

Efficient Zone based Multicast Routing Protocol for Mobile Adhoc Networks



Engineering

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ABSTRACT

Mobile Adhoc network (MANET) is a collection of self-organized mobile nodes without using any type of infrastructure. The goal of a MANET routing protocol is to transfer the data packets from one point to another safely and in minimum time. In recent years, many efforts have been made in designing multicast protocol for MANETs. It is difficult to design the efficient multicast protocol due to management of group membership, data packets forwarding and a large network size. So, in this paper we propose an Efficient Geographic Multicast Protocol which provides high efficiency of data delivery keeping in view the time taken and group membership management due to the zone based network.

I. INTRODUCTION

A network is a group of two or more devices linked together and a network which uses wireless data connections for connecting network nodes is called a wireless network. Wireless networks run in either of two alternative modes, called "infrastructure" and "ad hoc" mode. Ad hoc mode allows a Wi-Fi network to function without a central wireless router or access point. So they are a viable alternative to infrastructure mode in a few situations. A wireless ad hoc network is a local area network (LAN) that refers to any set of networks where all devices have equal status on a network and are free to associate to any other ad hoc network device in link range. It is made up of multiple "nodes" connected by links. Each node participates in routing by forwarding data packets to other nodes, so the determination of the node, that is forwarding the data is made dynamic on the basis of network connectivity. The network must allow any two nodes to communicate by relaying the information via other nodes.

Now-a-days ad hoc networks are used commonly in our daily life. Some applications of ad hoc network include, people sitting in a conference room sharing documents and other information via their laptops and computer, Armed forces distributing any awareness information, small sensor devices located in animals and any other locations that collectively, monitor habitats and environmental conditions, also includes emergency services communicating in a disaster area, emergency medical services and sharing video updates of specific locations among people etc. [1][4][3].

A mobile ad hoc network (MANET) is a self-configuring network of mobile devices connected by wireless links as shown in Fig 1. Each device in a MANET is free to move independently in any direction as the topology changes rapidly and unpredictably. So, devices in MANETs will therefore change its links to other devices frequently. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger internet. MANET nodes are equipped with wireless transmitters and receivers using antennas. At a given point in time, depending on the nodes' positions and their transmitter and receiver coverage patterns, transmission power levels and co-channel interference levels, a wireless connectivity in the form of a random, multi-hop graph or "ad hoc" network exists between the nodes. This ad hoc topology changes with time as the nodes move or adjust their transmission and reception parameters [1][4][3].



Fig 1 Mobile Adhoc Networks

The main characteristics of MANET is its distributed operation as there is no background network for the central control of the network operations. The control of the network is distributed among the nodes of the network. When a node tries to send information to other nodes which is out of its communication range, the packet should be forwarded via one or more intermediate nodes. In MANET, each mobile node is an independent node. If one route becomes invalid, it is possible in MANET that another route earlier found could still be valid and thus it will save the routing protocol from initiating another route discovery procedure. This type of configuration and the rapid deployment of ad hoc networks made them suitable for many applications including emergency operations like natural disasters, military conflicts, emergency medical situations etc.

II. RELATED WORK

First generation MANETs were used for different military scenarios in early 1970's. Packet radio networks was the first ad hoc network system sponsored by DARPA (Defence Advanced Research Projects Agency). The DARPA initiated research on the feasibility of using packet-switched radio communications to provide reliable computer communication and came up with packet radio network (PRNET). The DARPA PRNET has evolved through the years (1973-1987) to be a robust, reliable, operational experimental network. The DARPA PRNET project includes network devices, routing protocols and protocols for automatic distributed network management. Second generation exist from 1980's to the mid 1990's and its main aim was the same as for the first generation ad hoc networks system i.e. aiding combat operations and to provide packet switched networking to the mobile battlefield elements in infrastructure-less environments. Now, the developments were focused on the further advancement of the previously build ad hoc network structure and it was beneficial in improving the radio performance by making them smaller, cheaper and power-thrifty also scalability of algorithms resilience to the electronic attacks. Third

generation adhoc network systems are also known as commercial adhoc network systems started in 1990's with the developments of Bluetooth – adhoc sensor networks and cheap radio cards for personal computers. Nowadays MANET's are designed mainly for military applications for example JTRS and NTDR [3].

