An Improved Opportunistic Geographical Location Aided Routing (IOGLAR) in Mobile Ad hoc Networks

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Abstract—Mobile Ad hoc Networks (MANETs) are used for node to node communications for a fixed purpose under mobile conditions. Different applications have found MANETs useful for communication tasks. The challenges while such a communication is performed are plenty. Although a number of protocols have facilitated the communication between mobile nodes, there is an unavoidable interruption in the network due to link failures. In this paper, we have investigated the application of opportunistic routing in Location Aided Routing (LAR) protocol. Also we propose an enhancement on the LAR protocol to improve the linkability while routing. Simulations are performed by the network simulator to compare and analyze the LAR and the IOGLAR protocols.

Index Terms— Communication, location, link, mobile ad hoc network, performance analysis.

1. INTRODUCTION

Mobile ad hoc networks remain as a very useful and promising technology for communication in military, commercial and emergency services. Furthermore, an increasing number of devices such as laptops, personal digital assistants (PDAs), pocket PCs, tablet PCs, smart phones, MP3 players, digital cameras, etc. are provided with short-range wireless interfaces. In addition, these devices are getting smaller, cheaper, more user friendly and more powerful.

An example for a MANET is shown in figure 1, where the linked nodes are the ones within the transmission range of each other. In order to send information from a source to a destination, all linked nodes can be used to forward information towards the destination.

The main advantages why MANETs are extensively used are because they are: autonomous; allow portability and their lack of a fixed infrastructure.

The advantages however have also introduced some difficult issues into the network. These issues are quite challenging to be completely removed from the network. Dynamically changing topology is one of the greatest problems faced by the network. Hence a good number of communication protocols have evolved with an aim to overcome the difficulties and to facilitate efficient communication.

Location Aided Routing (LAR) is one of the many protocols proposed for the efficient routing. Opportunistic routing is another type where the immediate and available nodes are chosen for relaying data to the destination. In this paper, we incorporate the opportunistic routing into the LAR in a MANET and improve the linkability of the network. This is presented as the Improved Opportunistic Geographical Location Aided Routing (IOGLAR). The remaining sections of this paper include: related work; proposed IOGLAR and simulation analysis and discussion followed by the conclusion.
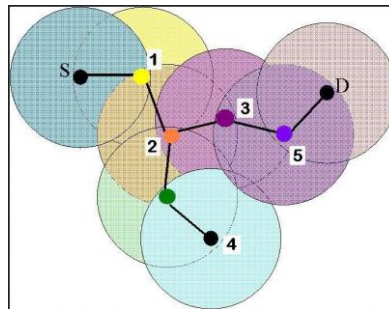
Fig. 1. Example of a MANET

2. RELATED WORK

Some of the protocols related to LAR are discussed here. Geographic routing (location/position-based routing)[1] for communication in ad-hoc wireless networks has recently received increased attention, especially in the energy saving area. In geographic routing, each node has knowledge of its own geographic information either via Global Positioning System (GPS) or network localization algorithms, and broadcasts its location information to other nodes periodically. The next relay node is selected only based on the location of the source node, its neighbors and its ultimate destination (contained in the data packet). Therefore, geographic routing is generally considered to be scalable and applicable to large networks[2].

a. Location Aided Routing

Location based routing[6] is usually, as its name suggests, performed based on the current location of the nodes in the network. In the location aided routing (LAR) algorithm, the request zone (the area containing the circle and two tangents) is fixed from the source, and nodes, which are not in the request zone, do not forward a route request to their neighbors. In LAR scheme, the source or an intermediate node A will forward the message to all nodes that are closer to the destination than A. The control part of LAR protocol is, essentially, equivalent to DSR flooding protocol [BMJHJ], restricted to the request zone. Therefore all nodes inside an area receive the routing packet, and the algorithm is therefore of partial flooding nature, causing excessive flooding rates.

b. Opportunistic Routing

ExOR is an integrated routing and MAC protocol that increases the throughput of large unicast transfers in multi-hop wireless networks. A source node has a packet that it wishes to deliver to a distant destination. Between the source and destination are other wireless nodes willing to participate in ExOR. The source broadcasts the packet. Some sub-set of the nodes receives the packet. The nodes run a protocol to discover and agree on which nodes are in that sub-set. The node in the sub-set that is closest to the destination broadcasts the packet. Again, the nodes that receive this second transmission agree on the closest receiver, which broadcasts the packet. This process continues until the destination has received the packet[5].

