IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-3, Issue-1 E-ISSN: 2347-2693

Analysis of Location Aided Routing Protocols for MANETs: A Literature Survey

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www.ijcaonline.org

Received: Dec /26/2014 Revised: Jan/8/2015 Accepted: Jan/20/2015 Published: Jan/31/2015

ABSTRACT- A Mobile Ad-hoc Network (MANET) consists of wireless hosts that may have various degree of mobility. Movement of hosts resulting in a change of topology which require some mechanism establishing the fresh route through mobile nodes and also determining new routes in case of failures. Several routing protocol based on routing information update mechanism, use of temporal information, routing topology, and utilization of specific resources. Proactive and reactive routing protocols have already been proposed based on routing information update mechanism for Ad-hoc networks. Location Aided Routing (LAR) can be classified as the routing protocol based on specific resources like Global Positioning System. LAR is a routing 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 takes the advantage of resource like GPS coordinates to identify a possible location of the destination node. Based on this information, LAR defines a portion of the network which called a request zone which will be subject to the limited flooding, thus reducing the total number of the control packet travelling through the network during the route discovery process. LAR-I algorithm, which determine the request zone and the expected zone in the process of route discovery. The significant communication overhead can be avoided if the routing strategy is changed. Different strategy of request zone can be used for that in Location Aided Routing e.g., Triangle and Rectangle request zone. Performance of MANET widely depends on the node mobility which was important parameter.

Keywords — LAR, Routing Protocol, GPS, Request Zone

I. INTRODUCTION

Wireless networks emerged in the 1970's, since then they have became increasingly popular. The reason of their popularity is that they provide access to information regardless of the geographical location of the user. They can be classified into two categories: infrastructure and infrastructureless networks. Infrastructure wireless networks, also known as cellular networks, have permanent base stations which are connected to other base stations through links. Mobile nodes communicate with another one through these base stations. Infrastructureless wireless networks, also known as ad hoc wireless networks, are a collection of wireless nodes that does not have any predefined infrastructure or centralized control such as base stations or access points [1].

Ad hoc wireless networks are different from other networks because of following characteristics: absence of centralized control, each node has wireless interface, nodes can move freely which results in frequent changes in network topology, and nodes have restricted amount of resources and lack of symmetrical links.

In wired networks, shortest path is usually obtained with distance vector or link state routing protocols. These protocols do not perform well in ad hoc wireless networks because wireless networks have limited bandwidth and there is not such central control. Therefore, modifications to these routing protocols or entirely new routing protocols are required for the ad hoc wireless networks [1, 2 and 3] .

In recent developments of routing protocols, location-based routing protocols exhibit better scalability, performance and robustness against frequently changing topology of the networks. Location-aided routing protocols use the geographical position of nodes to make routing decisions, which results in enhanced efficiency and performance. These protocols need that a node be able to obtain its own geographical position and the geographical position of the destination node. This information is obtained by means of Global Positioning System (GPS) and location services. The routing decision at each node is made based on the destination's position contained in the packet and the position of the neighbour nodes.

II. CLASSIFICATION OF ROUTING PROTOCOL

Table-driven, on-demand and hybrid routing protocols are three main categories of routing protocols for ad hoc wireless networks.

A. Table driven routing algorithms

Destination Sequenced Distance Vector (DSDV), Clustered Gateway Switch Routing (CGSR), Wireless Routing Protocol (WRP).

Table driven routing algorithms are also called proactive algorithms. Protocols that use this algorithm find all paths between source-destination pairs in a network and form the newest path with periodic route updates. Update messages are sent even if there are no topological changes. The protocols which are in this category are developed by changing distance vector and link state algorithms. These protocols store routing information in routing tables and give result very slowly because of periodic update of tables. This working strategy is not very suitable for wireless ad hoc networks because of a great deal of routing overload [2].

B. On demand routing algorithms

Dynamic Source Routing (DSR), On-Demand Distance Vector Routing (AODV) , Temporally Ordered Routing Algorithm (TORA), Zone Routing Protocol (ZRP).

Unlike table driven algorithms, on demand routing algorithms do not form route information among nodes. Routes are founded only in case of necessity. Routes are formed only when needed, in other words when any of the nodes wants to send a packet. Therefore, routing overload is less than table driven algorithms. However, packet delivery fraction is low because every node does not keep updated route information. Dynamic source routing (DSR) :In this algorithm, sender node determines the entire route of sent packet and adds the determined route information to the header of packet. This process can be made as static or dynamic. DSR protocol uses dynamic source routing. DSR algorithm does not send periodic updates. However, there is routing overload because all route information is added into each data packet. This overload increases in state of mobility and traffic density.

C. Hybrid routing algorithms

Multi Point Relaying (MPR) based algorithms, Position based algorithms: Directional routing algorithm (DIR), most forward within radius (MFR), geographic distance routing (GEDIR), distance routing effect algorithm for mobility (DREAM).

