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Enhanced Energy Aware Geographic Routing Protocol in MANET: A Review

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Abstract: *Mobile ad hoc networks (MANET) are characterized by multi-hop wireless links and resource constrained nodes. One of the major challenges in mobile ad hoc networks (MANETs) is link failures due to mobility. Because nodes in a MANET act as routers for any ongoing packet communication and have limited transmission ranges, the communication links are broken, and packet losses occur. To improve network lifetime, energy balance is an important concern in such networks. Geographic routing has been widely regarded as efficient and scalable. However, it cannot guarantee packet delivery in some cases, such as faulty location services. The matter gets even worse when the nodes on the boundaries of routing holes suffer from excessive energy consumption, since geographic routing tends to deliver data packets along the boundaries by perimeter routing. This paper will be a basis for study in the domain of geographic routing for the new researcher point of view.*

Keywords: *MANET, geographic routing, energy efficient, location information.*

I. Introduction

An ad-hoc network, as the name suggests, is a network formed by nodes connected arbitrarily for some temporary time. They provide a powerful paradigm for modeling open self configuring wireless networks and seem so appropriate to use in the fourth generation of mobile networks. Obviously, a convergence of all these technologies with 3G/4G [18] mobile networks will probably lead to various integrated solutions.

A Mobile Ad-hoc network (MANET) is consists of mobile routers connected wirelessly to each other where each node is free to move. This results in a continuously changing topology. Some examples of the possible uses of ad hoc networking include business associates sharing information during a meeting, soldiers relaying information for situational awareness on the battlefield and emergency disaster relief personnel coordinating efforts after a hurricane or earthquake.

In recent years, geographic routing algorithms have been extensively studied due to the popularity and availability of positioning services such as the global positioning system (GPS). Geographic routing is a promising candidate for large-scale wireless ad hoc networks due to its simplicity and scalability and takes advantage of the location information of the nodes are the very valuable for wireless networks. Since geographic routing does not require a route management process, it carries a low overhead compared to other routing schemes, such as proactive, reactive, and hybrid topology based routing protocols. Geographic routing protocols work on the assumption that every node is aware of its own position in the network; via mechanisms like GPS or distributed localization schemes and that the physical topology of the network is a good approximation of the network connectivity. In other words, these routing protocols assume that if two nodes are physically close to each other, they would have radio connectivity between them, which is true in most cases. Hence the protocols use node location information to route packets from source to destination. One big advantage of geographic routing schemes is the fact that there is no need to send out route requests or periodic connectivity updates. This can save a lot of protocol overhead and consequently, energy of the nodes. The most significant difference between MANETs and traditional networks is the energy constraint. Some applications such as environment monitoring need MANETs to run for a long time. Therefore, extending the lifetime of MANETs is important for every MANET routing protocol. However, most geographic routing algorithms take the shortest local path, depleting the energy of nodes on that path easily. The nodes located on the boundaries of holes may suffer from excessive energy consumption since the geographic routing tends to deliver data packets along the whole boundaries by perimeter routing if it needs to bypass the hole.

There should be a mechanism at node for robust communication of high priority messages. This can be achieved by keeping nodes all the time powered up which makes nodes out of energy and degrades network life time. Also, there can be a link or node failure that leads to reconfiguration of the network and re-computation of the routing paths, route selection in each communication pattern results in either message delay by choosing long routes or degrades network lifetime by choosing short routes resulting in depleted batteries. Therefore the solutions for such environments should have a mechanism to provide low latency, reliable and fault tolerant communication, quick reconfiguration and minimum consumption of energy. Routing protocols have a critical role in most of these activities. To measure the suitability and performance of any given protocol, some metrics are required. On the basis of these metrics any protocol can be assessed against its performance [3].

The remaining part of this survey paper is organized as follows:-In section II, we will discuss the taxonomy related to Geographic routing. In section III literature review in the field of geographic routing mechanism and in section IV we describe research challenges for geographic routing in MANET, the comparative study of previous protocols given in section V and in section VI; we will conclude the paper and give the future scope of this paper.

II. Literature Review

A number of research has been conducted on the geographic routing in MANET but still current result are not appropriated for MANET and geographic routing for MANET is still an open problem for research work. In this section, we briefly present routing protocols in MANETs. Then, we focus particularly on energy aware geographic routing since it is the Early research of geographic routing includes DREAM [1] and LAR [2] that proposed constrained flooding. The expected zone is defined by predicting the boundary of the destination node's movement. In both protocols, prediction is made based on the time difference between sending data and the location information's update, as well as the destination node's speed. We adopt this approach in our routing protocol and describe it in the third section. In the LAR protocol, before the transmission of a data packet, the source node finds a route by flooding routing packets in its *request zone*. In the DREAM protocol, however, according to the location information, the data packet is flooded in a restricted directional range without sending a routing packet. Although this kind of forwarding effectively guarantees delivery, its energy use is notably high, especially in large-scale networks. Recently, *Local maxima* in geographic routing have received much attention. Many routing protocols for planar network graphs are presented for solving this problem, such as GFG [3], GPSR [4], GOAFR+ [5] and CLDP [6].

In the following, we review the shared characteristics of these geographic routing algorithms. Geographic routing schemes use greedy routing where possible. In greedy routing, packets are stamped with the position of their destination; and a node forwards a packet to a neighbor that is geographically closer to the destination. Local maximum may exist where no neighbor is closer to the destination. In such cases, greedy forwarding fails, and making progress toward the destination requires another strategy. In particular, the packet needs only to find its way to a node closer to the destination than the local maximum; at that point, greedy routing may once again make progress.