Recently Multicast Routing Protocols such as tree based and mesh based are analysed. Tree-based protocols build tree structure for more efficient forwarding of packets to all the group members. Mesh based protocols create a multicast tree with some extra paths that can be used to forward multicast data packets when some of the links destroy. The main components of these protocols are given below:

- a) Group membership management: The group membership changes very frequent as each node may join or leave a multicast group randomly and this management becomes tougher as the group size or network size increases.
- b) Creation and maintenance of a tree- or mesh-based multicast structure: The tree-based structures are difficult to maintain in the presence of the movement of nodes and the change of multicast group membership, while the mesh-based group membership has the robustness at the cost of extra network resource consumption.
- c) Multicast packet forwarding: The multicast packets are forwarded along the existing tree or mesh structures, which often lead to break over the dynamic topology, especially in a large network having longer paths[3][4].

As we have seen many efforts were made to develop more efficient topology-aware protocols. The topology-based multicast protocols are generally not easy to scale to a larger network size, as the construction and maintenance of the tree or mesh structure involve high control overhead over a dynamic network [1].

III. ROBUST AND SCALABLE GEOGRAPHIC MULTICAST PROTOCOL (RSGM)

The RSGM protocol is based upon the two tier membership management and forwarding structure. At lower tier, square shaped zone structures built depending upon the position information. Foreach zone leader is elected. A leader collects the positions of the member nodes. At the upper tier;the leaders of the member zones report the zone memberships to the sources directly or through centre. The source forwards data packets to those zonesthat have group members. After the arrival of the packets at the member zones, they will be forwarded again to the local members through the leaders. In this protocol, it is assumed that every node is aware of its own position as the position can be found through the GPS [3][1][7][4][5].

Zone Construction and Maintenance

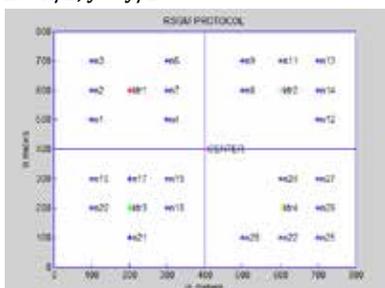
1) Zone construction:

The length of a side of the zone square is defined as zone size. (x_0, y_0) is the position of the virtual origin. In our scheme, a packet destined to a zone will also be forwarded towards its centre.

2) Centre construction:

The centre position (xc, yc) of a zone with co-ordinates (x,y) can be calculated as:

$$xc= x/2, yc= y/2$$



*Nodes ****Leaders *Centre
Fig 2 Zone Structure

3) On-demand leader election:

A leader will be elected in a zone only when the zone has group members in it. When a node M just moves into a new zone, if the Zone leader (Ldr) is unknown, M queries a neighbour node in the zone for Ldr. When failing to get Ldr information, M will announce itself as Ldr by flooding a leader message into the zone. Here we have elected the leader in all the 4 zones as :

- Ldr1= $(x/4, 3y/4)$
- Ldr2= $(3x/4, 3y/4)$
- Ldr3= $(x/4, y/4)$
- Ldr4= $(3x/4, y/4)$

4) Designing of Protocol:

First, construct the zone as described above. Nownext step is to define the centre using the above formula.At initial stage, we have to elect the leaders of all zones and they will be having all the information (its position co-ordinates, data) of the nodes lying in the respective zones. Data packets will be given to the nodes. At intermediate stage, a node will move to other zones then there are two possibilities: one is that it will be accepted by that zone as a node while the other possibility is that it will act as a leader there. In both the cases, data delivery should be safe and on time. After the movement of the node, the information is updated to the leader of that zone and also centrally so that in case of any data loss, data will be recovered. At the final stage, we will find that all nodes (moving or non-moving) are holding the same data that was assigned earlier. Also centre and the leaders of the zones are updated with the information.

