# Research on Various Routing Techniques in Wireless Ad-hoc Networks

**Koppisetti Giridhar, C. Anbuananth, N. Krishnaraj**

***ABSTRACT---Wireless Ad-hoc network is an emerging trend in which the nodes are having mobility features. In a wireless Ad-hoc network every node is capable of handling complete network structure which enables the nodes to participate in the data transmission in peer to peer systems. But to find a route to connect with or to communicate, there is big network structure in front of network administrator. The big deal is to route a particular transmission from a specified source and destination to find the best route among a bunch of nodes. In this paper we have given classification of various routing techniques with some issues related to them along with some of the advantages and disadvantages, which will help us to choose a better routing protocol to compute a route among nodes in wireless Ad-hoc networks.***

***Keywords: Routing, Wireless, Data Dissemination, Networks, Technology, Ad-hoc.***

## I. INTRODUCTION

In a network, communication may be established between a pair of nodes through wired or wireless communication techniques. Wired communication is not preferable in some of the networks because of their inconvenience to maintain cords among systems or nodes. Wireless communications are very useful to communicate with various nodes and far away systems. For connecting and for communicating with large number of those nodes, routing plays a vital role in the network.

Routing is the main issue in any wireless networks which shows the responsibility of completing the data transmission in the network. In wireless communication, routing can be done either statically or dynamically based on the network topology. If static routing is required in the wireless communication, routing must be done before the desired action starts, in dynamic routing, the routing might be done by using any of the protocol existed in wireless communication networks. While traversing to the destination node with a specific routing technology first we need to know more about various routing techniques that has to be used in setting the path.

In the following sections (section- 2, 3, 4 and 5) we discussed some of the routing methods might be useful for wireless Ad-hoc networks.

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## II. ROUTE COMPUTATION

In Ad-hoc networks, every system or computing device called a node can send and receive the data or routing information and forwards to its neighbour node according to network topology and routing information. For doing such things the network system needs computation, which can be done in any of the following ways.

### *2.1 Decentralized Computation*

In this Decentralized routing computation every node need to maintain global and complete information about network topology, which is useful to route to a targeted destination when any node receives the data packet if it is required to route in the network. Example of decentralized computation is link state routing (discussed in the upcoming sections).

### *2.2 Distributed Computation*

In this Distributed routing computation node maintains only local or partial information which will be used to route whenever it is required to do. When route computation is needed from source to destination, then many of the nodes will collaborate to find an optimal route. Examples of distributed computation are distance vector routing and reactive routing (discussed in the upcoming sections).

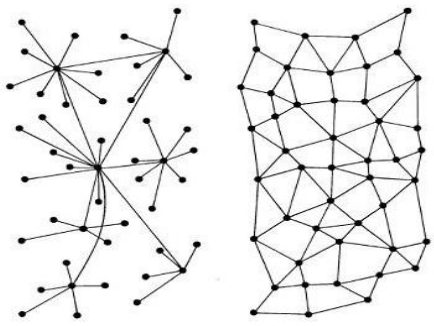

**Figure 1: Decentralized vs. Distributed computation [6]**

## III. TYPES OF ROUTING

Various routing strategies probably existed to route a data packet from a source to destination. Depends on the network topology and the number of nodes which are being participated in the data transmission, the performance of the network may be varied from protocol to protocol. Among them probably we need choose suitable routing technique for our data transmission. Following are some of the routing methods, they are

