

# Overview of Various Routing Protocols in Wireless Sensor Networks

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**Abstract** –Wireless Sensor Network (WSN) is a network which consists of thousands of sensor mobile nodes with no proper infrastructure and which are communicating over the wireless links. The nodes in a particular network transfer data from source to destination on the basis of particular routing protocol .There are no. of routing protocols used for finding efficient route on the basis of distance, throughput, network traffic etc. Routing protocols must be used for maintenance of routes as sensor nodes have limited resources like battery power, transmission range etc. So, for an effective data transmission there must be need for an effective routing protocol which must increase data transfer rate .In this paper we study and compare the various routing protocols like LEACH, HEED, DSR,ADSR ,DVR,DSDV on the basis of bandwidth, distance, security and communication overheads.

**Index Terms** – wireless sensor networks, sensor nodes, routing protocols, bandwidth, security.

## 1. INTRODUCTION

Wireless sensor networks (WSNs) are formed by thousands of sensor nodes communicating over wireless links without using a fixed networked infrastructure [21, 22]. WSNs are used in military environments, medical and health fields, disaster management, Industrial fields, home networks and in some other fields like detecting nuclear and explosive materials. As wireless communications leads to increased energy consumption so different routing protocols are used for data transmission. The path selection is a major issue in wireless communications as data transmissions between neighboring nodes interfere with each other. So, firstly WSNs should take into account reducing and avoidance of interference during transmission. Here sensor nodes senses or capture the data from particular environment and then transmit this data to the base station. Each sensor node must have the information about its neighbor nodes.

WSNs generally have dynamic topology as nodes are free to move across the network and topology of the networks change accordingly or rapidly. Routing means to forward data packets among nodes in a network. In WSNs routing is a core problem as new types of routing protocols are required due to security issues, bandwidth constraints, changing topologies of a network. The main problem in WSNs is to find the

appropriate path from source to destination with no interference among the nodes. The aim of this paper is to compare different routing protocols and study their shortcomings. So, the main problems in WSNs are:-

- Bandwidth and Energy Constraints
- Changing topologies
- Interference of nodes
- Security Overheads

Other challenges for wireless networks are managing of location of sensor nodes, hardware resources are limited like storage capacities, redundancy of data, limited battery power etc.

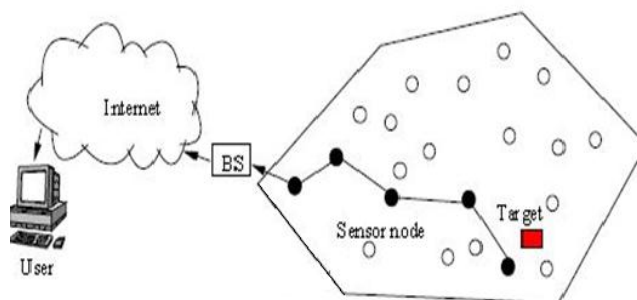


Fig 1:-General Structure of WSN

## 2. ROUTING PROTOCOLS USED IN WSNs

The main aim of the routing protocol is to establish and maintain the efficient route or path between the mobile sensor nodes. The efficiency of any wireless network depends on its routing protocol. The routing protocols are divided into following categories:-

- Topology based
- Position based

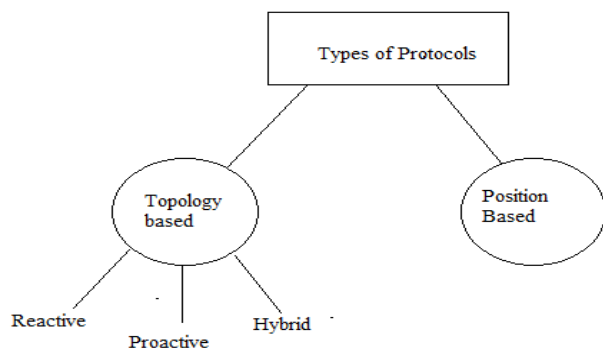


Fig 2:-Types of Protocols

### 2.1 Topology Based

Initially the routing protocols followed the topology based routing which basically contains the path establishment and path maintenance. Here decisions are made on the current available information about the links between the nodes. Topology based further divided into 3 categories:-

- Reactive
- Proactive
- Hybrid

In reactive protocols route is created only when the source send route requests for establishing a route to a destination. Route discovery procedure is used to create a route. In this way multiple routes are created for the destination. Example of reactive protocols are-AODV, DSR etc.

