Institute of Technology and Sciences, Haldwani, Distt. Nainital, (Uttarakhand), INDIA

ABSTRACT: Wireless Sensor Network is a network of classically small, battery power-driven and wireless device which has the sensing capability to communicate with the network. WSN is a demanding technology which is used for off-putting energy source and exchange between performance and duration. Numerous sensing nodes are encircled to monitor and interact with physical world so that more complex task can be executed by them.

Keywords: wirelsess sensor network, Routing Protocol-SPIN, DD GEAR,GAF, LEECH, TEEN, Cluster Head

I. INTRODUCTION

WSN is recently a most commonly used technology that has a advantages over traditional wired network and it helps us to develop miniature, low-priced, low power and multi-functional sensing devices. A wireless sensor network (WSN) is a network consist various spatially circulated devices which uses sensors to supervise the environment at different locations, such as temperature, sound, vibration, pressure, motion or pollutants [1-3]. In a accommodating network collection of sensor node are organized in homogenous or heterogeneous sensor nodes to form a wireless sensor network is [2]. Each small sensing node have the abilities of sensing data, data processing, organizing the data and communication from the ambient condition of its surroundings to get the useful information be familiar the network. Designing a sensor networks, different application requirement are needed such as small node size, low node cost, low power consumption scalability, reliability, self-configuration ,adaptability, channel utilization, fault tolerance, and security because most of the sensor network are application specific.

II. COMPONENT OF WSN

Various network component of WSN are and they play a vital role in the wireless network. They are -

1. Sensor Field*:* sensor field are the area in which the nodes are located.
2. Sensor Nodes*:* sensor node is a node which collect the sensory information and have a capability to perform some processing and communicate with other node in the network.
3. Sink*:* A sink is also a sensor node which gathers, processing the data and storing data from the other sensor nodes. Sink is used to decrease the networks overall energy requirements. Sinks node is a data aggregation.
4. Task Manager*:* A centralised node which extracts information from the network and disseminates control information back into the network is called Task Manager. It is also known as bas station.

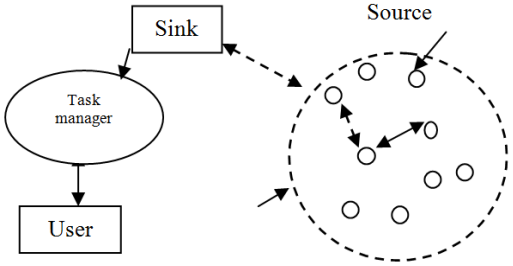

Fig. 1. Component of WSN.

III. CLASSIFICATION OF ROUTING PROTOCOL IN WSN

In WSNs routing protocols can be divided into three categories:

A. Flat- based routing.

B. Location Based Routing.

C. Hierarchical Based Routing.

A. Flat based Routing

Flat-based routing is essential when there is a requirement of vast number of sensor nodes and each node plays similar role. Therefore it is not promising to allocate a particular Id to every node because the number of sensor nodes is very huge

This leads to data-centric routing approach which is query-based protocol in which Base station sends query to a collection of particular nodes in a area and waits

for response of data from the sensors placed in the certain area[4-6]. Flat based or Data-centric protocols depend on the identification of required data, which help in eliminate many redundant trans missions.

(i) SPIN(Sensor Protocols for Information via Negotiation). The first data-centric protocols [7] is SPIN. To reduce redundant data and save energy, data negotiation considers between nodes .The main aim of SPIN protocol is to forename the data using advanced descriptors or meta-data. Before the transmission of data, by the use of a data advertisement mechanism meta data are exchanged amongst sensors, it is the key feature of SPI N .On receiving new data advertises from its neighbors and interested neighbors each node of SPINs meta-data negotiation solves the typical exertion of flooding such as redundant information transit, source sightlessness and overlapping of sensing areas thus, to achieve a large number of energy efficiency. To understand the application specific there is no standard meta-data format. To exchange data between nodes SPIN defined three messages which allow a network to communicated in the network efficiently and they are: ADV message -: This message allow a sensor to advertise a particular meta-data in the network. REQ message-: This message is used to request for the important data in the network. DATA message -: This message is used to transmit the actual data. The advantages of SPIN is that every node require to identify simply its single-hop since the topological changes are localized. However, the data advertisement mechanism in SPIN's cannot promise the data delivery. consequently, for applications SPIN is not a fine alternative such as for intrusion detection.

