Energy Efficient Routing in Wireless Sensor Networks

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Abstract – Wireless Sensor networks are moderately distributed self-governing sensors to monitor physical environment condition, such as temperature, sound, pressure etc, and to collectively send their data by the network to a main location. Due to high density of sensor node and it obstruct the linking range, Packet sends in sensor networks is continuously accomplish by all multi-hop data transaction[1].This paper present routing protocols for wireless sensor networks (WSNs). The key problems in Wireless Sensor Networks (WSNs) is the design of energy-adapted Routing Algorithm, due to the limited energy of sensor nodes. In this paper, we have to discuss the various routing protocol i.e. SPIN, LEACH, PEGASIS, Modified PEGASIS. In SPIN, it is data centric routing technique. It solves the problem of duplicate information passing, overlapping of sensing area. LEACH is hierarchical routing protocol for Wireless Sensor Networks to increase the network lifetime. It is popular energy efficient algorithm for wireless sensor network. It involves distributed cluster formation. PEGASIS protocol is chain based routing scheme. The key problem in Wireless Sensor Networks (WSNs) is the design of energy-adapted Routing Algorithm, due to the limited energy of sensor node. PEGASIS protocol is depend on the parameters i.e. Distance and Residual energy. At the end of paper, we have to compare all the routing protocol and find out which protocol to reduce the power consumption.

Index Terms – Wireless Sensor Networks, Routing Protocols, Energy Efficiency, PEGASIS, LEACH, Multipath Routing.

1. INTRODUCTION

The node of wireless sensor networks is represent with narrow energy[2]. Wireless sensor nodes spread out into the network to listen the physical or environmental condition such as temperature, sound, vibration at different location. The data move over the network each sensor absorbs energy in receiving or sending the data. The period of network based on the energy is used on every communication. And how we can prolong the period of node in which routing protocol plays an significant role. Wireless sensor network is a network that contained thousands of smallest node that are graphically distributed which listen physical or environmental conditions. In WSN, energy consumption is of two types. First is useful energy consumption and second is wasteful energy consumption.

Useful energy consumption is due to*:*

1. Transmitting/receiving data,

2. Processing query requests

3. Forwarding queries/data to neighbouring nodes.

Wasteful energy consumption is due to:

1. Idle listening to the media

2. Retransmitting due to packet collisions.

Therefore, we observe that little energy is used while sending and receiving the data. At the beginning, protocols are not prepared according to specification. So we proposed energy efficient routing protocols that are discussed in detail.

2. MODEL OF WIRELESS SENSOR NETWORK

Wireless Sensor Network consists of smallest sensor node with limited storage and processing capability.The components of Wireless Sensor Network are described as below:

Sensor Field

Sensor field is an area where the node can be deployed.

Sensor Node

Sensor nodes are heart of the Wireless Sensor Networks. It collects the information from the environment and send this information to the Base Station (BS).

Base Station

Base Station takes the data from various node, then process and save all data that take from node. Message regularity between nodes are decreased because of Base Station by decreasing the energy condition of whole network.

Gateway Sensor node

The gateway sensor node doing as an entrance to other networks. The base station also called the centralized domination room for data withdrawal diffused the information across the networks, data processing and storage centre with user access controls.

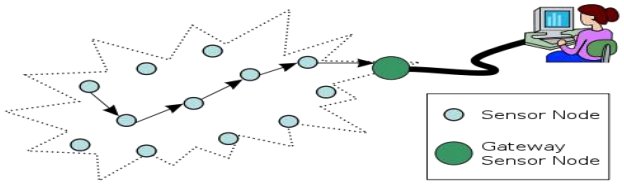


Fig.1

Data is flow to these facilities either over the internet, wireless channels, satellite etc. Sensor networks expand in a precise geographical area that constructs Challenges of routing in wireless sensor network .

Wireless multi-hop networks, and the sensor nodes apply wireless medium for transmission namely infrared, radio, Bluetooth during communication.

The huge advancement in the wireless sensor networks has led to its use in broad range of applications. So that it is also constrains too many restrictions. The performance wise routing protocols for key challenges in WSN are following:-

Energy Conservation

One of the most important aspect that affect the sensor networks is the low power availability. For minimum energy ,we have to make that protocol which reduce the minimum energy.

Robustness

In the robustness of WSNs, two relevancy of WSNs are introduced; the link relatedness is less than number of links whose ejection is disconnect. Node related is defined the node gather in which neighbouring node are removed.

Data Aggregation

Main aim of data aggregation[8] is to accumulate and combine the data in power efficient manner. Data sensed by multiple sensors nodes have a specific level of repetition. The main points of data repetition is to raise the backbone to route collapse through protocol, the improvement of data is to be gone , fix up message and the similar time cancel the lots of delay that are connected to sending of data.

