Supporting Competent And Measurable Group Communication Over Mobile Adhoc Networks

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Abstract- **Group communications are important in Mobile Adhoc Networks (MANET). Multicasting is an effective method for implementing group communications. However the implementation of competent and scalable multicasting over mobile adhoc network is challenging because the implementation of efficient membership management and multicast packet forwarding over dynamic topology is difficult, for implementing competent and scalable multicasting we use an Efficient Geographic Multicast Protocol (EGMP), this protocol uses virtual zone based structure for implementing scalable and competent multicasting over mobile adhoc networks. The EGMP uses position information in order to guide the zone structure building, multicast tree construction, multicast packet forwarding and also this protocol reduces the overhead for route searching and tree structure maintenance. Finally we design a scheme to handle empty zone problem**

Keywords: Mobile adhoc networks, wireless network, multicast, protocol.

I INTRODUCTION

Wireless mobile ad-hoc network (MANET) [1] technology is designed for the establishment of network anywhere and anytime without any fixed infrastructure to support the mobility of the users in the network. In other words, a wireless mobile ad-hoc network is a collection of mobile nodes with a dynamic network infrastructure. Wireless mobile ad-hoc network does not have any central server or base station for providing connectivity, and all network intelligence must be placed inside of the each mobile user device. where wireless mobile nodes have formed a network with one node too far to reach. In such an environment, each mobile user acts as a routing node, and a packet is routed from a source to its destination by incorporating of other network users, since the topology of ad-hoc network can change quickly and unpredictably, it should be adaptable to changes, such as when a link breaks a node leave the network or a new node is attached to the network.

There are increasing interests and importance in supporting group communications over mobile adhoc networks (MANET). Example applications over mobile adhoc networks (MANET) include the exchange of messages among group of soldiers in a battlefield, communications among the firemen in a disaster area, and the support of multimedia games and teleconferences. Multicasting technique uses one-to-many or many-to-many transmission pattern to realize a group communication. However, there is a big challenge in enabling efficient multicasting over a MANET, whose topology may change constantly. In general the conventional multicast protocols [2-3], can be categorized into two main categories, they are 1) Tree based multicast protocols, and 2) Mesh based multicast protocols. The tree based multicast protocols uses a tree-based structure for forwarding packets in between source and destination nodes. However due to the constant movements as well as frequent network joining and leaving from individual nodes it is very difficult to maintain the tree structure using these conventional tree based multicast protocols (e.g., MAODV, AMRIS [4], MZRP [5], MZR). The Mesh based multicast protocols uses a mesh based structure for forwarding packets in between source and destination nodes. However with the use of redundant paths, the mesh based multicast routing protocol enhance the robustness of packet routing. The specified conventional multicast protocols do not have good scalability or measurability due to overhead incurred for route searching and creation and maintenance of the tree/mesh structure over dynamic MANET.

In this paper we propose an Efficient Geographic Multicast protocol (EGMP) in order to reduce the packet header overhead and this EGMP uses a zone-based scheme to efficiently handle group membership management.

II PROPOSED WORK

1) In proposed work we implement a group communications in a competent and scalable manner by using virtual zone based scheme, this scheme mainly used for efficient group membership management and reliable multicast packet forwarding, and also this scheme allows each individual node to join and leave a group quickly.

2) In proposed work geographic unicasting is enhanced to handle the routing failure due to the use of estimated destination position with reference to zone and applied for sending control and data packets between two entities, so that transmissions are more robust in the dynamic environment.

3) In this paper, we use an Efficient Geographic Multicast Protocol, according to this protocol, all the nodes in the network can be self organize themselves into set of zones, each zone contains list of group joins, where each group join contains list of individual nodes, and zone leader (zldr) is elected for each zone, the zone leader is responsible for managing communications between various group joins in respective zone, and finally the message packet is forwarded based on the destination zone position inserted in message packet header. The performance of EGMP can evaluate through simulation and quantitative analysis.

4) In this paper, we introduce one important concept i.e. zone depth, this zone depth is mainly used for guiding tree structure maintenance and tree branch building especially in the presence of node mobility.

In this network source node sends message packet to various zone leaders and again each zone leader sends a packet to various group members whom it contains, and finally each group member can send a message packet list of individual nodes which it contains.

III RELATED WORK

In this related work, we first describe the basic procedure assumed in traditional multicasting protocols and a few geographic multicast algorithm proposed in the literature. Conventional topology based multicast protocols can broadly classified into two categories they are 1) Tree based protocols, 2) Mesh based protocols. In tree based protocol, the tree structure topology is used for more efficient forwarding of packets to all group members. Some of the tree based protocols are MAODV [9], AMRIS [10], MZRP, and MZR. In mesh based protocol we expand multicast tree with some additional paths, this paths mainly used for forward a packets when some of the links breaks. Some of the mesh based protocols are ODMRP [11], FGMP [12]. The construction and maintenance of tree or mesh based structure involves high overhead and high time delay over dynamic network. So in order to reduce the overhead and time delay we use Efficient Geographic Multicast Protocol, this protocol uses location aware approach for efficient membership management and reliable packet transmission.