Hybrid routing algorithms aim to use advantages of table driven and on demand algorithms and minimize their disadvantages. Position based routing algorithms that is classified in the hybrid routing algorithms category include the properties of table driven and on demand protocols and are usually interested in localized nodes. Localization is realized by GPS that is used to determine geographical positions of nodes. Position changes which occur because of nodes mobility in MANET cause changes in routing tables of nodes. The GPSs, which are embedded in nodes, are used to update information in tables in position-based algorithms. That makes position-based algorithms different from the table driven and on demand algorithms.

III. LITERATURE REVIEW

Ko and Vaidya [4] presented *Location-Aided Routing* (LAR) protocol which uses the location information to identify the request zone and expected zone. Request zone in this protocol is the rectangular area including both senders as well as receive. By declining the search area, this protocol leads to the decrease in routing overheads.

Zaruba, Chaluvadi and Suleman [5] proposed *LABAR (Location Area Based Ad-hoc Routing)* protocol. It requires only a subset of nodes to know their exact location forming location areas around these nodes. Nodes that are enabled with GPS equipment are referred to as G-nodes. G-nodes are interconnected into a virtual backbone structure to enable efficient exchange of information for the mapping of IP addresses to locations. This protocol is a combination of proactive and reactive protocols, because a virtual backbone structure is used to disseminate and update location information between G-nodes, while user packets are relayed using directional routing towards the direction zone of the destination.

Karp and Kung [6] proposed *GPSR (Greedy Perimeter Stateless Routing)* which uses the location of node to forward the packets on the basis of distance. The packets are forwarded on a greedy basis by selecting the node closest to the destination. This procedure continues until the destination is reached. In some cases the best path may be through a node which is farther in distance from the destination node. In such scenario right hand rule is applied to forward around the obstacle and resume the greedy forwarding as soon as possible.

Tzay and Hsu [7] presented a location based routing protocol called *LARDAR*. Firstly, it uses the location information of destination node to predict a smaller triangle or rectangle request zone that covers the position of destination in the past. The lesser route discovery space reduces the traffic of route request and the probability of collision. Secondly, in order to adapt the exactness of the estimated request zone, and reduce the searching range, it applied a dynamic adaptation of request zone technique to trigger intermediate nodes using the location information of destination node to redefine a more precise request zone. Finally, an increasing –exclusive search approach is used to redo route discovery by a progressive increasing search angle basis when route discovery failed.

Mohammad A. Mikki [8] introduced an *Energy Efficient Location Aided Routing (EELAR)* Protocol for MANETs that is based on the Location Aided Routing (LAR). EELAR makes significant reduction in the energy consumption of the mobile nodes batteries by limiting the area of discovering a new route to a smaller zone. Thus, control packet overhead is considerably condensed. In

EELAR a allusion wireless base station is used and the network's
circular area cantered at the base station is divided into six equal sub-areas. At route discovery as an alternative of flooding control packets to the whole network area, they are swamped to only the sub-area of the destination mobile node. The base station provisions locations of the mobile nodes in a position table.

Karim El Defrawy and Gene TsudikIn [9] addressed some interesting issues arising in suspicious MANETs by designing an *anonymous routing framework (ALARM)*. It uses node's current locations to construct a secure MANET map. Based on the recent map, every node can decide which other nodes it wants to communicate with. ALARM takes benefit of some advanced cryptographic primitives to achieve node verification, data integrity, anonymity and intractability (tracking-resistance). It also offers opposition to certain insider attacks.

Haiying Shen and Lianyu Zhao [10] proposed an *Anonymous Location-based Efficient Routing protocol* (ALERT) to offer high anonymity protection at a low cost. ALERT dynamically partitions the network field into zones and randomly chooses nodes in zones as intermediate relay nodes, which structured a non-traceable anonymous route. Furthermore, it hides the data initiator/receiver among many initiators/receivers to reinforce source and destination anonymity protection. ALERT achieves better route anonymity protection and lower cost compared to other anonymous routing protocols. Also, ALERT achieves analogous routing effectiveness to the GPSR geographical routing protocol.

IV. LOCATION AIDED ROUTING

One of the routing algorithm in MANET is Location Aided Routing(LAR) which uses the location information of the host in the network. When a node S needs to find to route to node D, Node S broadcasts route request message to all it neighbors thereafter node S will be referred to as the sender and node D as the destination. A node say X, on receiving a route request message, compares the wanted destination with its own identifier, if it matches means the request is for a route to itself (i.e., node X). Otherwise, node X broadcasts the request to its neighbors. To avoid redundant transmissions of route requests a node X only broadcasts a particular route request once(repeated reception of a route request is detected using sequence number). It is easy to detect the repeated request because each message originated from source node is numbered for identification purpose[4].

When the route request is in progress the route request is propagated to various nodes, the path traversed by the request is included in the forwarding route request packet. Using the flooding approach, provided that the desired destination is reachable from the sender, the destination should eventually receive a route request message[4]. On receiving the route request, the intended node responds by sending a route reply message to the sender the route reply message follows a path that is obtained by reversing the path followed by the route request received by D (the route request message includes the path traversed by the request).