In proactive protocols each node has complete information regarding the entire network topology. If any changes occur in the network topology then the routing table gets updated automatically. Here updated data packets must be transmitted across the entire network. The main problem is to maintain the different routing tables which varies from protocol to protocol. Example-DSDV, GSR etc.

In hybrid protocols features of reactive and proactive protocols are combined. These protocols are designed for larger networks. It maintains the traffic load across the network. Each node must have a zone which is predefined known as cluster. All clusters make a hierarchical network structure. Example-ZRP, ZHLS etc.

### 2.2 Position Based

Position based routing protocols assumes that each node in the network must aware of locations or positions of all other nodes in the network. Global Positioning System (GPS) is a best technique to determine the exact location of the source node, neighbor node and destination node. So, there is no need to maintain the paths and updating of the routing tables.

Some protocols used for routing in WSNs are:-

#### 1) LEACH

This protocol based on Clustering based technique in which nodes are organized into hierarchy of clusters .Each node has a cluster head which transfers the data packets. The cluster head is selected by using threshold value  $t(n)$ . A random number either 0 or 1 is selected by each node in a cluster which further compared with threshold value  $t(n)$ .If the selected number is less than  $t(n)$ ,then that node becomes the head of cluster, if not then it becomes an ordinary node.. Threshold value is calculated by the following formula,

$$t(n) = \begin{cases} \frac{p}{1-p * (\frac{r \bmod 1}{p})} & \text{if } n \in G \\ 0 & \text{if } n \notin G \end{cases} \quad [8]$$

Here  $p$  is the percentage of the cluster head nodes among all nodes,  $r$  is the round number,  $G$  is the collection of the nodes which have not yet been selected as head nodes in the first  $1/P$  rounds.

This protocol has 2 stages:-

**Set-up stage**-In this each node will decide to become a cluster head or not which is based on threshold value. After selection of the cluster head, each of other nodes in a network will select its own cluster head which further join the cluster based on energy. Each node will choose cluster head nearest to it.

**Steady-State Stage**- In this LEACH rotate the cluster head for evenly distribution of energy consumption and balances the load in wireless sensor networks.

The main disadvantages of LEACH are-

1. It is suitable only for homogeneous WSNs.
2. There is no mechanism for providing security.

#### 2) HEED

HEED is Hybrid Energy Efficient Distributed clustering algorithm. It is suitable for Heterogeneous WSNs. It is used for the selection of different cluster heads on the basis of the energy distribution between neighboring nodes. As we know in cluster one node acts as a cluster head, which further communicates with another nodes. HEED increases the lifetime of the nodes and stabilizes the neighboring nodes. Here one node is mapped to one cluster. This node communicates with the cluster head and makes its decision on the basis of available information.

The main disadvantage of HEED is that here energy level of cluster head may decrease which results in loss in data transmission.

#### 3) DSDV

Destination-Sequenced-Distance-Vector-Routing is a protocol in which each participating node acts as a router. Each node

has a table which consists of entries for all the possible destinations. Table also contains the address identifier of the destination. A sequence number must be associated with every route. A route with highest sequenced number always be selected.

Disadvantages of DSDV are-

1. DSDV requires updating of routing tables which uses battery power and bandwidth even if network is idle.
2. It is not suitable for highly dynamic networks.
3. Scalability is poor.
4. No support for multipath routing.
5. Wastage of bandwidth occurs due to advertising of routing information which is unnecessary.

4) DSR

Dynamic Source Routing is a reactive protocol in which sender determines the route from source to destination. Here all information must be maintained at mobile nodes. It contains two phases-Route Discovery, Route maintenance. Route reply only be generated if message has reached at destination node. All nodes in a network contains route caches in which all source routes are present. When any node want to send a packet it firstly checks the route cache.