IV EFFICIENT GEOGRAPHIC MUTICAST PROTOCOL (EGMP)

In this section we explain EGMP in detail and also here we describe some notations which are used in rest of the paper. In section 4.1 we present EGMP Protocol overview , In section 4.2 and 4.3 we present schemes for zone leader election and neighboring table generation and finally in section 4.4 , 4.5 we introduce mechanism for multicast tree construction, multicast packet forwarding.

A. EGMP Overview

EGMP protocol supports measurable and reliable membership management and multicast packet forwarding through the use of virtual zone based structure. At the lowest layer of virtual zone based structure, in reference to predetermine virtual origin all nodes in the network is self organize themselves into set of zones. Each zone contains list of group joins. The leader is elected for each zone to manage the local group membership. At the upper layer of virtual zone base structure the leader acts as a representative for its zone to join or leave a multicast groups as required. Finally a network wide bidirectional tree is built. For providing efficient membership management and reliable packet transmission, the location information will be integrated along with the design. EGMP supports bidirectional packet forwarding along the entire tree structure that means by using this protocol we can send a packet along all branches of tree. Here we cannot send a packet directly to the route of the tree first. The below figure 3 gives some basic idea behind in zone structure building. In this figure each square represents one zone and virtual origin is represented by coordinates like (x, y), by using this virtual origin we perform zone portioning.

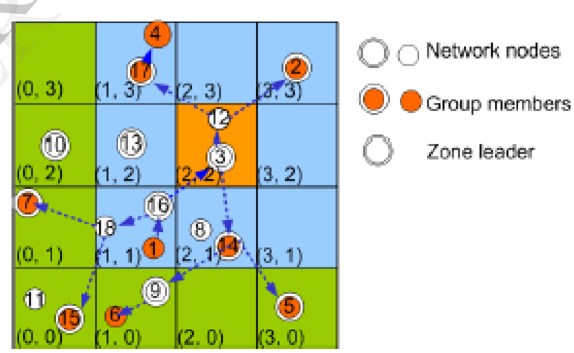

Fig. 1: Zone structure and multicast tree

Some of the notations used in this paper are
1) Zone**:** All the nodes in the network is divided into number of zones, in the above figure each square represent one zone.
2) Zone Size(S): Zone size is nothing but length of size of zone square
3) Zone ID: Zone ID is nothing but identification number of a zone. Generally a node can calculates its zone ID by using position coordinates (x, y) such as a = [(x-x0)/S], b = [(y-y0)/s], where (x0, y0) is a position of virtual origin.

B. Zone Leader Election

By using Efficient Geographic Multicast Protocol, the zone leader can be elected by using following method.
If zone contains more than one node, in that situation a node with highest node ID is treated as a zone leader and next we set a flag value to '1' in its node neighboring table.

C. Neighboring Table Generation

In this section we describe procedure for generating neighboring table. Each node which is present in each zone can maintain one neighboring table; this table contains details like node ID of neighboring nodes, their position details, zone ID details and flag values of zone leader, for example the neighboring table for node 18 (as present in Fig. 3) is shown in below table 1.

Node ID	Position of nodes	Flag values	ZoneID details
16	(x16,y16)	1	(1,1)
1	(x1,y1)	0	(1,1)
7	(x7,y7)	1	(0,1)
13	(x13,y13)	1	(1,2)

Table 1: The neighboring table of node 18 in Fig3

D. Zone based Geographic Forwarding

In this section we describe procedure for performing zone based geographic forwarding.

By using zone structure, the communication process includes an intra zone transmission and inters zone transmission; here we use EGMP to avoid the overhead in tracking the exact locations of a potentially large number of group members, location service is integrated with zone-based membership management without the need of an external server, according to this protocol the packet is first forwarded to the center of destination zone first, after arriving at the destination zone, th**e** packet will be forwarded to specific receiving node depending on message type. Zone center is calculated by using this following formula

1) Zone Center*:* For a zone with zoneID (a,b), and position of zone center (xc,yc) can be calculated byformula

$$xc = x0 + (a + 0.5)Xs, yc = y0 + (b + 0.5)Xs$$

(1) here **'s'** represents zone size and (x0,y0) represents virtual origin.

E. Multicast Tree Construction

In this section we summarize the procedure for constructing a multicast tree. The multicast tree is mainly constructed for achieving group communications. For implementing scalable and efficient group communications we use an efficient geographic multicast protocol, according to this protocol, the multicast tree is formed in the granularity of zone depth. EGMP significantly reduces tree management overhead with the guidance of location information and with the use of destination zone location (which is inserted in packet header) the message packet is transmitted without occurring high time delay and overhead. And finally we construct a virtual zone based tree, in this tree each zone is handled by one zone leader, each zone leader can have its own multicast table, this table contains various group entry details like groupIDs, rootzoneID, upstream zoneID details, various downstream zone list and downstream node list.

