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A Review on Location Aided Routing Protocol in Mobile Adhoc Networks

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Abstract: ***Ad hoc networks are the decentralized network consisting of randomly moving nodes. One of the main tasks in these networks is routing of data packets. Many protocols have been proposed for routing of data packets among these nodes. Our goal is to explore the working and analyze the various aspects and parameters of position based LAR protocol. This protocol suggests an approach to utilize the location information for routing purpose. This approach is beneficial in reducing the search area and limits flooding as well as increases the throughput. Existing systems work on the idea of single source and single destination system but our focus is mainly on developing a system having single source and multipoint destination. This makes a significant impact on the throughput as well as end to end delay.***

Keywords: Ad-hoc On-demand Distance Vector, Location Aided Routing, Location service, request zone, expected zone.

1. Introduction

Mobile Ad hoc networks consist of autonomous system of wireless mobile nodes having no fixed infrastructure. Route between two hosts in a mobile ad-hoc network consists of hops through no. of hosts. In such systems, the change in topology is very unpredictable. So, the task of finding and maintaining the routes is non-trivial.

Routing protocols can be divided into two ways, Topology-Based Routing and Position-Based Routing. In Topology-Based Routing, the route between the nodes is based on the information about the links existing in the network. In Position-Based Routing, the routing is based on the information about the geographical position of the nodes, called as the location information.

1.1 Location Services

A specific mechanism is employed for the most of the Position-Based Routing protocols, called Location Service which provides Location Information. Location Services can be categorized as: Proactive and Reactive.

In proactive protocols, a moving node shares its location information with other moving nodes; accordingly there will be immediate updating of location information from each mobile node. In Reactive protocols, there is on-demand transmission of location information between the mobile nodes. So the location information is merely transmitted on request. Hence reactive location services behave in a manner where it asks for the location information when required. For each mobile node in reactive location services, there is an embedded location table containing the location information [10].

1.2 Ad-hoc On-demand Distance Vector (AODV)

Ad-hoc on-demand distance vector (AODV) is a reactive routing protocol for mobile ad-hoc networks (MANETs). AODV, as the name implies, is a distance-vector routing protocol that uses the hop count, or the number of nodes in a route, to discover the best routes between the nodes in the network. AODV attempts to discover a route to destination only when it is needed, i.e., a source node has data to be delivered to destination but a route to destination is unknown. A source node initiates the route discovery process by broadcasting a route request (RREQ) packet to all of its neighbors. The nodes that receive RREQ packets re-broadcast them in the network until the destination or a node that knows the path to destination is found. Once an RREQ message arrives at the destination or at a node that knows a path to the destination, a route reply (RREP) message is generated and unicast back to the source node. Arrival of RREP message at the source indicates a completion of route discovery process, at which point the data packets are forwarded to the destination using unicast transmission.

The AODV route discovery process also employs such mechanisms as sequence numbers and hop count to prevent a node from forwarding the same RREQ twice and to limit how far the request messages will travel in the searched MANET domain. This route discovery technique is referred to as flooding and it is often employed because of its simplicity.

2. Related Work

Aboki et al. (2013) [10] proposed a routing protocol called PLAR for mobility model which suggested new location services and provided location information such as geographic coordination, current speed and direction of motion to predict the position of destination node. It also incorporated the "Information Life Time" in the location service as an important factor to evaluate the fresh location Information. Thus it led to more precise predictions. The simulation results show that the overhead of PLAR protocol is less than that of LAR.

Chaki N. (2010) [7] designed a new, location-aided, robust, reactive routing protocol LAR^2P for discovery of the shortest route in MANET within a small set-up period by considering only the nodes towards the destination from a given source node. This protocol removes the drawbacks of Dijkstra or Bellman-Ford. LAR^2P is flooding-free, location aided robust, reactive routing protocol reduced the set-up time and number of control messages as compared to other reactive protocols**.**

Hnatyshin et al. (2011) [13] Location-aided routing (LAR) is a mechanism which attempts to reduce the control message overhead of Ad-hoc on demand distance vector (AODV) routing protocol by flooding only the portion of the network that is likely to contain the route to destination. LAR makes use of the Global Positioning System (GPS) coordinates to identify a possible location of the destination node. Based on all this information, LAR protocol defined a portion of the network which subject to the limited flooding, hence reducing the total number of the control packet traveling through the network during the route discovery process.

