



**SURVEY ARTICLE**

# WIRELESS SENSOR NETWORK AND ITS ROUTING PROTOCOL: A SURVEY PAPER

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**Abstract—** *Wireless sensor network contain hundreds of sensor nodes. These sensor nodes uses radio signal using communication. A wireless sensor node is well found with radio transceiver, sensor device and power component. A wireless sensor network is made up of sensor, embedded techniques, distributed information mechanism. Wireless sensor network is much versatile as compared to traditional wireless network. In this paper there is a complete study of WSN with their routing protocols. Now, as the Quality of service is important consideration for any network so also discussed quality of service with challenges for WSN.*

**Key Terms:** - wireless sensor network; routing protocols; QoS; leach; Apteen; Teen

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## I. INTRODUCTION

First time data transmission being performed using radio signals, by the US army during the Second World War. After this transmission in 1971, first packet based communication network call ALOHANET was created at a university of Hawaii's ALOHANET was first network that connected computer in star topology. Each node in wireless sensor network have limited processing speed, storage capacity and communication bandwidth. These nodes don't have fixed size, and the size of node depends on area in which they will perform. There are three type of sensor node.[1]

1. Normal node collects the sensor data but they cannot store the data in large capacity.
2. Sink node collect data from normal node for storing and processing.
3. Gateway node that receives the data from sink node, connect it to the external entity called observer.

Since wireless sensor nodes do not need to communicate directly with the nearest high-power control tower or base station, but only with their local peers. Rise in the technology has enabled to keep the tiny low power device, multiple parameter sensing and wireless communication capability. Low cost of sensor, made it possible to use hundreds or more sensor for covering area that will increase reliability and range of wireless sensor network.

## II. APPLICATION FOR WIRELESS SENSOR NETWORK

There are many areas where sensor works as forecasting, drinking water quality, soil moisture monitoring, gas and water supply, distributed pipeline monitoring and control mining operation and management. Power cast takes the capabilities of wireless sensors a step further by allowing them to be powered without wires and without the need to change batteries. Wireless sensor networks are providing tremendous benefit for a number of industries. The ability to add remote sensing points, without the cost of running wires, results in numerous benefits including energy and material savings, process improvements, labor savings, and productivity increases

Wireless sensors networks are being widely deployed, and Power cast’s technology can provide benefit for many applications including

1. Building Automation / Access Control / Security
2. Energy management
3. Smart Grid / Sub-station
4. Monitoring
5. Industrial Monitoring
6. Structural Health Monitoring
7. biodiversity mapping
8. disaster relief operation

### III. CLASSIFICATION OF SENSOR NETWORK

Sensor network can be classified into two categories.

#### 3.1 Proactive Network

The node in the proactive network randomly switches on their sensor and transmitter, sense the environment, transmit the data of interest. Thus they provide a snapshot of the relevant parameter at regular interval and are well suited for the application requiring periodic data monitoring.

#### 3.2 Reactive Network

In this type of network, nodes respond immediately to high Changes in the value of sensed attributes.

### IV. PROTOCOL IN WIRELESS SENSOR NETWORK

Various protocols have been designed that accept and store the query of user, send the answer that is send by the network. Similar to the Adhoc, the protocol set up a path immediately.