1) Multicast Group Join

In this section we describe the procedure for multicast group joins. Suppose when a node 'N' wants to join multicast group 'G' (Ex: G1, G2…Gn), if it is not a leader zone, it sends JOIN-REQ message to its zone leader. This JOIN-REQ {N,POSN,G,{Nold}} message contains details like node ID, its position and groupIDs which it want to join, and address of the old group leader (Nold), this Nold address is used when a leader is handoff, by using this Nold address we can update the JOIN-REQ . If the JOIN-REQ message is received from same zone, the zone leader can add node N to its downstream node list of its multicast table. Suppose if a JOIN_REQ message is received from another zone, the zone leader compare the depth of requesting node zone and depth of its own zone, suppose the requesting node zone depth is small, the zone leader adds requesting zone to its downstream zone, otherwise the JOIN-REQ message forwarded toward the root zone, and finally the zone leader sends JOIN-RPLY to source of JOIN-REQ message. The zone-depth is calculated by using below formula.

Zonedepth=max(| x0-x1 |, | y0-y1 |) (2)

Here (x0, y0) is the origin of root zone and (x, y) is origin of the zone which it currently used.

2) Multicast Group Leave

In this section we describe the procedure for deleting multicast groups from multicast tree. Suppose when a node N wants to leave group 'G', for that node N sends a LEAVE (N, G) message to its zone leader, and next the zone leader removes the node N which is present in LEAVE message from its downstream node list. Suppose the node N is not present in downstream node list, in that situation the zone leader sends LEAVE (N, G) message to upstream zone, suppose the requested node is present, the zone leader removes requested member node N from group G.

F. Multicast Packet Forwarding

In this section, we summarize how the multicast packets are transmitted to its respective destinations.

1) Packet Sending From Source

After the multicast tree constructed, suppose all the members of group wants to send a packets to respective destinations, that packets will be forwarded along all branches of multicast tree. In most tree based protocol, the source node always sends packets initially to the root of tree.

Ex: Suppose the node15 (present in fig3) wants to send to root zone (2, 2), in this example the root zone is too far away from node15, in that we can send a packet by using any tree based protocol, the searching of root zone takes high time delay and overhead, so in order avoid overhead we use EGMP protocol, by using this protocol the packet is forwarded along all branches of tree, so the searching speed is increased and delay will be reduced.

2) Multicast Data Forwarding

In this section we summarize, how the multicast data is forwarded in between different nodes. When a nodeM has a multicast packet, suppose it wants to forward that packet to list of destinations (D1, D2, D3...), for that the zone leader decides next hop nodes towards each destination by using geographic forwarding, after deciding next hop nodes , a nodeM inserts list of next hop nodes and destinations associated with that hop nodes in packet header. Consider a below example

Ex: Msgpacket (N1:D3, D4; N2:D2….)

In the above example node N1 is the next hop node for destinations D3, D4, and node N2 is the next hop node for destination D2.Based on the destination locations inserted in packet header a node N forwards a packets in an competent and reliable manner, if destination position is not present, in that situation a node N drops a packet.

Ex: Suppose a node 3 (present in fig3) receives a multicast packet from zone (1, 1), this node 3 forwards this packet to all downstream zones (2, 1), (1, 3), (3, 3) and

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after node 3 determines the next hop nodes for each destinations and finally node3 insert list (12: (1, 3), (3, 3); 14: (2, 1) in the packet header. Suppose this packet is forwarded, the nodes 12, 14, 8 will receive a packet. If a packet is received by node8, that packet will be dropped, because we can not specify any destination zone to that node and if a node receives a packet it sends a packet to respective destination zone (2,1) .

V. CONCLUSIONS

The designing of competent and scalable multicast protocol over mobile ad hoc network (MANET) is challenging. In this paper, we introduce an efficient and scalable multicast protocol (EGMP) for MANET. The scalability and efficiency of EGMP achieved by using two-tier virtual zone based structure. At the lowest layer of virtual zone based structure, in reference to predetermine virtual origin the nodes in the network is self organize themselves into set of zone, the leader is elected for each zone to manage local group membership management, at upper layer the leader acts representative for its zone to join or leave a multicast group as required. Compare to traditional multicast protocol, the efficient geographic multicast protocol produces an efficient membership management, less overhead and less time delay for sending packets to respective destination nodes. In this paper we design scheme to handle empty zone problem, which is challenging for any zone- based protocol. In proposed work the empty zone problem can be handling by using EGMP protocol. The performance and scalability of EGMP can be evaluated through the use of simulation and quantitative analysis results.

VI. REFERENCES

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