Junyan et al. (2010) [3] proposed a new location aided routing protocol LAGSR a proactive link state routing protocol, based on GSR, which reduced the inaccuracy of link state routing caused by topology change in high speed moving conditions of nodes. A link weight assignment method was deployed according to the relative position and speed of each pair of nodes. The experiments proved that LAGSR gave more accuracy than GSR in MANET composed of high-speed moving nodes.

Mamoun H.M. (2011) [4] proposed a new Location Aided Hybrid Routing Protocol for MANET (LAHRP). This protocol aimed to optimize bandwidth usage of MANETs by reducing the routing overload and decrease energy consumption of the mobile devices by reducing the required number of operations for route determination. Simulation results that LAHRP exhibited superior performance than DSR routing algorithm in terms of routing overload, packet delivery ratio and end-to-end delay.

Wang et al. (2008) [6] proposed a protocol DBLAR for MANETs. It traces the Location Information of destination nodes and the distance between the nodes, and avoids flooding in the whole networks. Also, Distance Update Threshold (DUT) was used to update overhead of location information of nodes. Simulation shows that the performance of DBLAR was better than LAR in terms of packet successful delivery ratio, routing-load and average end-to-end delay.

Wang and Wang (2005) [8] proposed an improved location-aided routing (ILAR) protocol to improve the efficiency of location-aided routing protocol by using the GPS. The request packet was broadcasted in a request zone based on the baseline between the source node and destination node to determine the next broadcasting node. The neighboring node having the shortest distance to the baseline was chosen as the next broadcasting node. The path chosen reduced the network overhead. This protocol also involved route maintenance. Finally, experimental results showed that the proposed ILAR protocol outperformed LAR protocol.

3. LAR Protocol

Our study concentrates on Location-aided routing (LAR) protocol and its improvements. LAR is a modification of AODV protocol which relies on Global Positioning System (GPS) coordinates and traveling velocity of the nodes to limit flooding to a small area which is likely to contain a path to destination. This approach reduces the amount of control traffic traveling through the network during the route discovery process because only a portion of the network is being searched. Location Aided Routing (LAR) is one of the most popular mechanisms for reducing control message overhead in AODV. LAR assumes that the nodes in the network know their own location and can obtain the last known position of the destination node. Based on this information, LAR limits the route search area to the portion of the network where the route to destination node is likely to be located. LAR modifies the route discovery process so that only the nodes which belong to the search area would rebroadcast RREQ messages. When an RREQ packet reaches to an intermediate node, the node first determines whether it belongs to the search space defined by the incoming RREQ message. If the node is part of that search space then the RREQ packet is rebroadcasted, otherwise the packet is discarded.

3.1 Route Discovery Using Flooding

The basic flooding algorithm is discussed below:
A source node S wants to find a path to destination node D, node S broadcasts a RREQ to all of its neighbors. Intermediate node X receives this request and compares the destination with its own identity. If it does not match, then node X further broadcasts the request to its neighbors. Node D responds by route reply RREP messages to sender which traverses the path in reverse of the path received by D. A route request packet contains path of all nodes traversed starting S. Timeout scheme is used to restart route request with new sequence number in case of transmission error or node D is unreachable from S. Location-aided route discovery is based on "limited" flooding [3].