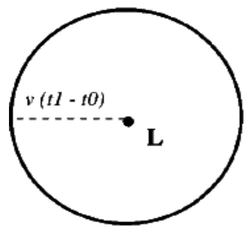
There may be some situation that the destination will not receive a route request message (for instance, when the destination is unreachable from the sender or route requests are lost due to transmission errors). In such cases, the sender needs to be able to re-initiate the process of route discovery. Consequently, when a sender initiates route discovery, it sets a timeout. If during the Route discovery is initiated either when the sender S detects that a previously determined route to node D is broken, or if S does not know a route to the destination. After route establishment when node S sends a data packet towards a particular route, a node on that path returns a route error message, if the next hop on the route is broken. When node receives the routing error message, it initiates the process of route discovery for destination D. Using the above approach, observation was made that the route request would reach to every node which are reachable from node S[4]. Using location information, we attempted to reduce the number of nodes to whom route request is propagated

A. Location Information

The protocol termed as Location-Aided Routing (LAR), as it makes use of location information to reduce routing operating cost. Location information used in the LAR protocol may be provided by the Global Positioning System (GPS). With the availability of GPS, it is possible for a mobile host to know its physical location. In reality, position information provided by GPS includes some amount of error, which is the discrepancy between GPS-calculated coordinates and the real coordinates[4].

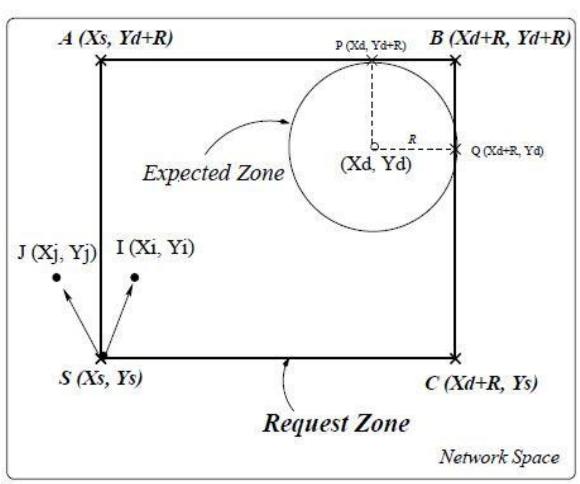
B. Expected zone

Suppose we have a node S that needs to find a route to node D. Assume that node S knows that node D was at location L at time t0 , and that the current time is t1 . Then, the "expected zone" of node D, from the viewpoint of node S at time t1 , is the region that node S expects to contain node D at time t1 . Node S can determine the expected zone based on the knowledge that node D was at location L at time t0 . For instance, if node S knows that node D travels with average speed v, then S may assume that the expected zone is the circular region of radius v(t1 – t0), centered at location L. If actual speed happens to be larger than the average, then the destination may actually be outside the expected zone at time t1 . Thus, expected zone is only an estimate made by node S to determine a region that potentially contains D at time t1 . If node S does not know a previous location of node D, then node S cannot reasonably determine the expected zone in this case, the entire region that may potentially be occupied by the ad hoc network is assumed to be the expected zone[4]. In this case, the algorithm reduces to the basic flooding algorithm. In general, having more information regarding mobility of a destination node, can result in a smaller expected zone.



C. Request zone

Consider node S that needs to determine a route to node D. LAR algorithms use flooding with one modification. Node S defines a request zone for the route request. A node forwards a route request only if it belongs to the request zone. To increase the probability that the route request will reach node D, the request zone should include the expected zone [4]. We assume that node S knows that node D was at location (x_d, y_d) at time t0 . At time t1 node S initiates a new route discovery for destination D. We assume that node S also knows the average speed v with which D can move. By means of this, node S defines the expected zone at time t1 to be the circle of radius R=v (t1 – t0) centered at location (x_d, y_d). The source node S can thus determine the four corners of the expected zone. S includes their coordinates with the route request message transmitted when initiating route discovery process[4]. When a node receives a route request, it rejects the request if the node is not within the rectangle request zone specified by the four corners included in the route request. When node D receives the route request message, then node replies by sending a route reply message.The destination D on receiving route request will include its current location and current time in the route reply message. When node S receives this route reply message (ending its route discovery), it account the location of node D[4].



V. CONCLUSION

The paper introduces different categories of ad-hoc routing protocols and reviewed several locations based routing protocols. These Location based routing protocols differ with each other in a ways of finding and maintaining the routes between source to destination but share the common aim of reducing control packet overhead ,maximize throughput, minimize the power consumption and end-to end delay.

In Location Aided Routing protocol location information may be used to reduce the routing overhead in ad hoc networks. Location-aided routing (LAR) protocols limit the search for a route to the so-called request zone, determined based on the expected location of the destination node at the time of route discovery. Optimization of request zone and adaptation of request-zone dynamically is one of the technique to increase the efficiency and throughput and reduce the message overheads.

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