IV.PERFORMANCE EVALUATION

A. Simulation Overview

i. We implemented the protocol for MANET within the MATLAB.The designed protocol is used to compare how fast the moving node deliver the data in different zones in both the cases, acting as a node or acting as a leader and it is measured in time (sec) in MATLAB. Fig2 shows the initial zone structure of the designed protocol. This protocol works in all the cases for which it is designed. We have created 4 zones having area 800*800 m with 28 random nodes evenly distributed among them.

V. SIMULATION RESULTS

Assumptions:

- a) Zone 1 is source zone for all the cases.
- b) There is no effect of location of moving nodes.

Results:

- i. The proposed protocol has been designed and tested under various environmental conditions and desired results have been achieved. Fig2, shows the initial zone structure of the designed protocol. This protocol works in all cases for which it is designed.
- ii. In Fig 3, the mobile node n4 moves from zone 1 to zone 2, and now its data is removed from zone 1 and it is accepted by zone 2. The information (position and data) of this node n4 is handed over to zone 2.Its information is updated by leader of zone 2 (Ldr2) and also updated centrally while the data of other zones remain unaltered.
- iii. In Fig 4, the mobile node n4 moves from zone 1 to zone 3, now its data is removed from zone 1 and it is accepted by zone 3. The information (position and data) of this node n4 is handed over to zone 3.Its information is updated by leader of zone 3 (Ldr3) and also updated centrally while the data of other zones remain unaltered.
- iv. In Fig 5, the mobile node n4 moves from zone 1 to zone 4, now its data is removed from zone 1 and it is accepted by zone 4. The information (position and data) of this node n4 is handed over to zone 4.Its information is updated by leader of zone 4(Ldr4) and also updated centrally while the data of other zones remain unaltered.
- v. In Fig 6, the mobile node n4 moves from zone 1 to zone2, now its data is removed from zone 1 and it is not accepted by zone 2. Now it declares itself as a leader in zone 2. The information (position and data) of this node n4 is switched to zone 2(as a leader itself). Itsinformation is also updated

centrally while the data of other zones remain unaltered.
 vi. In Fig 7, the mobile node n4 moves from zone 1 to zone3, now its data is removed from zone 1 and it is not accepted by zone3. Now it declares itself as a leader in zone 3. The information (position and data) of this node n4 is switched to zone 3 (as a leader itself). Its information is also updated centrally while the data of other zones remain unaltered.