Disadvantages of DSR are-

1. No security mechanism is provided.
2. Need for updating and maintaining route caches.

5) AODV

Ad hoc On-demand Distance Vector is a combination of DSR and DSDV. In AODV routes are constructed only for specific destinations and which are not present in the communication does not need to keep these routes. It is basically used when there is no valid route present between two end points. It has 3 message types:-

- Route Request-used for initiating and finding the route.
- Route Replies- used for finalization of routes.
- Route Errors-used when any link breakage occurs in an active route.

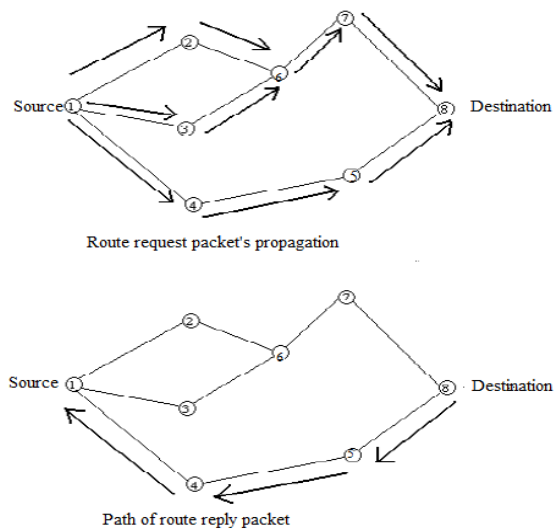


Fig 3:-Route request and reply

Disadvantages of AODV are-

1. No efficient route maintenance technique is present.
2. Bandwidth and Security overheads.

6) DVR

Distance Vector Routing Protocol- based on calculation of distance and direction between the source and destination nodes. It is basically used by routers for forwarding the packets in a particular network. Distance is the term which describes the cost to reach a particular node. Direction is the next hop address. It relies upon the direction in which the data packet must be forwarded. It generally uses the shortest path between the source and destination. Here each node maintains a table or vector which contains a minimum distance to each node.

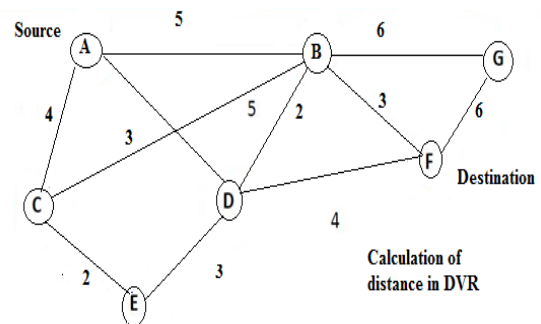


Fig 4:-Distance Vector Routing

Disadvantages of DVR are-

1. In this protocol distance is considered as main parameter. To find the efficient route other Quality of service factors like bandwidth, trust of node, drop rate etc.
2. Shortest paths are based on neighboring nodes. So, all nodes are not included in this protocol.

### 3. PROBLEM FORMULATION

The wireless sensor networks are highly dependent on routing protocols for data transmission. There are different types of protocols present which are based on distance, energy efficiency, route establishment, updating of routing tables, sending messages for route construction and maintenance. Many problems have occurred for the selection of an efficient protocol like bandwidth, energy efficiency, security, scalability, and trust and drop rate of nodes. There is no protocol which covers all the Quality of Service Parameters and increases the lifetime of the network. Some protocols consider only distance as a main parameter for data transmission like AODV, DVR while some protocols are based on route establishment, maintenance like DSR. So, there is a need for the protocol that covers all the important features like security, energy efficiency, and bandwidth and is suitable for all types of networks.

### 4. CONCLUSION

We have reviewed many routing protocols in this paper. The main aim of every protocol is to find the efficient route for data transmission. Previously, all algorithms find routes on the basis of distance like DVR, AODV. We also study the shortcomings of every protocol and we came to know that certain Quality of Services parameters are not included in every protocol like bandwidth, security, drop rate, trust rate for effective data transmission. These parameters are considered as a new research area for the development of efficient routing protocol for WSNs.

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