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Survey on Location Based Routing Protocols in MANET

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Abstract- Due to the infrastructure less and dynamic nature of mobile ad hoc networks it becomes challenging to establish and maintain a connection between two end points. Therefore designing a routing protocol for MANET is now became a broad area of research. While establishing and maintaining a end to end connection or route in a MANET many routing parameters like routing overhead, end to end delay, packet delivery fraction can get affected. So the routing protocols are designed in such a way that optimizing these parameters. In routing protocols like AODV, DSR etc. routing overhead is a big concern as route request floods in all direction in these protocols. In location based routing, the nodes location information is used to route the packets. In LAR the route request is forwarded in the direction of destination node. This selective flooding reduces the routing overhead in the network. This paper gives the study and comparison of some location based routing protocols.

Keywords: MANET, LAR, Routing parameters.

I. INTRODUCTION

Mobile ad hoc network is a self configuring dynamic network in which any node can leave or join the network at any time. Due to these features routing in MANET became a big challenge. Any node which is part of communication link may move away so the connection may break down. In this condition many times network has to re-establish the connection. To establish a connection between two end points, the routing path has to be found out between these two points. This task is done by routing protocols. There are many routing protocols like AODV, DSDV, DSR are available. The major drawback of these protocols is routing overhead. It is the total number of packets or messages sent over a network to establish a path between end points. In these protocols the routing packets are sent or flooded in all directions.

Location based routing protocols are specially designed for reduction of routing overhead. In location based routing protocols the flooding area of routing messages is reduced by using location information of destination node. That area of flooding is called as request zone. They also work well in packet delivery fraction and end to end delay. But there are many problems to it as location estimation, holes in request zone etc. To get location information is a very critical problem in MANET because there are some limitations on using GPS. We can't use GPS to get location information of nodes within the MANET in some cases. For indoor network GPS can't be used because there is a problem of GPS range inside the houses or offices. For smaller wireless devices or sensor node it is difficult to install GPS hardware and antenna over it. GPS is very expensive for such small devices or networks. In standard GPS there is location error up to 20-30 meters. For MANET such error can't be tolerated. If MANET is highly dense, that means nodes are very close to each other within network then GPS can't be used in such cases [9][10].

II. STUDY OF LOCATION BASED ROUTING PROTOCOLS

A. *Location Aided Routing*

One of geographical-based routing protocol is location-aided routing (LAR). The main objective of LAR is to limit flooding of routing request packets in a small group of nodes which belong to a request zone. Compared with other routing protocols such as AODV or DSR, in which routing packets are flooded throughout the network, LAR saves considerable bandwidth and leaves those mobile nodes that are not between the source and destination untouched.

The area of network in which current location of destination is expected to be is known as "expected zone" and the area through which request packet has to travel is called as "request zone". By using location information, the Location-Aided Routing (LAR) protocols limit the search for a new route to a smaller "request zone" of the ad hoc network. This results in a significant reduction in the number of routing messages. There are two schemes which decide the request zone in LAR.

To construct the request zone, the expected zone of the destination needs to be obtained first. Suppose both the average speed (say v) and the location of the destination at time t0 (say L) are known to the source, the expected zone of the destination at time t1 is the circle with center at L and radius of v(t1 - t0).

Two different schemes are brought to construct the request zone: (1) a rectangular request zone which contains the location of source and the expected zone of the destination; or (2) the group of the nodes closer to the destination than the source.

Variations to request zone

As shown in figure 1 it is alternative definition to the request zone in LAR scheme1. In this figure it is seen that request zone includes only expected zone circle. But in LAR scheme1 it considers the whole rectangle containing source node coordinates as one end of diagonal of rectangle and other end encompassing expected zone. In figure 1, rectangular request zone shown is the request zone considered in LAR scheme1. If we compare these two request zones then it can be seen that the area of alternative request zone is less than rectangular request zone in LAR scheme1. That means the routing overhead in alternative request zone is less than the rectangular request zone.

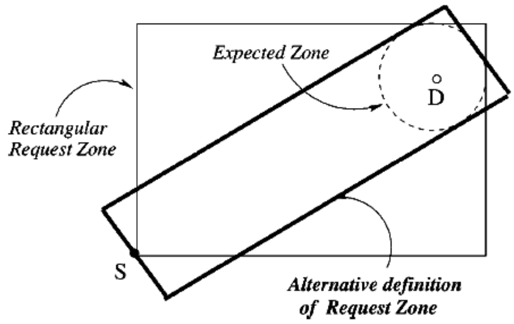

Fig 1 Alternative definitions of request zone for LAR scheme 1 [5].