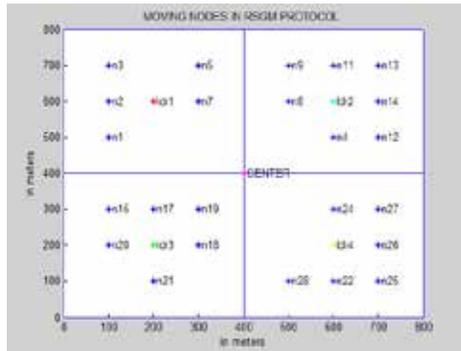


Fig 3

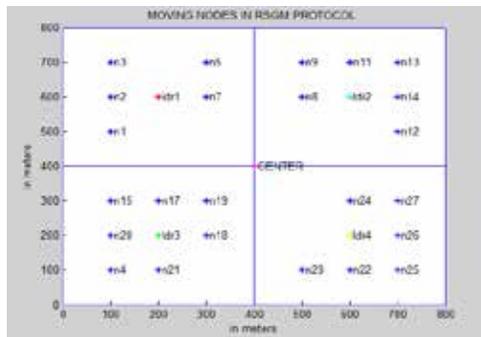


Fig 4

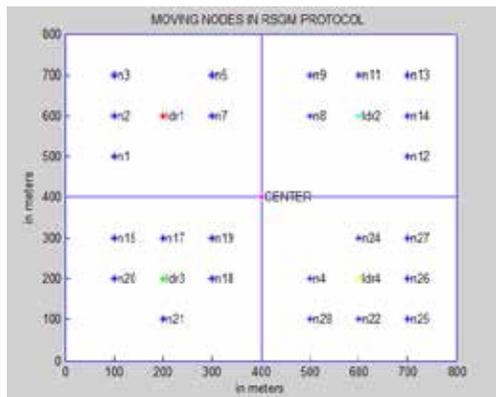


Fig 5

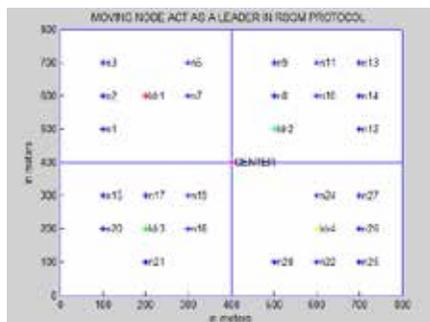


Fig 6

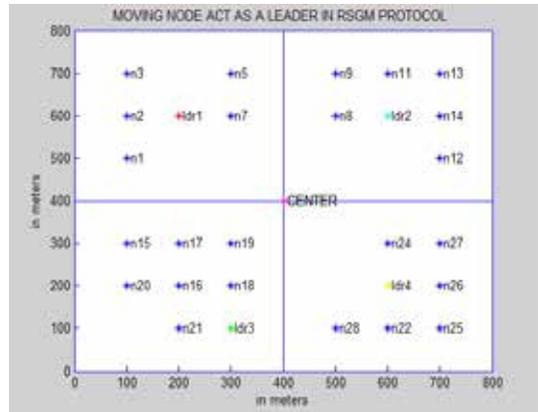


Fig 7

vii. In Fig 8, the mobile node n4 moves from zone 1 to zone4, now its data is removed from zone 1 and it is not accepted by zone 4. Now it declares itself leader in zone 4. The information (position and data) of this node n4 is switched to zone 4 (as a leader itself). Its information is also updated centrally while the data of other zones remain unaltered.

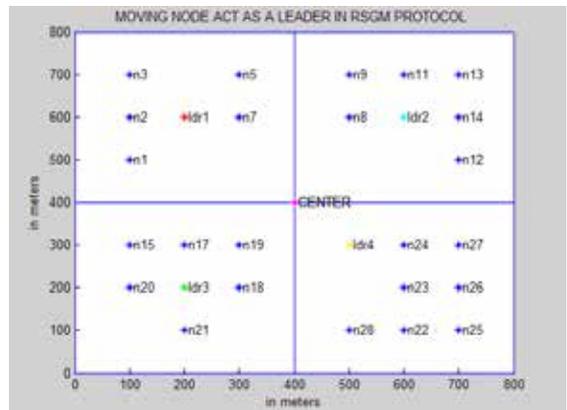


Fig 8

Destination Zone	Status	Time Elapsed
Zone 2	As a node	0.15321
Zone 3	As a node	0.15417
Zone 4	As a node	0.15122
Zone 2	As a Leader	0.14909
Zone 3	As a Leader	0.14957
Zone 4	As a Leader	0.14314

Fig 9

node as anode versus node as a leader

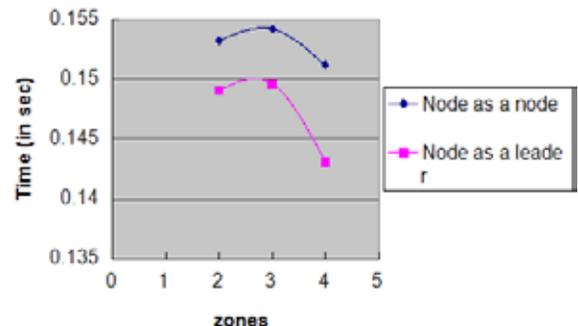


Fig 10

VI. CONCLUSION & FUTURE SCOPE

It is observed from the graph shown above that efficiency in terms of end to end delivery is better when the moving node declares itself as a leader in the destination zone. On further elaboration, it is noted that minimum time is elapsed when node 4 moves from zone 1 to zone 4 and declare itself as a leader. Using these results the graph is plotted for the time elapsed with respect to all the destination nodes.

The future work of this project can be done in number of ways like the protocol can be implemented when the moving node has to handover the data to any node before leaving the zone and also by keeping the centre of the zone movable. The implementation of the protocol can be done in case of multiple movements of multiple mobile nodes another way is by keeping the zone shape hexagonal. It can also be designed by allocating dynamic data to multiple mobile nodes and by varying zone size. The implementation can be done by increasing the number of node.

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