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An Analytical Study on Hybrid Routing Algorithm in Mobile Ad Hoc Network

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ABSTRACT: MANET is combination of wireless mobile nodes that communicate with each other without any kind of centralized control or any device or established infrastructure. Therefore MANET routing is a critical task to perform in dynamic network. Without any fixed infrastructure, wireless mobile nodes dynamically establish the network. Routing Protocols helps to communicate a mobile node with the other nodes in the network by sending or receiving the packets. In MANET different types of routing protocols have been recommended. These protocols can be classified into three main categories reactive (on-demand), proactive (table-driven) and hybrid routing protocols. This paper focus on hybrid routing protocols like LAHRP, ZRP.

KEYWORDS: MANET, LAHR, ZRP.

I. INTRODUCTION ON MANET

A MANET is a type of ad- hoc network that can change locations and configure itself on the fly. MANET can be a model Wi-Fi connection, or another standard, like a cellular or satellite transmission. MANET has many applications like military, communication, conference meeting, automated battlefield, creating virtual classrooms and in sensor network. The main feature of MANET restoring and self organizing and transmission through multiple hops. Topology because nodes are self managed without any pre existing structure. MANET has different characteristics bandwidth constraint and limited physical security. MANET used routing protocols for sending data source to destination [1] [2] [3]. MANET diagram as shown in fig.1.

Computer networks were originally developed to connect number of devices through wires so that the devices can share some information and data with each other. With the increase in network sizes, the requirement of inter network communication was observed which leads to the development of internet and suit of protocols. It was necessary to provide network access to the entities which are not physically attached to any wired network. To enable this, the wireless networks were developed. Wireless network is a computer network that utilizes wireless network connection.

There are two categories of wireless networks [5]:

1. Infrastructured Network
2. Infrastructure-less Network

Infrastructured network contains fixed and wired gateways whereas infrastructure-less network contains multi hop wireless nodes and it has no fixed infrastructure. MANET comes under the second category. MANET [1] [2] is a temporary wireless network in which no fixed infrastructure is used. So in MANET, topology changes frequently as mobile nodes moves independently and changes their links to the other nodes very quickly. Each mobile node acts a router and forwards the traffic to the other nodes in the network. If two mobile nodes are within each other's transmission range, they can communicate directly, otherwise the nodes in between have to forward the packets for them [4].

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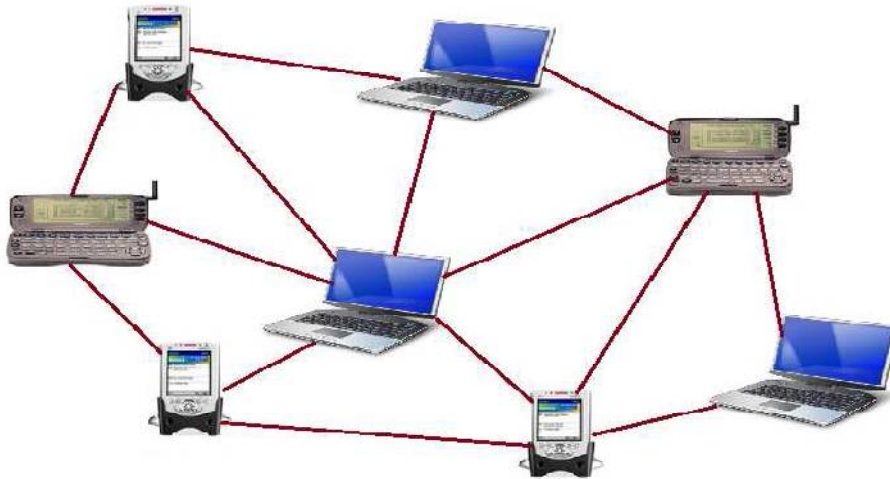


Fig.1. Mobile Ad hoc Network

A mobile ad hoc network may consist of only two nodes or hundred nodes or thousand nodes as well. The entire collection of nodes is interconnected in many different ways. As shown in figure 1 there is more than one path from one node to another node. To forward a data packet from source to destination, every node in the network must be willing to participate in the process of delivering the data packet. A single file is split into a number of data packets and then these data packets are transmitted through the different paths. At the destination node, all these packets are combined in sequence to generate the original file, routers.