ExOR's design faces the following challenges. The nodes that receive each packet must agree on their identities and choose one forwarder. The agreement protocol must have low overhead, but must also be robust enough that it rarely forwards a packet zero times or more than once. Finally, ExOR chooses the forwarder with the lowest remaining cost to the ultimate destination.

3. PROPOSED WORK

The proposed IOGLAR uses a fairly sophisticated routing strategy for routing information to the destination. Every data attaches to the packet header the location information of the destination. When the source finds an available node to send the data to, it first checks for the link status of the node using the received signal strength of the node of interest. This does not require any request-reply mechanism because all nodes can hear all the other nodes within their range, which is an assumption in the opportunistic routing mechanism. The operation of the proposed scheme is showed in the figure 2.

Linkability is a factor proposed to improve the location aided routing. The key factors used to assess the linkability of the nodes are Received Signal Strength (RSS) and mobility. It is calculated by the equation (1).

$$\chi = RSS(n) / Velocity(n). \quad\quad (1)$$

4. SIMULATION ANALYSIS

Network Simulator (NS) is a simulation tool targeted at both wired and wireless (local and satellite) networking research. NS is a very promising tool and is being used by universities and researchers. In this report we provided information how to install NS2 on UNIX and Windows. Then we discussed how to use NS2 to simulate wired and wireless networks. A simple but limited method is to combine the existing components with OTcl scripts; a complex but powerful method is to implement new components into NS2 using C++.

To analyze the efficiency of IOGLAR, the parameters in Table 1 are used for the simulation in the network simulator.

TABLE I. SIMULATION PARAMETERS

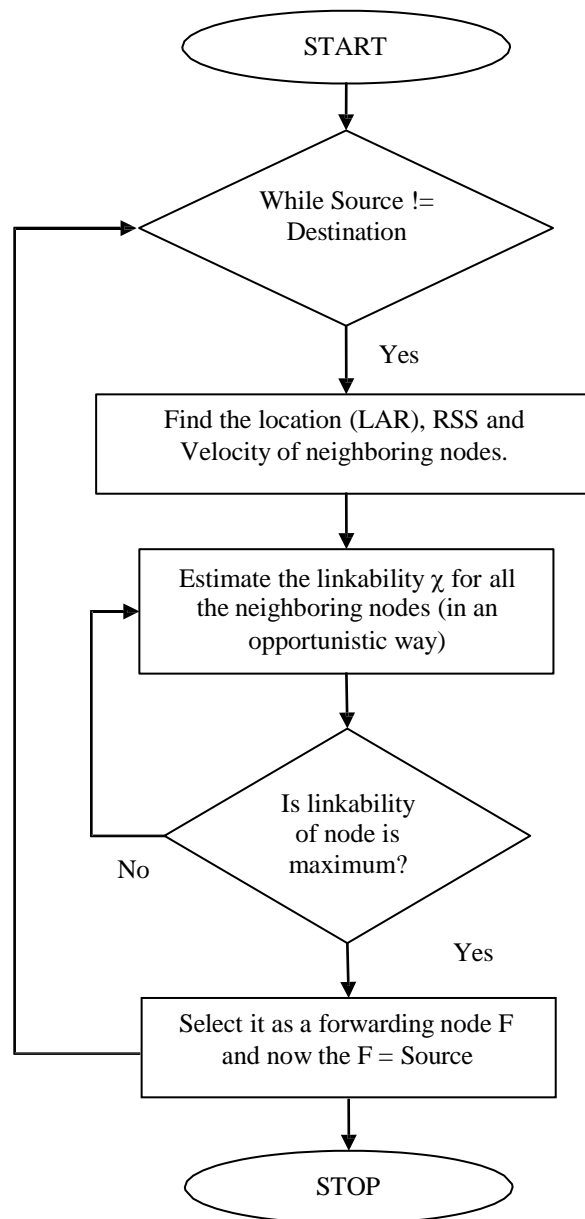| Parameter	Value
Simulation Time	50 ms
Number of nodes	50
Routing scheme	LAR
Traffic model	CBR
Mobility model	Random way point mobility model
Mobility speed	50 m/s
Simulation Area	1000×1000
Transmission range	250m