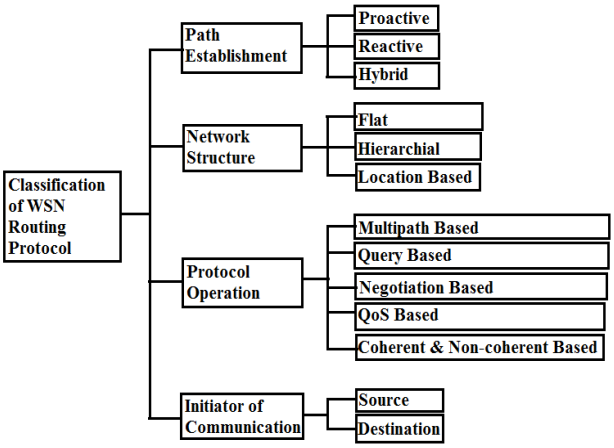


**Figure 2: Classification of Wireless Sensor Network Routing Techniques [8]**

*3.1 Single Path Routing*

A single route is found in some routing protocols from source to destination. This single path routing is effective when there is a small network, which saves storage space because it needs to store single routing information at every node.

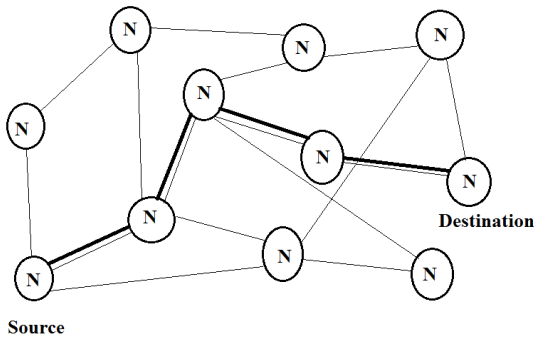


**Figure 3: Single Path Routing**

*3.2 Multipath Routing*

This protocol finds multiple routes from source to destination. We can have multiple available paths between a pair of nodes. The advantage of multipath routing is that if any node was broken in the path, we can choose for an alternative route available in routing tables.

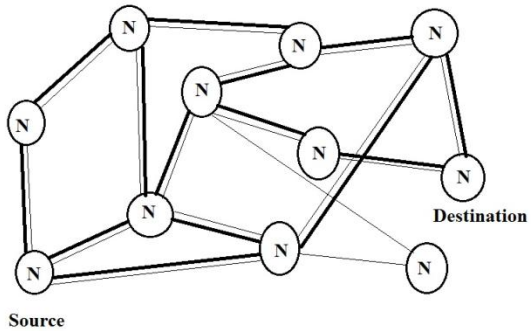


**Figure 4: Multipath Routing**

*3.3 Pro-active Routing*

The nodes need to update the routing information periodically when there is a change in nodes or broken nodes in the path along with network topology. The advantage of this routing is that the source can send data directly as the route is already available in the network. And the disadvantage is that the current periodical information in data dissemination consumes a lot of scarce in node bandwidth.

*3.4 Re-active Routing*

In this reactive routing it discovers all the possible routes in the networks called route discovery. The process used to detect and rebuild any route breakage is called route maintenance. The route may not be existed in advance before transmission, but it will be set when it comes to start. It finds one or more routes from source to destination when any packet needs to be sent in the network.

**Table1: Comparison between Three Routing Protocols [9]**

| Parameters | Proactive protocol | Reactive protocols | Hybrid protocols |
|---|---|---|---|
| Routing Structure | Mostly Flat | Flat | Hierarchical |
| Scheme of Routing | Table-driven | On-demand | Combination of proactive and reactive protocols |
| Overhead in Routing | High | Low | Medium |
| Latency | Low | High | High for outer zones and low for local destinations |
| Scalability | Low | Not suitable for large networks | Suitable for large networks |
| Requirements of storage | High | Dependant on no of routes needed or maintained | Depends on size of each cluster |
| Availability of Route | Available always | Computed based on need | Depends on destination's location |
| Updates in Route Periodically | Always required | Not required | Used inside every cluster |
| Control Updates | High | Low | Lower than proactive and reactive protocols |
| Information about Routing | Stores in table | Doesn't store | Based on requirement |
| Mobility Support | Periodical updates | Route maintenance | Combination of both |

*3.5 Flooding*

It is one of the routing techniques used to broadcast the data to all the nodes through various paths in the network. In which every node will receive the packet, which in turn at least one copy of the desired packet will reach the destination. Flooding doesn't require knowledge about any network topology. Flooding is generally not used to send data packets, but sends only control packets.