II. ROUTING IN MANET

Routing [4] is the process of transferring a packet from source to its destination. In the routing process, a mobile node will search for a path or route to communicate with the other node in the network. Protocols are the set of rules through which two or more devices communicate with each other. In MANET, routing tables are used for routing purpose. Routing tables contain the information of routes to all the mobile nodes. The routing protocols in MANET are broadly classified into three categories [2] [4] [6]:

- Proactive or Table Driven Routing Protocols
- Reactive or On-Demand Routing Protocols
- Hybrid Routing Protocols

III. HYBRID ROUTING ALGORITHM FOR MANET

Hybrid routing algorithm combines the advantages of both reactive and proactive routing algorithms. Initially proactive approach is used to have route information then reactively demand of the route is served to the needy node. These protocols exploit the hierarchical network architecture and allow the nodes with close proximity to work together to form some sort of backbone, thus increasing scalability and reducing route discovery [3]. Nodes within a particular geographical area are said to be within the routing zone of the given node. For routing within this zone, Proactive i.e. table-driven approach is used. For nodes that are located outside this zone, Reactive i.e. an on demand approach is used. So in Hybrid Routing Protocols, the route is established with proactive routes and uses reactive flooding for new mobile nodes [2].

In Hybrid Routing protocols, some of the characteristics of proactive and some of the characteristics of reactive protocols are combined, by maintaining intra-zone information proactively and inter-zone information reactively, into one to get better solution for mobile ad hoc networks [3].

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Some hybrid protocols are

A. Location-aided hybrid routing protocol (LAHRP)

B. Zone Routing Protocol (ZRP)

A. Location-Aided Hybrid Routing Protocol (LAHRP)

Location-aided route discovery based on limited flooding. LAHRP [7] Use location information to reduce the number of nodes to whom route request is propagated. Location information may be obtained using Global Positioning System (GPS).

- LAHRP Exploits location information to limit scope of route request flood using GPS
- Expected Zone is determined as a region that is expected to hold the current location of the destination. Expected region determined based on potentially old location information, and knowledge of the destination's speed
- Route requests limited to a *Request Zone* that contains the Expected Zone and location of the sender node
- In fig. 2, Request Zone
 - i. Define a Request Zone
 - ii. LAHRP is same as flooding, except that only nodes in request zone forward route request
 - iii. Smallest rectangle including S and expected zone for D

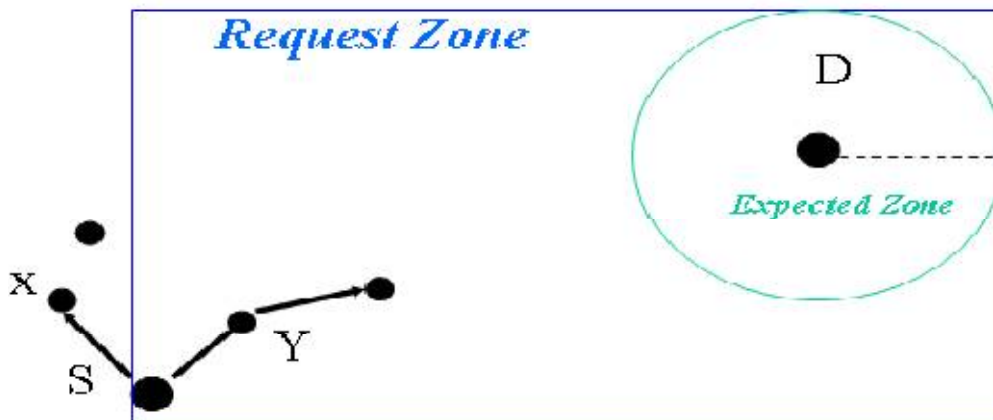


Fig.2. LAHRP- Request Zone

Advantages:

- Reduces the scope of route request flood
- Reduces overhead of route discovery

Disadvantages:

- Nodes need to know their physical locations
- Does not take into account possible existence of obstructions for radio transmissions