As shown in figure 2 it is alternative definition to the request zone in LAR scheme2. In this figure it is seen that request zone (outer circle) includes expected zone circle and source node on the circle of request zone. But in LAR scheme2 it considers the whole circle containing source node coordinates as on it and encompassing expected zone as request zone. In figure 2 initial circular request zone shown is the request zone considered in LAR scheme2. But in alternative request zone the request zone is adaptively considered. That means when request comes to inner node I then to forward request by I it considers the request zone calculated by node I that means inner circle shown in figure 2. That means request zone adaptively changing while request is moving towards destination. Also the area of request zones is going decreasing. If we compare these two request zones then it can be seen that the area of alternative request zone is less than initial request zone in LAR scheme2. That means the routing overhead in alternative request zone is less than the initial request zone.

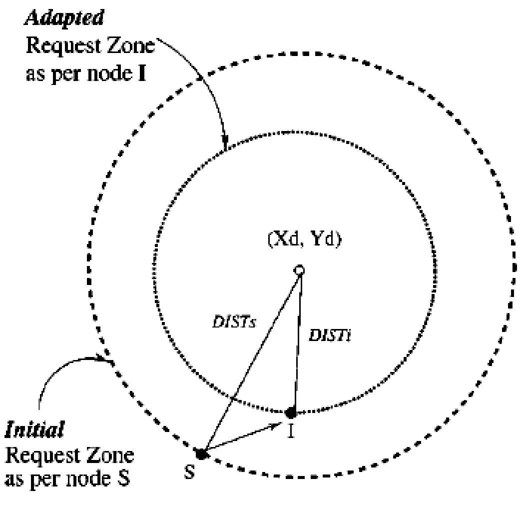

Fig 2 Alternative definitions of request zone for LAR scheme 2 [5].

B. *IHLAR*

In reactive routing end-to-end delay is more because of the route discovery phase for long path takes much of time. In this IHLAR protocol, reactive protocol AODV is integrated with a geographic protocol. For long path geographical routing works better. Topology-based routing usually finds the shortest path, in number of hops. So the path length of hybrid protocol is correspondingly shorter than geographic protocol. This IHLAR protocol integrates two type of routing schemes as follows.

a. Topology-based routing (Intra-Zone-Routing)

In this algorithm, each node maintains a table of neighbors within specified numbers of hops (ρ-radius). Using this information zone is formed. When a source node or a forwarding node wants to send or forward a packet to a destination node, then first of all it checks whether the node is in the table. If the destination node resides within zone of the source node or the intermediate node, then the node will route the packet using AODV protocol, as shown in Fig. 3. If source node S wants to send a packet to D1, D1 is within the zone, then AODV is used to route the packet. For highly mobile networks it's better to keep zone radius shorter because for high mobility topology based routing does not work well. [1]

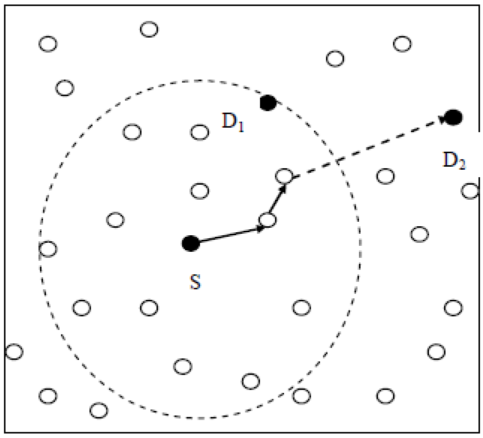

Fig.3 Routing in IHLAR [1]

b. Geographical routing (Inter-Zone-Routing)

If the destination node is not within the zone of source node then the greedy forwarding is used. It means that the next node is geographically closer to the current node. As shown in Fig.4 S needs to communicate with D2, but D2 is out of the zone. Thus S forwards packet to the closest node towards to the destination until packet reaches to the zone of destination. Once it reached to the zone of destination then topology based routing is used to forward the packet. But packet may be stuck at a dead-end node during greedy forwarding. In this case no node is closer to the destination than the source node itself. In this situation, ARP is used in this case to detour around voids. In angular routing protocol, each node maintains a neighbor table containing location-information of its one hop nodes. Nodes send a packet, which includes its location and speed information, non-periodically at a rate proportional to their speeds. The angles of neighbors are calculated with respect to destination position. When node encounters a void condition, then the node selects a neighboring node that makes minimum angle, among available neighbors as shown in fig 4. Here node A is a “dead-end” node, no neighbor node is closer to the destination than the node A. Then node N1 is selected as forwarder because it makes least angle with the destination. [1]