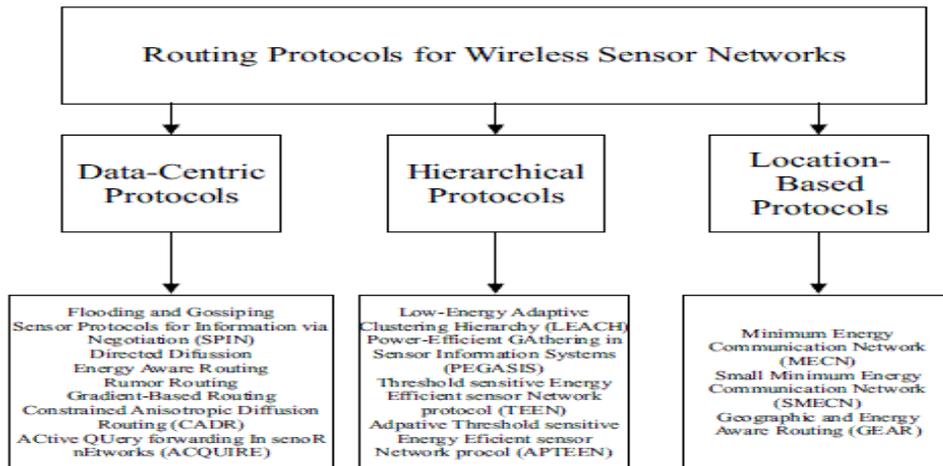


Fig 1 routing protocols of wireless sensor network

#### 4.1 FLAT ROUTING IN SENSOR NETWORK

Concept of routing in wireless sensor network is different from wireless or wired network. Wireless sensor network is data centric; don’t require that the data should move between specific nodes, in wireless sensor network each node will approx. same data. So rather than transmitting same data repeatedly concept is to aggregate the data then transfer it. This process is known as data fusion.

##### 4.1.1 Directed Diffusion:

It one of the data broadcasting protocol developed for wireless sensor network. It consists of element – interest, data message, data and reinforcement. An interest is a message which specifies what a user wants .any data that is stored or processed as information can be an event .in addition data is named using attribute value pair. A sensing task is broadcasted throughout the sensor network as an interest for named data. This broadcast sets up gradient within the network designed to draw the event. Specifically a gradient is direction state created in each node that that receives an interest. The gradient direction setup toward the neighboring node from which

the interest is received. Event starts flowing towards the originator of interest along multiple gradients path. The sensor network reinforces one or more small number of these paths.

#### 4.1.2 SPIN

A group of adaptive protocol called, spin that broadcast all information to each of the node that lay the network. So each node will have the same data as its neighbor's node. This protocol distributes the information to all nodes even when a user doesn't require it.

#### 4.1.3 Flooding and gossiping

These two don't require any routing algorithm for transmitting data in wireless sensor network. In flooding when node broadcast the data, every sensor receives the packet, send it to all the neighbor node. When the transmission is completed or packet received at the destination node, then the broadcasting is halted. The Concept of flooding is easy but causes a problem called implosion, in which the destination node has various copies of duplicate message.

In gossiping the problem of implosion is rectified, by sending the data packet to the selected neighbor rather than broadcasting it to all node of network. Since delay time increased because path is selected before transmission of packet's this protocol doesn't much concentrate on energy consumption.

### 4.2 HIERARCHICAL ROUTING PROTOCOLS

The main objective of hierarchical routing protocol is minimization of energy consumption of sensor node. The node with higher energy will be selected as cluster head. Cluster head also responsible for sending and processing the information. Once the cluster head is selected, remaining node of that cluster will perform sensing.

#### 4.2.1 LEACH

The goal of leach protocol is to enhance the life of network. This protocol uses the arbitrarily circulation of local cluster base station to equally circulates the energy load between the sensor in the network. Leach performs two tasks.

- 1) Selection of cluster head, call the setup phase.
- 2) Maintaining the cluster during the transmission of data, called steady phase.

#### 4.2.2 GREEDY PEREMETER STATELESS ROUTING

The GPSR protocol is based on the algorithm that combines the greedy packet forwarding and parameter forwarding method. This protocol transfers the data packet in wireless datagram networks. Greedy packet forwarding is a technique that allow source to know the geographic position of the destination integrated in the route request. GPSR gives information each node of network, position of all the neighbor node in a table. This information also refreshed within a regular time interval.

Leach, PEGASIS, TEEN, APTEEN are other hierarchical protocol.

### 4.3 LOCATION BASED PROTOCOLS

Distance between two particular node calculated to find the location information so that energy consumption can be evaluated. To provide the location information of each of the node, gps device can be combined in the embedded board. Geographical routing protocols provide the several techniques to route that data to improve energy efficiency or latency.

#### 4.3.1 Minimum Energy Communication Network (MECN)

MECN computes an energy efficient sub network .the MECN utilized a low power geographic position system for a certain sensor network. It selects a relay region for every node. The relay region consists of nodes in surrounding area where transmitting through those nodes is more energy efficient than direct transmission. The objective of MECN is to find a sub network that will have fewer nodes and needs minimum power for transmission between any two selected nodes. MECN is self-designed and then can dynamically adapt to node failure or adding new sensors.

#### 4.3.2 Small Minimum Energy Communication Network (SMECN)

SMECN construct a network which is small than the network created by MECN, SMECN basically find the hurdle between any two nodes. Hence the sub graph  $G'$ , constructed by SMECN for minimum energy usage satisfying the following condition.