B. ZONE ROUTING PROTOCOL(ZRP)

Zone routing protocol is hybrid routing algorithm which use the advantages of both proactive and reactive routing algorithms. ZRP was proposed to reduce the control overhead of proactive routing protocols and decrease the latency caused by route discovery in reactive routing protocols. ZRP routing protocol diagram as shown in fig.3. The Zone Routing Protocol was the first Hybrid routing protocol [8] [9]. It was proposed to reduce the control overhead of Proactive routing protocol and to decrease the latency of Reactive routing protocol. It is suitable for the networks with large span and diverse mobility patterns. For each node a routing zone is defined separately. Within the routing zone,

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routes are available immediately but for outside the zone, ZRP employs route discovery procedure. For each node, a separate routing zone is defined. The routing zones of neighboring nodes overlap with each other's zone. Each routing zone has a radius ρ expressed in hops [8]. The zone includes the nodes whose distance from the source node is at most ρ hops. In fig.4, routing zone of radius 2 hops for node A is shown. Routing zone includes nodes all the nodes except node L, because it lies outside the routing zone node A.

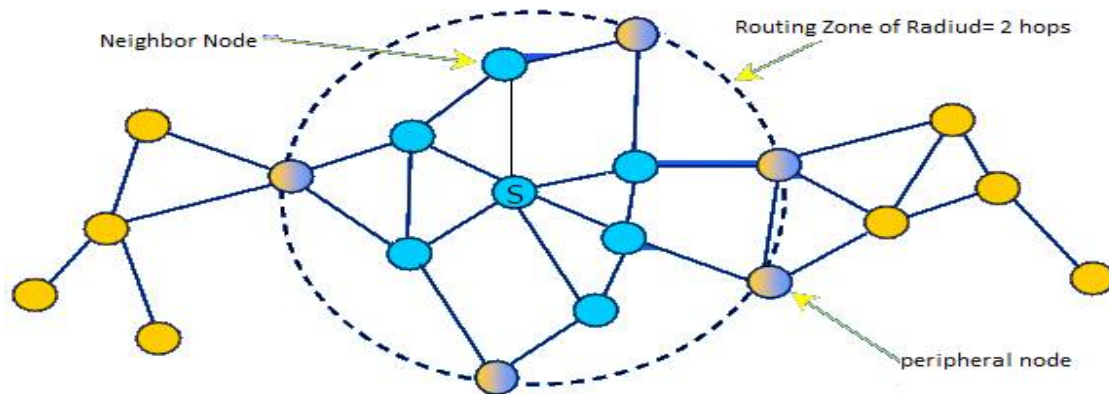


Fig.3. ZRP

The routing zone is not defined as physical distance, it is defined in hops. There are two types of nodes for a routing zone in ZRP [8]:

- Peripheral Nodes
- Interior Nodes

The nodes whose minimum distance to central node is exactly equal to the zone radius ρ are Peripheral Nodes while the nodes whose minimum distance is less than the zone radius ρ are Interior Nodes. In fig. 4, Peripheral nodes are E, F, G, K, M and Interior Nodes are B, C, D, H, I, J. The node L is outside the routing zone of node A.

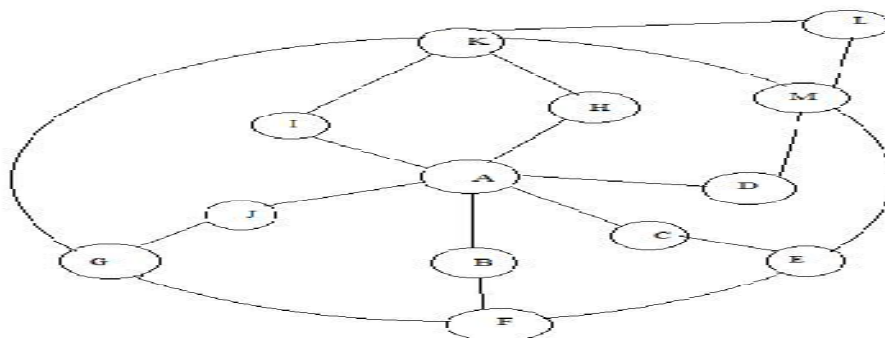


Fig.4. Routing Zone of Node A with Radius $\rho=2$ hop

- All nodes within hop distance at most d from a node X are said to be in the routing zone of node X .
- All nodes at hop distance exactly d are said to be peripheral nodes of node X 's routing zone
- Intra-zone routing: Proactively maintain routes to all nodes within the source node's own zone.
- Inter-zone routing: Use an on-demand protocol (similar to DSR or AODV) to determine routes to outside zone.
- In fig.5, node S perform route discovery for node D. First, the packet is sent within the routing zone of the source node to reach the peripheral nodes (Intra zone routing).
- Then the packet is sent from the peripheral nodes towards the destination node.(inter zone routing)