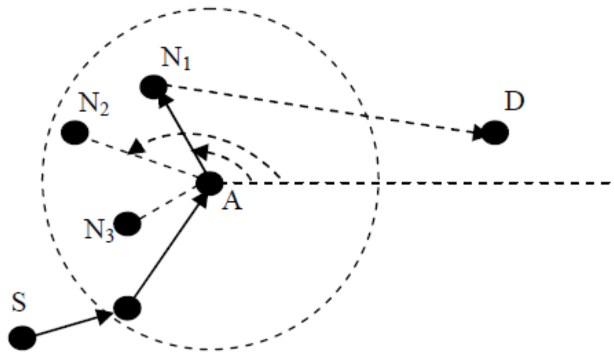

Fig. 4 Node selection in void [1]

C. *ARZAODV*

In Adaptive Request Zone, request zones are based on the variation of distance between source node and destination node while both nodes are mobile. The request zones are adaptively chosen depending on the distance between source node and destination node and radius of expected zone as shown in the Fig 5

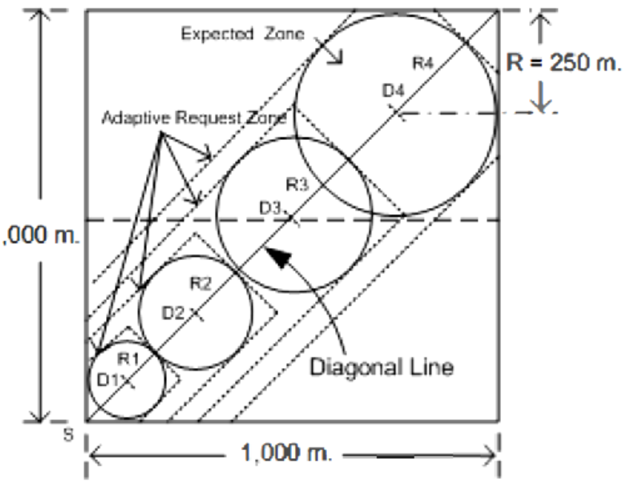

Fig 5 adaptive request zones in ARZAODV [2]

As shown in fig 5, the area of 1,000 X 1,000 meters is considered. If distance between source node and destination node is larger than or equal to three fourth of the diagonal line (S->D4), the maximum of radius R4 =250 m is taken for calculating the expected zone and also increase the request zone respectively. If the distance between source node and destination node is larger than or equal to a half of the diagonal line (S->D3), the maximum of radius R3 =187.5 m is taken. If the distance between source node and destination node is larger than or equal to one fourth of the diagonal line (S->D2), the minimum of radius R2 = 125 m is taken. If source node and destination node locates very close like node S and node Dl, the minimum of radius Rl = 65 m will be taken. It divides the variation of the distance to adapt the radius of expected zone four parts based on the diagonal line. [2]

D. *LAROD–LoDiS*

In this scheme geographical routing protocol LAROD integrated with a location service.

a. LAROD

LAROD is a geographical routing protocol that uses geographical routing with the store–carry–forward principle. It uses greedy packet forwarding when possible. To forward a message toward the destination, a custodian simply broadcasts the message. All nodes within a predefined forwarding area are eligible to forward the packet and are called tentative custodians. All tentative custodians set a delay timer *td* specific for each node, and the node whose delay timer expires first is the selected as new custodian. Upon becoming a custodian, the node forwards the message in the same manner as the previous custodian. The current custodian repeats the broadcast of the message until a new custodian becomes available due to node mobility. The rebroadcast time is randomly chosen for each transmission between two configured values. The values should be chosen so that forwarding opportunities are not missed as well as to avoid wasting bandwidth. It is possible that not all nodes in the forwarding area will overhear the broadcast made by the new custodian, thereby producing packet duplicates. This case will not only increase the load in the system but will enable the exploration of multiple paths to the destination as well. When the paths of two copies cross, only one copy will continue to be forwarded. To prevent a packet from indefinitely trying to find a path to its destination, all packets have a time to live expressed as duration. When the TTL expires, a packet is deleted by its custodian. [3]

b. LoDiS

In LoDiS, every node acts as a location server, and location data are updated by data exchange between nodes. The reason that all nodes are location servers is to avoid delaying the packet at the source node. If only a limited set of nodes were location servers, then the response time of location servers increases. Due to the disconnected nature of IC MANETs, this response may be long. But maintaining such information at every node should not increase a problem of memory and extra overhead.