- 1) Number of nodes in  $G'$  is less than the  $G$  while containing all nodes in  $G$ .
- 2) Energy required for transmission in  $G'$  should be less than energy consumed by graph  $G$ .

## V. OTHER ROUTING PROTOCOLS IN WSN

In wireless sensor network on the basis of operation routing protocols are also classified into multipath based, query based, negotiation based, quality of service based routing techniques.

### 5.1 Multipath Routing Protocols

This type of routing protocols uses multiple paths instead of a single path in order to enhance network performance. Directed diffusion is a good example of this type of routing. [3]

### 5.2 Query based Routing Protocols

In this type of routing protocol destination nodes propagate a query for data (sensing task) from a node through the network, and a node with this data sends the data that matches the query back to the node that initiated the query. Directed diffusion, RUMOR, ACQUIRE, COUGAR are good examples of this type of routing protocol. [3]

### 5.3 Negotiation based routing protocols

These protocols use high-level data descriptors in order to eliminate redundant data transmissions through negotiation. Communication decisions are also made based on the resources available to them. SPIN family protocols are good examples of negotiation-based routing protocols. [3]

### 5.4 Quality of Service Based Routing Protocols

In QoS-based routing protocols, the network has to balance between energy consumption and data quality. In particular, the network has to satisfy certain QoS metrics (delay, energy, bandwidth, etc.) when delivering data to the base station. SPEED (Stateless Protocol for Real-Time Communication in Sensor Networks) is good example of this type of protocols. [3]

## VI. QUALITY OF SERVICE IN WIRELESS SENSOR NETWORK

Objective of quality of service is to provide much better network services over existing. Quality of service of wireless sensor network defines three features: delay, loss, jitter

### 6.1 Delay

It is the total time being spent in a network for transmitting a data packet from source to destination.

### 6.2 Jitter

It is variation of time for delivering the data packet from the last one delivered.

### 6.3 Loss

Total data received over total data send by network. Maximum loss degrades the quality of network.

Traditional wired network uses end to end communication model, for sending data one node to another node hence the loss, delay, jitter can be considered in wired network. While in wireless sensor network, each node broadcast the data to all nodes so quality of service parameter is fully acceptable. in wireless sensor network ,even the end to end communication model is not required but the factor of energy consumption is considered since each node must be capable of broadcasting data, so wireless sensor network quality of service parameter are coverage area ,exposure, energy cost and network life time.

## VII. CHALLENGES OF WIRELESS SENSOR NETWORK

### 1) Power

Each protocol considers this limitation. Since power consumption is important factor for setting up the infrastructure of wireless sensor network. as distance increases the power consumption will also increase. When there more obstacles are in between the nodes then multi hop routing consumes more energy than directing routing.[1]

### 2) Bandwidth

Lack of bandwidth presents more difficulties in achieving the good performance in wireless sensor network. Using data compression and utilizing different bandwidth capabilities based on nature of stream are two proposal to overcome the scare of bandwidth.[1]

### 3) Memory Size

Since sensor node do not have much storing capability so memory size is one more important factor for considering wireless sensor network performance. As the limitation of memory size is affecting most proposals to enhance wireless sensor network networking capabilities.[1]

#### 4) Standardization

There are no standards are fixed for functions of wireless sensor network .though Zigbee is considered as first standard for wireless sensor network.

#### 5) Lifetime

Life of wireless sensor network lies on nodes. Each node in wireless sensor network has its own power source like battery. If battery low then no node will sense any event. In future wind power or solar power can be thought as option for recharging battery in future.

#### 6) Density

Since each node in wireless sensor network broadcast the packet to the entire node so each node have multiple copy of data. This causes the redundancy of data. Even this provides the reliability but needs the aggregation of these multiple copies which consumes more power.

### VIII. CONCLUSION

Routing in sensor networks is a new area of research, with a Limited, but rapidly growing set of research. In this paper, Survey of routing techniques in wireless sensor networks which have been presented in the literature. The Main Objective to extend the life time wireless sensor Network. The routing techniques are classified based on the network Structure into three Categories: Flat, hierarchical, and Location based. QoS is considered as one of the most important feature for Wireless Sensor Network Routing Protocols.

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