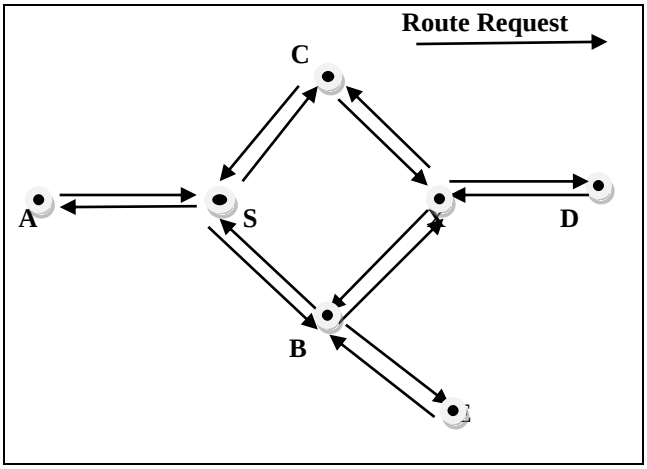

Figure 1: Illustration of Flooding

3.2 Preliminaries

3.2.1 Location Information

The proposed approach is termed Location-Aided Routing (LAR), as it makes use of location information to reduce routing overhead. Global Positioning System (GPS) is used to obtain the location information of any node.

3.2.2 Expected Zone and Requested zone

The Expected Zone is the region where source node S thinks that the destination node D may lie at time t. Suppose the node S knows about the location L of node D at time t_0 and t_1 is the current time.

If S knows that D has an average speed v, then S makes an assumption that the expected zone is the circular region of radius $v(t_1 - t_0)$ having centre at location L. The size of expected zone can be reduced if node has more information about the mobility of a destination D.

The LAR algorithm includes in the request zone having all the nodes in the circle or semi-circle. An expected zone does not include node S, both Source and Destination must lie in the request zone. Node S defines (implicitly or explicitly) a request zone for the route request.

A route request is forwarded only if it belongs to the request zone. A route request is not forwarded to a neighbor found outside of the request zone.

S initiates a new route discovery with expanded request zone if a route is not discovered within the timeout period;

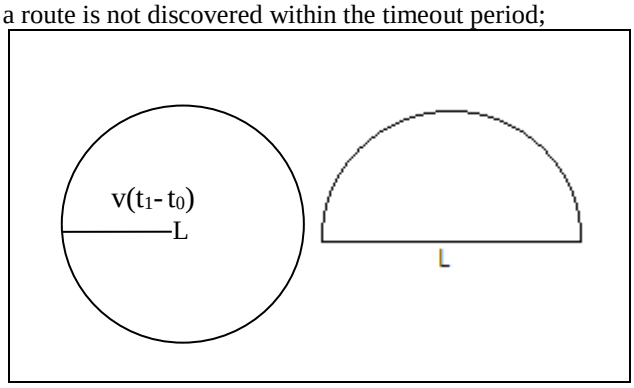

Figure 2: Examples of Expected Zone

all the zone. The path finding probability may increase with increase in size of request zone as well as increase in overhead.

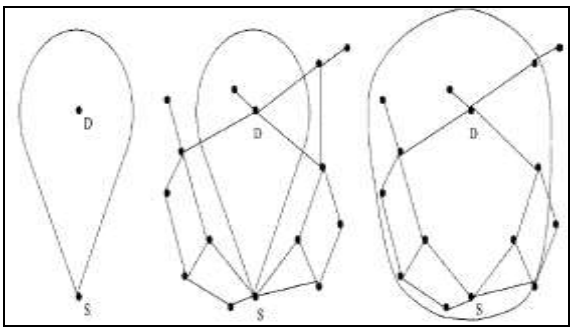

Figure 3: Examples of Request Zone

In the figure 3, an edge between two nodes means that they are neighbors [3].

3.3 Types of LAR

3.3.1 LAR Scheme 1

In LAR, if a node wishes to establish a route to node D, and S knows the location information about the node D(x_d, y_d) as well as its average speed v_d at time t_0, then an expected zone can be calculated easily for a Circular region with centre of (x_d, y_d) and radius of R = $v_d(t_1 - t_2)$ in the time t_1.