Fig. 2. Working of the IOGLAR

a. Network Throughput

Throughput means the number of packets delivered successfully in a network. For LAR and IOGLAR the throughput is plotted in figure 3. It is obvious that the throughput is higher for the proposed IOGLAR than the LAR scheme.

b. Packet Loss

Packet loss is the total number of packets lost during communication. Figure 4 shows that the total packets lost by IOGLAR are much lesser when compared with the LAR protocol.
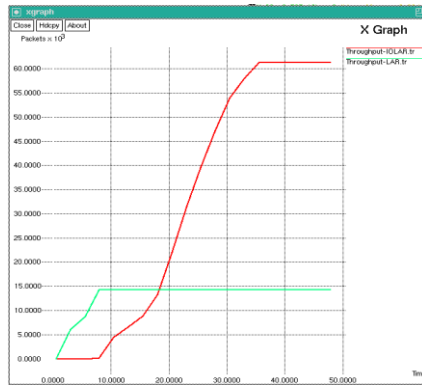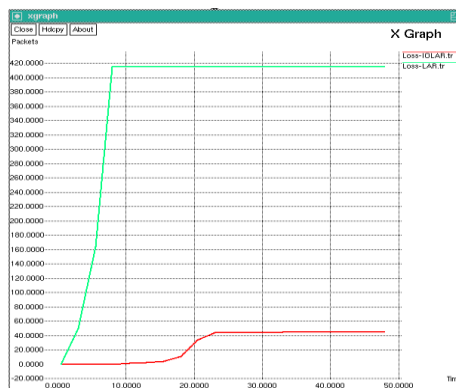
Fig. 3. Throughput of LAR and IOGLAR

Fig. 4. Packet Loss of LAR and IOGLAR

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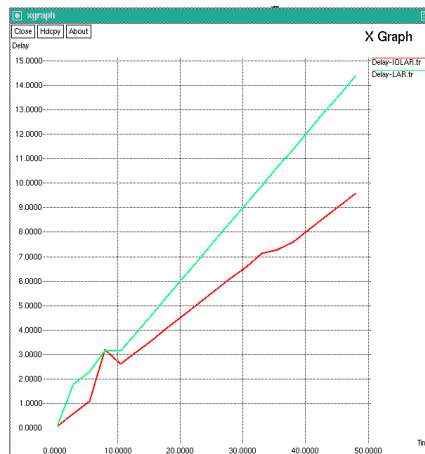   *l*
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Fig. 5. Delay of LAR and IOGLAR

The total delay of the network is minimized by the IOGLAR protocol when compared to the LAR. The overall performance of the IOGLAR is better when compared to the LAR because of the opportunistic routing mechanism incorporated and also because of the linkability check at every communication operation.

5. CONCLUSION

The proposal, design, simulation and analysis of the Improved Opportunistic Geographical Location Aided Routing (IOGLAR) are presented in this paper. Conventional location aided routing is performed along with the opportunistic routing with greater linkability in IOGLAR. Through simulations in the network simulator we have proven that the IOGLAR is more efficient when compared to LAR in terms of quality of service. Parameters like throughput, delay and loss have been presented as a proof of concept.

Future works can incorporate security to the LAR and IOGLAR routing protocols. Tiny real time experiments can also be performed for extensive study on this protocol.

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