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- Each node collects information about all the nodes in its routing zone proactively. This strategy is similar to a proactive protocol like DSDV.
- Each node maintains a routing table for its routing zone, so that it can find a route to any node in the routing zone from this table.
- Each node periodically broadcasts a message similar to a hello message known as a zone notification message.

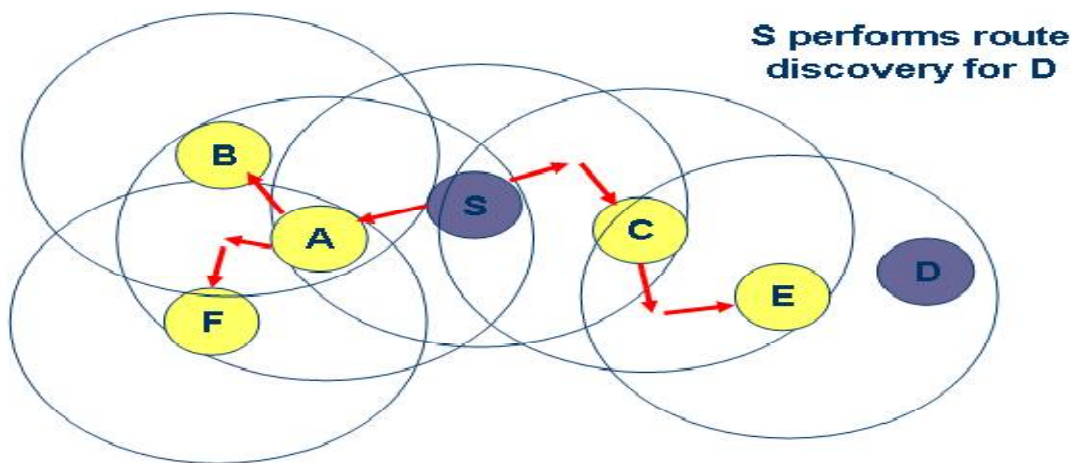


Fig.5. RREQ Broadcasting

Advantages:

- Less control overhead as in a proactive protocol or an on demand protocol.

Disadvantages:

- Short latency for finding new routes.

The source node sends a route request to the peripheral nodes of its zone. Route request contains source address, the destination address and a unique sequence number. Each peripheral node checks its local zone for the destination. If the destination is not a member of this local zone, the peripheral node adds its own address to the route request packet and forwards the packet to its own peripheral nodes. If the destination is a member of its local zone, it sends a route reply on the reverse path back to the source. The source node uses the path saved in the route reply packet to send data packets to the destination. By adjusting the transmission power of nodes, numbers of nodes in the routing zone can be regulated. Lowering the power reduces the number of nodes within direct reach and vice versa. ZRP uses both the strategies i.e. Proactive and Reactive routing. Within a routing zone, Proactive strategy is used. Between the routing zones, Reactive strategy is used. ZRP refers to locally proactive routing component as Intra-zone Routing Protocol (IARP). The globally reactive routing component is named as Inter-zone Routing Protocol [8].

IV. CONCLUSION

In this paper, we survey a routing algorithm called LAHRP for optimizing band-width usage and decreasing energy consumption by reducing routing overload for MANETs. The LAHRP algorithm uses available bandwidth efficiently because of its high packet delivery ratio and low normalized routing overload. The algorithm is not affected with the number of nodes increased in the network. It only increases the size of routing matrix held by master node. On the other hand, this drawback could be removed by clustering procedure of network. The nodes are clustered according to their geographical closeness of each other. Clustering speeds up the route determination process. From the results it is concluded that with the increase in number of mobile nodes, ZRP gives high throughput. Load increases with the increase in nodes.



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