(ii) Directed Diffusion. An important solitary in the flat based routing protocol of sensor networks is Directed Diffusion [8]. The main aims of directed diffusing is that data can be diffused through sensor nodes by means of a naming method for the data. Using this method help to get rid of redundant operations to save energy of network layer routing. For the data it uses the attribute-value pairs and for on demand basis it uses those pairs for queries the sensors. To direct create a query, it defined a concern which consist a record of attribute-value pairs such as given name of objects, period, time, geological region, etc. A base station broacast its concern by its neighbours. To use it later every node receiving the concern that is able to do caching. The nodes have the ability for data aggregation in network, which is known as a minimum Steiner tree problem [23]. The advantages of Directed Diffusion is that it is data centric protocol, hence there is no need of addressing mechanism for node because in direct diffusion communication take place between neighbour-to-neighbour.

Aggregation and caching can be done by each node, there is no requirement for maintaining overall network topology since it is on-demand and is highly energy efficient.

Yet, it cannot be useful to all sensor network applications. It is query-driven on demand data model where uninterrupted data delivery to the base station will not work efficiently for all the sensor network applications that need.

B. Location based Routings

In Location based routing protocols nodes are recognized by its location where the routing in a data of nodes can be done by the geographic location of the nodes. It helps to utilize the location information to communicate the data to the required area relatively than the entire network. In order to analyses the distance between two exacting nodes for sensor networks the routing protocols requires location information so that energy utilization can be estimated. The individual location information of the nodes is obtained by the low down power GPS receivers which is implanted in the nodes. A number of protocols are mostly designed for mobile ad hoc networks design [9]. However, they are also well related to sensor networks where there is a smaller amount or no mobility. There are some location based protocols which are designed for wireless ad hoc networks, such as Cartesian and trajectory-based routing [7]. The main aim of location-based protocols is that instead of a node identifier as the target of a packet it uses only an area. In an area if some node is located it will be good enough as a destination node and can receive and process a message. The location-based routing protocols take into account the mobility of sensor nodes and perform very well when the density of network increases. But, the performance is very poor when the network deployment is sparse, and there is no data aggregation and further processing by the header node.

(i) GEAR(Geographic & Energy Aware Routing). GEAR is an energy-efficient routing protocol proposed for routing queries to target regions in a sensor field [9]. The main aim of this protocols is that by the help of location information one identified the smallest cost path to route the packets to the destination node while the sensors are believed to have localization hardware capable, such as a localization system [10] that be familiar with their existing positions, and all the sensors are awake of their remaining energy as well as the locations and remaining energy of every neighbours. To send a packet toward its destination area GEAR uses energy conscious heuristics which is based on geological information to choose sensors. Then, to broadcast the packet inside the end area GEAR uses a recursive geographic forwarding algorithm.

(ii) GAF (Geographic Adaptive Fidelity). GAF is another location based protocol which uses the method to turn-off continuous connectivity between communicating sensors. GAF [11] is an energy-aware routing protocol first and foremost proposed for MANETs, but also be used for WSNs since it conserve energy. The nodes which come in the exacting geographical range can be connected with a fastidious network. Under the identical network the communication cost of nodes will be similar. At some point in the routing decision any single node from the exacting network will come to life and takes part in routing and other nodes in the similar network will go

to asleep situation to keep away from redundant energy exhaustion.[12]. The aspire of GAF is based on an energy model [13, 14] that considers energy expenditure because of the response and broadcast of packets as well as inactive occasion in order to sense the occurrence of received packet with the help of radio sensor. In GAF, GPS or other location systems [13, 18, 19] that provide sensor field and this field are separated into network squares and every sensor uses its location information, to connect itself with a exacting network in which it resides. GAF demoralized this kind of network to recognize the sensors that are consequent from the viewpoint of packet forwarding. It main aims is to make best use of the network life span by attainment a state where every network has merely single active sensor based on sensor position system. The position of sensors is based on their remaining energy levels. In fig-2 state transition in GAF is shown which have three states: a) Active state b) sleeping state c) Discover state

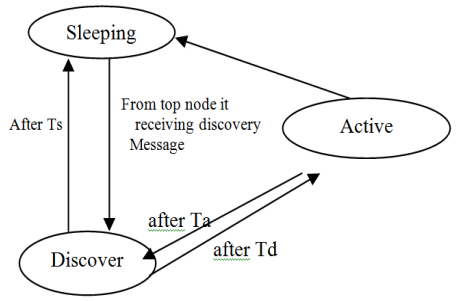

Fig. 2. State transition in GAF.