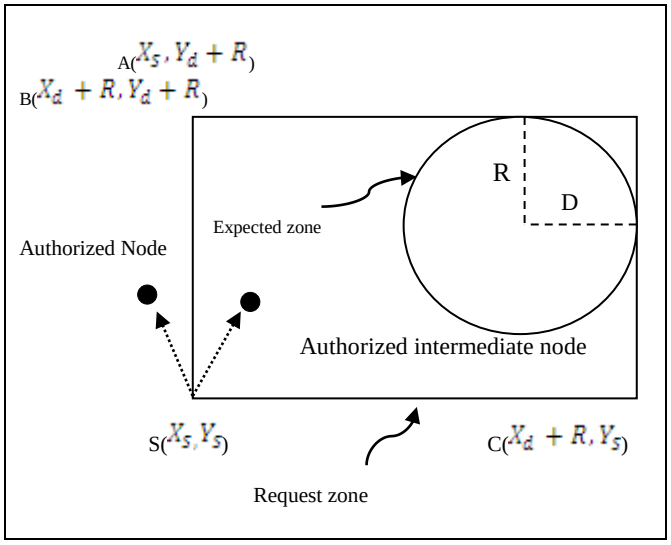

Figure 4 LAR Scheme 1

In this algorithm node S defines the rectangular region comprising Source node and Expected Zone. Therefore, intermediate nodes only within that specific request zone region will forward the route discovery packets.

3.3.2 LAR Scheme 2

This scheme is used for routes with shorter physical distance between source and destination node. Source node computes the distance to the destination and sends it to all its neighbors. Neighbors calculate their distance to the destination. If it is less than the distance sent, the neighbors will send the new distance to their neighbors until RREQ reaches to destination. Destination node sends route reply to source similar to LAR 1 scheme.

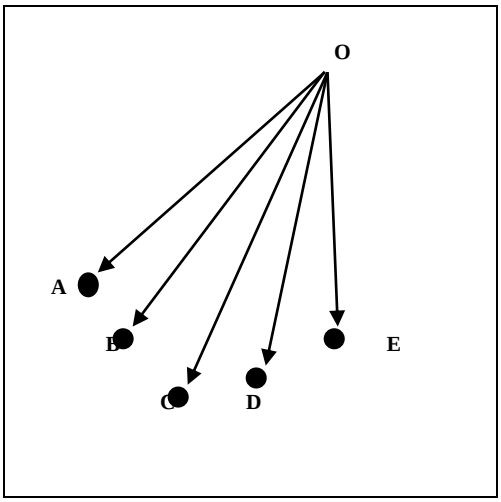

Figure 5 LAR Scheme 2

4. Performance Metrics

4.1 Throughput

It is a dimensional parameter of the network which gives the amount that how many data packets can be processed in a given amount of time and whether the data packets are correctly delivered to the destinations.

4.2 Average end to end delay

The average end-to-end delay of data packets is the time interval between the data packet generation time and the time when the last bit arrives at the destination.

4.3 Routing Overhead

Protocol overhead is the additional bandwidth used by a communication protocol. LAR is mainly designed for reducing the overhead between the nodes.

5. Conclusion

This paper discussed that how routing information can be used to reduce the routing overhead. Two types of Location-

Aided Routing protocols are presented showing the delivery of data packets in two different ways. Use of location information significantly reduces the routing overhead and throughput gets increased as compared to the protocols which do not use location information. LAR protocol also reduces the route discovery area. Various techniques of LAR have also been discussed along with their features and vulnerabilities. So time management needs to be done to improve efficiency of various routing protocols.. Thus it can be concluded that LAR can become a preferred mechanism in route discovery in MANET.

Table 1.1 Comparative study of existing LAR protocols

LAR Protocol	Advantages	Disadvantages
PLAR	Less overhead than LAR Efficient for High speed mobile nodes	Not suitable for vehicular adhoc networks
LAHRP	Optimizes bandwidth usage of MANETs by reducing the routing overload Less energy consumption	Increases the size of routing matrix held by master node.
LAR^2P	Improved robustness and lower message complexity than LAR Routing maintenance	Only suitable for low average hop-count
ILAR	Reduced number of route discovery packets and increased average route lifetime.	__
DBLAR	More delivery ratio and less overhead than LAR	Vulnerable to attacks

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