Node Deployment

Two type of node are deployed, i.e. deterministic or randomised. In deterministic approach, we manually set the sensor node in already defined path before the data is routed.

In randomised approach .i.e. random deployment[10] of sensor node, we have to set the node randomly. It means e.g. volcanos area so we can throw the sensor node by helicopter. Because there is some places i.e. remote area the person cannot be go. There is many problem in randomised approach if node falls nearly redundancy occurred and if node falls far than lot of energy is used to send the data. It is a big challenge in routing in wireless sensor network.

Scalability

Scalability[9] is the capability of system, network or process to handle the growing amount of work .It is also a big challenge in routing in wireless sensor networks.

3. ROUTING PROTOCOL

Routing protocol specifies how nodes communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network.

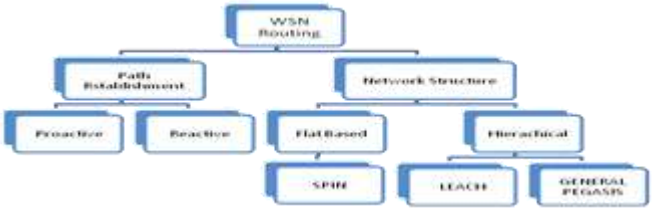


Fig.2

1. *Path Establishment*

Path establishment [3]is an approach used to find the path.

1.1 *Proactive*

An approach where each router can build its own routing table based on the information that each router (or node) can learn by exchanging information among the network's routers.

1.2 *Reactive*

Routing is an approach where the routing process needs to discover a route whenever a packet arrives from a source and need to be delivered to a destination.

2. *Network Structure*

Network Structure is a term used to describe the method of how data on a network is organized and viewed.

2.1 *Flat Based Routing*

2.1.1. *SPIN*

Spin is a flat based routing protocol Sensor Protocols for Information via Negotiation[6] (SPIN) transmit data to sensor nodes and it is part of data-centric routing technique the principle behind SPIN was by choosing data through high level meta-data or descriptors. The exchange of meta-data between sensor nodes through announcement of data scheme that are communicated prior to transmission, a vital feature of SPIN. Every node after receiving the new data will advertise to not only to nearer neighbours but also to all neighbours who are interested, that is, those who do not have the data, retrieve the data by sending request messages. A SPIN meta-data negotiation mechanism solves the problem of flooding like redundant information passing, overlapping of sensing areas and resource blindness. For exchange of data between nodes three messages have defined. These are: ADV message to allow a sensor to advertise a particular meta-data, REQ message to request the specific data and DATA message that carry the actual data as shown in fig. 3. The foremost important of SPIN indicates that of frequent topology changes because

any changes are done undertaken locally, and every node will get to know about the changes at next neighbouring single-hop. A broadcast technique from SPIN information does not ensure the possibility for data delivery. An example point to this, if the nodes that are want to take the data and is away from the source node and the nodes in between source and destination are not interested in that data, such data will not be delivered to the destination at all. Therefore, making SPIN not suitable for application such as intrusion detection which requires the reliability of data delivery.

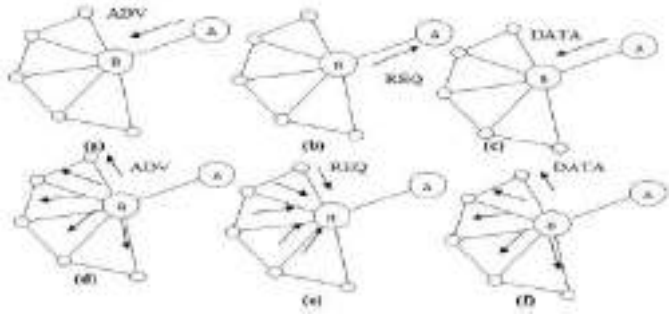


Fig. 3

2.2.1. *LEACH*

Low Energy Adaptive Clustering Hierarchy (LEACH)[4] is one of the cluster-based protocols in sensor network. The procedure of LEACH protocol are the random selections of some nodes to form cluster heads and rotate every role of the cluster-heads in order to objectively share the load energy between the sensors in the network. The cluster-head nodes also constrict data being transmitted from the nodes that is in the same group of that particular cluster, and convey aggregated packets to the Base Station (BS) base station. The operation of LEACH is separated into two phases, the setup phase and the steady state phase. In the setup phase, the clusters are standardize and cluster head i.e.CH[5] are selected. In the steady state phase, the actual data transfer to the base station takes place. The span of the steady state phase is longer than the duration of the setup phase in order to reduce overhead. During the setup phase, a predestined fraction of nodes, p, elect themselves as CH as follows. A sensor node selects a random number, r, in between 0 and 1. If this random number is less than a threshold value, T (n), the node becomes a cluster-head for the current round. The threshold value is calculated based on an equation that incorporates the desired percentage to become a cluster-head, the current round, and the set of nodes that have not been selected as a cluster-head in the last (1/P) rounds, denoted by G. It is given by:

$$T(n) = \frac{P}{1 - P(r \bmod (1/P))} \quad if\ n \in G$$

LEACH uses single-hop routing where each node can transmit directly to the cluster-head and the sink.