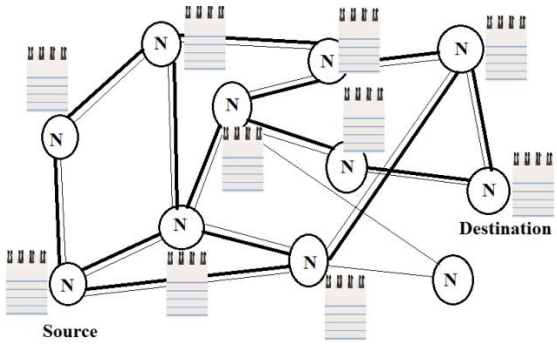


**Figure 5: Flooding**

*3.6 Link State Routing*

In link state routing, every node disseminates its link information to its neighbour node. That means every node which is participating in the data transmission will have the link information towards the destination. If any link changes made or link breakage occurred in the network, then that information will be flooded over all nodes in the network. The changes in those link states, dynamically set the network topology, and send the link information to every node.

**Table 2: Comparison between Link state and Distance vector routing protocols [10]**

| Features | Distance Vector | Link State |
|---|---|---|
| Convergence | Slow | Fast |
| Updates | Frequently | Event triggered |
| Loops | Prone to routing loops | Less subjected to routing loops |
| Configuration | Easy | Difficult |
| Network types | Broadcast for updates sent | Multicast for updates sent |
| Topology | Doesn't know network topology | Knows entire network topology |
| Automatic route summarization | There is no automatic route summarization | Route summarization will automatically done |
| Path calculations | Hop count | Shortest path metric |
| Scalability | Limited | Can be highly scalable |
| Protocols | RIP, IGRP | OSPF, IS-IS |
| Algorithm | Bredford algorithm | Dijkstra's algorithm |
| Manual route summarization | Yes | Yes |
| Metric | Hop count | Link cost |

*3.7 Distance Vector Routing*

This routing technique involves a distance vector which is going to be shared to every other node with destination ID, next hop to be visited and distance between current nodes to destination in the network. When the distance vector arrived at any node from its neighbour node, immediately it computes a new route, and shares its distance vector to its neighbour node. Similarly by combining the next hop of nodes by following the distance vector at every neighbour, we will reach the destination.

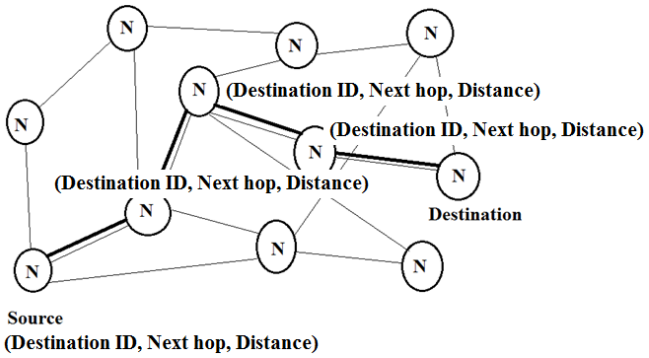


**Figure 6: Distance Vector Routing**

*3.8 Source Routing*

In this routing the entire routing information will be included within the header of the data packet, so that the intermediate nodes can forward those packets to further nodes until it reaches destination. No need of maintaining updated information at intermediate nodes as they have complete routing information at every node. In order to route from every node it is very simple to have the source routing technique with entire routing information at header, ignoring routing decisions in the network. The disadvantage of this source routing technique is, when there is a large network then it is almost impossible to have the complete routing information within the header as it wastes scarce of bandwidth.