Note that if the graph is not planar, face routing may fail. Wireless networks connectivity graphs typically contain many crossing edges. A method for obtaining a planar sub graph of a wireless network graph is thus needed. Greedy routing operates on the full network graph, but to work correctly, face routing must operate on a planar sub graph of the full network graph. Geographic routing algorithms planarize graphs using two planar graph constructs that meet that requirement: the Relative Neighborhood Graph (RNG) and the Gabriel Graph (GG). The RNG and GG give rules for how to connect vertices placed in a plane with edges based purely on the positions of each vertex's single-hop neighbors. Up to the present, literature, such as GOAFR+, CLDP and LCR [15], has focused on methods of deleting these crossing links.

However, there are several drawbacks to pure geographic routing. In certain circumstances, one cannot guarantee delivery by greedy routing, for example, when there is the rapid movement of nodes. Because of this, the location information of a destination node is rather inaccurate. Secondly, greedy routing is a single-path transmission process which means once the process drops a data packet the whole routing fails. Thirdly, there have been several schemes to overcome the *Local maxima*.

All the schemes can be classified into two categories: perimeter routing [5, 6] and the back pressure rule [7, 8].

Mobile networks use a power-aware routing protocol in [17]. However, to save energy as much as possible, its iterative relay process will result in unacceptable end-to-end delay. Due to the non-linear attenuation of wireless signals, it is possible that one hop consumes more energy than multiple hops. Yet it can be impractical to change from one hop to several, following the mechanism in [17]. The end-to-end delay may increase significantly, especially in a high-density network.

III. Challenges in Manet

The major challenges [1] faced by this architecture can be broadly classified as:

1) Dynamic topologies: Nodes are free to move arbitrarily; thus, the network topology--which is typically multi hop, may change randomly and rapidly at unpredictable times, and may consist of both bidirectional and unidirectional links.

2) Device discovery- Identifying relevant newly moved in nodes and informing about their existence need dynamic update to facilitate automatic optimal route selection.

3) Bandwidth-constrained-variable capacity links: Wireless links will continue to have significantly lower capacity than their hardwired counterparts.

4) Energy-constrained operation: Some or all of the nodes in a MANET may rely on batteries or other exhaustible means for their energy. For these nodes, the most important system design criteria for optimization may be energy conservation.

5) IP-Layer Mobile Routing-An improved mobile routing capability at the IP layer can provide a benefit similar to the intention of the original Internet, viz. "an interoperable internetworking capability over a heterogeneous networking infrastructure".

6) Limited physical security: Mobile wireless networks are generally more prone to physical security threats than are fixed-cable nets. The increased possibility of eavesdropping, spoofing, and denial-of-service attacks should be carefully considered.

7) Diffusion hole problem: The nodes located on boundaries of holes may suffer from excessive energy consumption since the geographic routing tends to delivers data packets along the hole boundaries by perimeter routing if it needs to bypass the hole. This can enlarge the hole because of excessive energy consumption of the node boundaries nodes.

IV. Comparative Study

As per literature survey we have done yet there are many parameter in the geographic routing based techniques which we can compare and put them in such a graph which will be helpful for the future researchers. There are various protocols are available in this area. So we are doing a comparative study of main geographic routing protocols, listed in tables based on characteristics and advantages and disadvantages-

Geographic routing technique	**Major characteristics**	**Route Discovery**
Zone Based Routing	• Use a fixed zone-based partition scheme to partition the network. • Usage of source based routing. • ZBR has a good scalability.	• Source based route request.
Global Positioning System	• GPS-free has been developed that provides knowledge of the geometric location of nodes in a MANET	• It uses optimization technique for Route Discovery.
Location Aided Routing	• Region stability is based on the expected zone as well as request zone.	• Interregional route discovery. • Intraregional route discovery
DREAM Protocol	• The data packet is flooded in a restricted directional range without sending a routing packet.	• It use discount factor for RREQ.
Energy aware geographic routing protocol	• It is based on the expected zone and forwarding area. It uses greedy approach and when it fails it switch to the perimeter routing.	• Source node multicast RREQ packet.

LINK STABILITY TECHNIQUES	**ADVANTAGES**	**DISADVANTAGES**
Zone Based Routing	• lower overhead, • lower probability of link breakage • higher throughput	• Being a Proactive protocol it consumes high bandwidth.
Location Aided Routing	• It has minimized the size of the route discovery process by defining the range of the destination node.	• Control complexity is higher then GPSR.
DREAM Routing Protocol	• This kind of forwarding effectively guarantees delivery. • Its energy use is notably high, especially in large-scale networks.	• Packet loss ratio is higher then GPSR.
GPSR Protocol	• Data forwarding overhead is low. • Local maxima are easily found.	• It induces great traffic. • Group Leader is Single Point of Failure. • Its packet delivery ratio is less than EGR.
Energy Aware Geographic Routing Protocol	• It has higher packet delivery ratio when compared with GPSR.	• It suffers from diffusion hole problem.

V. Conclusion and Future Scope

We have started this work by a simple thing keeping in mind to detect the parameter which affects the geographic routing in a network. This paper described basic concepts and functionalities of the energy constrained geographic routing based routing techniques and reviewed the work carried out in the areas of MANET. The detailed paper review major geographic based techniques and also put the comparative study of few of them and also tabulate on the basis of their main characteristics. In future there is a need to develop more enhanced energy efficient geographic routing protocols which will also good in terms of high packet delivery ratio, increased network lifetime and delay time in packet delivery should be minimized.

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