Therefore, it is not relevant to networks deployed in large regions moreover, the notion of dynamic clustering brings extra overhead, e.g. head changes, advertisements etc., which may diminish the gain in energy consumption.

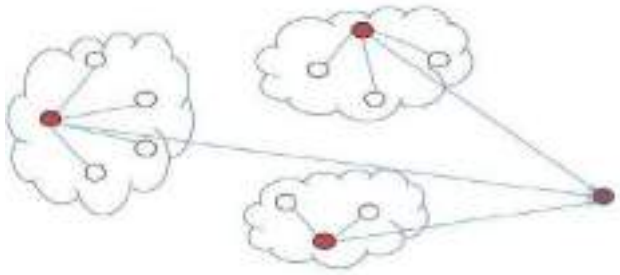


Fig.4

2.2.2. *General PEGASIS*

The PEGASIS[7] (Power Efficient Gathering in Sensor Information Systems) protocols construct the chain of sensor node using a greedy approach. General PEGASIS protocol solve the problem of LEACH. Therefore, LEACH protocol uses one hop model in which some cluster i.e. farthest away from base station and send the data to base station that means the nodes going to die quickly because of minimum energy and largest distance.

In the PEGASIS, construct the chain starting from the farthest node to sink node by using greedy approach. The closest node is send the data to its neighbour node is put as next node in the chain. This process is go on when all the sensor node are included in chain. This way will disseminate load of energy among the sensor node in network. Before passing the data to next node the data fusion take place. PEGASIS is a two-step process.

A. Chain Construction

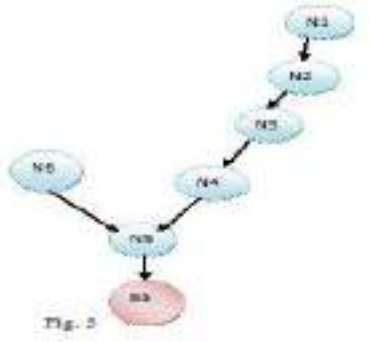
B. Gathering Data

A .Chain Construction

In chain construction, construct the chain route the data from all node and send to leader node. The leader node is selected by high energy node selection procedure. In this procedure, for every round of data communication, we selected the number of node which is nearest to sink and in those nodes which have highest energy is selected as leader node. This strategy is aimed maximising towards the lifetime of node in network. In figure 5, chain is constructed between the nodes and finally the node n5 is selected to pass the data to base station or sink.

B. Gathering Data

In this step, after selected the leader node now gather the data from the all node in the chain and leader node is responsible for forwarding the aggregated data to sink node.



Therefore in the figure1, the farthest node N1 send the data to N2, N2 node has its own data and also N1 data. Then N2 uses data fusion process and send the fused data to N3.This process will continue until leader node get the all data and the leader node send the aggregated data to sink node. In the GENERAL PEGASIS, more energy required to send the fused data but the energy is limited of sensor node. So, nodes goes die quickly. It will decrease the network lifetime as well as decrease the presence of live node so that no more node will remain exist But it will save the energy because it send the information to nearest neighbour node.

Comparison:-

Parameter	SPIN	LEACH	General PEGASIS
Type of protocol	Flat	Hierarchical	Hierarchical
Delivery of Data Model	Data centric based	Cluster based	Chain based
Power Consumption	Limited	Higher than SPIN but lower than General PEGASIS	High
Overhead	High	Lower than SPIN but higher than General PEGASIS	Lower than LEACH
Leader Node per round	0	1	1
Network Lifetime	low	Higher than SPIN	High
Scalable	limited	Good	Better
Load Balancing	No	No	No

4. CONCLUSIONS

In this paper we proposed energy efficient routing scheme that increase our network lifetime. We highlight different routing protocol and at end we compare all routing protocol. According to comparison, we choose General PEGASIS protocol that suitable to increase the network lifetime. PEGASIS protocol solves all the problem of all the protocol that discuss in this review paper. General PEGASIS protocol solve the problem of one hop model, it means that node save the energy to send the information to nearest neighbour node. It improves the performance of energy efficiency and network lifetime.

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