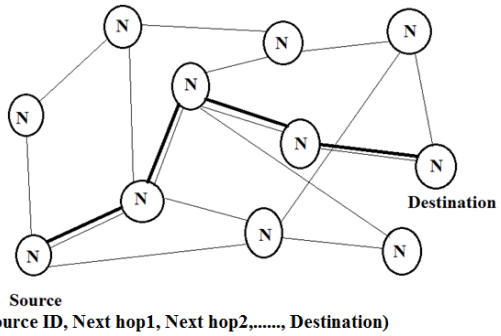


**Figure 7: Source Routing**

*3.9 Hop-by-Hop Routing*

Along the route every node need to maintain next hop information towards destination. If any node receives data packet then it will be forwarded to next hop based on the information it contains. There is a problem that this routing may form routing loops.

## IV. ROUTING UPDATE

### *4.1 Periodical Update*

The routing information will be disseminated periodically using periodical update protocols. The network stability is very high in this periodical update protocol and simplifies the network. This enables new nodes to understand the network topology. The protocol may not keep up to date when there is a large period between the updates. If it is too small then many data packets will be disseminated between nodes which consume more bandwidth.

### *4.2 Event-driven Update*

In this event driven update protocol an update packet will be disseminated over the network of nodes for changes in network topology when it occurs in the network. If the network topology changes rapidly then too many update packets will be disseminated in the network which consumes the precious bandwidth.

### *4.3 Hybrid Update Mechanism*

To overcome the drawback in above update protocol one threshold point needs to be initialised. The present hybrid update protocol is a combination of both periodical and event driven update protocols in which periodical updates may be disseminated and its distance vector will be shared over the network. A message will be sent immediately when any link was broken.

## V. ROUTING STRUCTURE

### *5.1 Flat Structure*

The routing functionality is same for every node because all the nodes are at the same level. Generally small networks use this routing structure due to its simplicity and efficiency. The disadvantage of this level routing structure is, when there is a large network it takes large volumes of data and takes long time to reach the routing information at remote nodes.

**Table 3: Comparison between Flat and Hierarchical structure**

| Parameters | Flat Structure | Hierarchical Structure |
|---|---|---|
| Route propagation | All over the network | Divide large network into small network |
| Protocol type | Classful routing | Classless routing |
| Suitable environment | Not appropriate for large networks | Limited route propagation between areas |
| Protocols | RIPv1, IGRP, RIPv2 | EIGRP, OSPF, IS-IS |
| Routers | All routers are peers | Some routers only communicate within an area |

### *5.2 Hierarchical Structure*

To overcome the difficulty in the above structure Clusters will take part in this routing structure. Some group of nodes will be partitioned as a cluster in which internal routing information can be saved in the network. These clusters are dynamically organized to form a wireless network which maintains the routing information at every node. And some clusters are grouped into a large cluster called super clusters and so on. By having clusters a stable network and network topology will be maintained within the cluster. Dynamics in cluster level and super cluster level controls the traffic at a long distance and will be reduced.

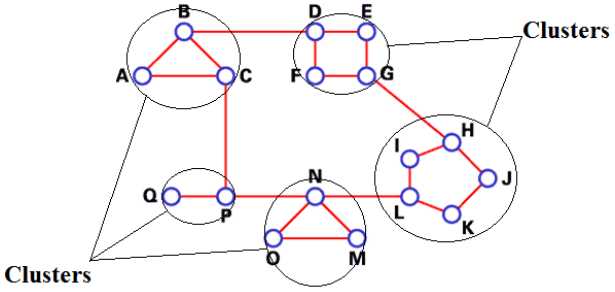


**Figure 8: Hierarchical Routing [7]**

## VI. CONCLUSION

In this paper, we discussed various routing techniques and their classifications emerging in wireless Ad-hoc networks, explains need of routing computation, process of computation performed in the network, dissemination of routing information among the network. However, there are advantages and disadvantages for some routing protocols, the world prevails wireless Ad-hoc networks.

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