C. Hierarchical based protocol

Hierarchical protocols aim at clustering the nodes so that cluster heads can do some aggregation and reduction of data in order to save energy Many research projects in the last few years have explored hierarchical clustering in WSN from different perspectives [2]. Clustering is an energy-efficient communication protocol that can be used by the sensors to report their sensed data to the sink. In this section, we describe a sample of layered protocols in which a network is composed of several clumps (or clusters) of sensors. Each clump is managed by a special node, called cluster head, which is responsible for coordinating. As shown in Figure 2, a hierarchical approach breaks the network into clustered layers [20].

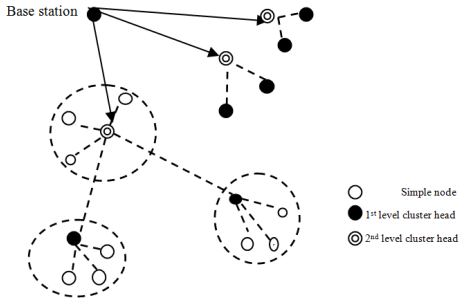

Fig. 3. Hierarchy clustering.

(i) LEACH(Low-energy adaptive clustering hierarchy. Low-energy adaptive clustering hierarchy (LEACH) [14] is one of the most accepted hierarchical routing algorithms for sensor networks. Based on the arriving signal power the aim is to make clusters of the sensor nodes and use local cluster heads as routers to the base station. To dispense the energy consumption beside its set of connections low energy adaptive clustering hierarchy[17] uses the clustering principle to save energy because the transmissions is done by the cluster head not by the sensor node. To collect the data, network is separated into Clusters and the data dispensation and aggregation are local to the cluster, hence cluster heads are select at random in order to stable the energy dissipation of nodes. The random number between 0 and 1 is chooses by the node.

$$T(n) = \begin{cases} \dfrac{p}{1 - p * (r mod \dfrac{1}{p})} & if\ n \in G \\ 0 & otherwise \end{cases}$$

From above equation is a threshold equation. In this equation if the number is less than the present round node turn into the cluster head. All the information is collected by the cluster head in the nodes which are coming inside its cluster. The cluster head play an important role in the network which is used for collecting data from its cluster members and combine it. Then each cluster head forward the combined data to the base station. It reduces energy consumption by minimizing the communication cost between sensors and their cluster headstand turning off non-head nodes as much as possible [15]. LEACH is totally dispersed and requires no overall information of network. Though, LEACH uses single-hop routing where every node is able to broadcast directly to the cluster-head and the base station. Consequently, it is not appropriate to networks deploy in big area. in addition, the increase in energy consumption of active clustering brings extra transparency, which reduce consumption of energy.

(ii) TEEN(Threshold Sensitive Energy Efficient Sensor Network Protocols). Threshold sensitive Energy Efficient sensor Network protocol (TEEN) [16] is a hierarchical protocol considered to be receptive to rapid changes in the sensed attributes such as temperature. TEEN uses a hierarchical approach all along with the utilize of a data-centric protocols. TEEN [18,19] is a hierarchical clustering protocol, the sensor network structural design in TEEN is based on a hierarchical combination where nearer nodes form clusters and this procedure go to the next point till it reaches to the base stations. TEEN is helpful for applications where the users know how to manage a exchange between energy competence, data correctness, and response period with passion. The cluster heads broadcast two thresholds i.e. hard and soft thresholds after the clusters are created to decrease energy consumption by reducing the number of transmissions as message transmission consumes extra energy than data sensing,. Figure 3, which is redrawn from [15], depicts this concept of clustering. Even if

TEEN is fairly energy-efficient, it is not practically applicable for applications to facilitate sensed data.

IV. CONCLUSION

Currently, in the field of research area wireless sensor network become the most important technology and this technology along with its Routing protocols make the WSNs network energy efficient and life time of a individual sensors should be for a long period. Due to the insufficient energy resources of sensors energy efficiency is one of the main challenges in the design of routing protocols for WSNs. the protocol like LEACH,TEEN,
SPIN, Directed diffusion ,GEAR and GAF are proved to be energy efficient The energy efficiency model is untested while the sensor nodes exhibit mobility. The Future works possibly focus on mechanism that will achieve better energy efficiency for wireless sensor networks.

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