When the routing protocol requests a location from LoDiS, one thing that it should consider is that the location may be wrong, but if the provided location points the packet in the right direction, it should be best solution for the routing. To reduce the location error, the geographical routing protocol should update the location data in a packet for each node that the packet traverses. This approach is done by inquiring that node’s local LoDiS server whether it has more accurate information about the destination. Because nodes closer to the destination should have better information on the destination's location, the accuracy of the destination position is incrementally increased. [3]

E. *ALERT*

In this routing it is considered that network area is rectangle. Each node knows the bottom-right and upper left boundary of the network area. This information enables a node to locate the positions of nodes in the entire network for zone partitions in ALERT.

ALERT features a dynamic and unpredictable routing path, which consists of a number of dynamically determined intermediate relay nodes.

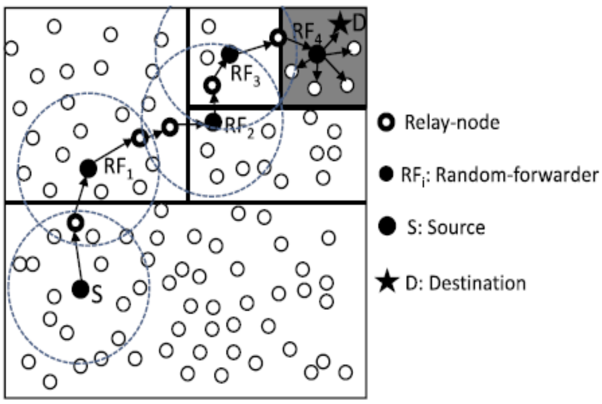

Fig. 6 Routing in ALERT [4]

Fig. 6 shows an example of routing in ALERT. The shaded zone is the destination zone. Specifically, in the ALERT routing, each data source or forwarder executes the hierarchical zone partition process. First of all it checks whether source node itself and destination are in the same zone. If not so, it divides the zone alternatively in the horizontal and vertical directions. This process is repeated until source node itself and destination node are not in the same zone. It then randomly chooses a position in the other zone called temporary destination (TD), and uses the GPSR routing algorithm to send the data to the node closest to TD. This node is called as a random forwarder (RF). At the last step, the data are broadcasted to k nodes in destination zone ZD, providing k-anonymity to the destination. Given an S-D pair, the partition pattern in ALERT varies depending on the randomly selected TDs and the order of horizontal and vertical partitions, which provides a better anonymity protection. ALERT sets the partition in the alternative horizontal and vertical manner in order to ensure that a packet approaches D in each step. As GPSR, it assumes that the destination node will not move far away from its position during the data transmission, so it can successfully receive the data. In this design, the tradeoff is the anonymity protection degree and transmission delay. A larger number of hierarchies generate more routing hops, which increases anonymity degree but also increases the delay. To ensure the delivery of packets, the destination sends a confirmation to the source upon receiving the packets as acknowledgement. If the source has not received the ack during a predefined time period, it will resend the packets. [4]

III. COMPARISION

The comparison of location based routing protocols is done based on literature survey given in table 1.

The given methods are compared based on routing overhead, end to end delay, packet delivery ratio and security provided in the protocol. In IHLAR use of topology-based routing and geographical routing for intra-zone and inter-zone communication respectively results in reduced end to end delay. In ARZAODV due to the adaptive request zone, routing overhead is reduced to the great extent. LAROD-LoDiS gives a much higher delivery rate than topological routing. ALERT strengthens the anonymity protection of source and destination by hiding the data initiator/receiver among a number of data initiators/ receivers.

IV. CONCLUSION

From the study of these location based routing protocols it can be concluded that they works best for the routing overhead as nodes know their physical positions in a network. Also the packet delivery ratio is relatively high and as compared to pure reactive routing protocol end to end delay is also lower. Location based routing protocols works best in the case of given performance parameters if the location information is known. Getting updated location information is very critical task as there are limitations on using GPS in MANET. The routing overhead can be reduced to a great level if exact location of destination is known. Also the security can be provided in these protocols for their use for military purposes.

Table1 Comparison of existing methods

Protocol\Parameter	Routing overhead	End to end delay	Packet delivery ratio	Security	Location based	Proactive/Reactive
ARZAODV	Low	Low	High	No	Yes	Reactive
IHLAR	High	Low	High	No	Partially	Reactive
LAROD-LoDiS	Low	High	High	No	Yes	Hybrid
ALERT	High	Low	High	Yes	Yes	Reactive

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