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Efficient Zone Based Bidirectional Multicast Tree over MANET using RSGMP

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***Abstract* – The challenge faced nowadays is to design a scalable and robust multicast routing protocol in a mobile ad hoc network (MANET). The use of mobile ad hoc networks (MANETs) is to be achieved with fast progress of computing techniques and wireless networking techniques. MANET is used because wireless devices could self-configure and form a network with an arbitrary topology. The difficulty is in achieving the group membership management, multicast packet forwarding, and the maintenance of multicast structure over the dynamic network topology for a large group size or network size. Robust and Scalable Geographic Multicast Protocol is used for handling multicasting in mobile ad hoc networks. Virtual architectures are used in this protocol. MANETs have unstable wireless channels and node movements. Scalability and efficiency of group membership management is performed through a virtual-zone-based structure. The location service for group members is integrated with the membership management. The control messages as well as the data packets are forwarded along efficient tree-like paths. Geographic forwarding is used to achieve further scalability and robustness. Source tracking mechanism is designed for handling flooding of information. Other than that, empty-zone problem faced by most zone-based routing protocols is efficiently being handled. Overall advantages are higher delivery ratio in all circumstances, with different moving speeds, node densities, group sizes, number of groups, and network sizes. This has minimum control overhead and joining delay.**

***Keywords* – Zone, Multicast, Mobile Ad-Hoc Networks (MANET), Routing, RSGMP.**

I. Introduction

Group communications are important in Mobile Adhoc Networks (MANET). Since, it is challenging to implement efficient and scalable multicast in MANET due to the difficulty in group membership management and multicast packet forwarding over a dynamic topology, we propose a novel Efficient Geographic Multicast Protocol (EGMP). Though, several strategies have been proposed to further improve the efficiency of the protocol we design a scheme to handle empty zone problem faced by most routing protocols using a zone structure. The issues are Multicast Tree Construction, Multicast Group Join, Signal Blocking and Packet loss, Multicast Route Maintenance and optimization. it is difficult to manage group membership, find and maintain multicast paths with constant network topology changes, it is critical to reduce the states to be maintained by the network, and make the routing not significantly impacted by topology changes. Recently, several location based multicast protocols have been proposed for MANET. Robust and Scalable Geographic Multicast protocol (RSGM), is a protocol which scales to a large group size and network size. It provides robust multicast packet transmissions in a dynamic mobile ad hoc network environment. RSGM makes use of position information to support reliable packet forwarding. It introduces a zone based scheme to efficiently handle the group membership management. The zone based structure is formed virtually. To avoid the need of network wide periodic flooding of source information, the Source Home is used to track the positions and addresses of all the sources in the network.

II. Related Work

This paper focuses on the following modules:
1. Multicast tree construction
2. Dynamic topology
3. Packet delivery.

III. Zone Construction

Virtual zones are used as references for the nodes to find their zone positions in the network domain. The zone is set relative to a virtual origin located at (x0, y0), which is set at the network initialization stage as one of the network parameters. The length of a side of the zone square is defined as zone size. Each zone is identified by a zone ID (zID). A node can calculate its zID (a, b) from its pos (x, y) as follows:

$$a = [\frac{x - x0}{zone_{size}}]$$

$$b = [\frac{y - y0}{zone_{size}}]$$

For simplicity, we assume the entire zones IDs are positive. A zone ID will help locate a zone, and a packet destined to a zone will be forwarded toward its center. The center position (x_c, y_c) of a zone with zID (a, b) can be calculated as:

$$x_{center} = x0 + (a + 0.5) * zone_{size}$$

$$y_{center} = y0 + (b + 0.5) * zone_{size}$$

IV. Tree Construction

In EGMP, instead of connecting each group member directly to the tree, the tree is formed in the granularity of

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zone with guidance of location information, which significantly reduces the tree management overhead. With a destination location, a control message can be transmitted immediately without incurring a high overhead and delay to find the path first, which enables quick group joining and leaving.

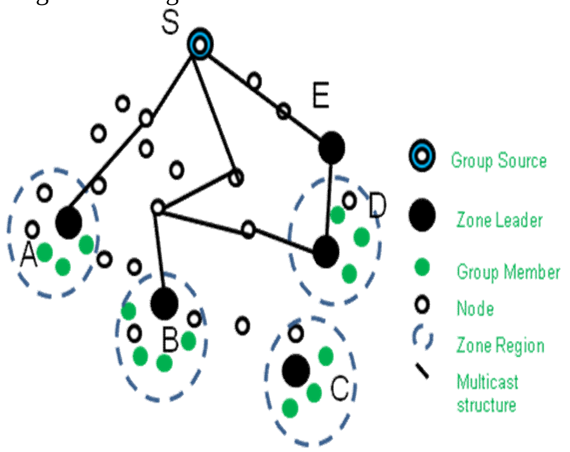

Fig.iv. Multicast tree construction

A. *Multicast Group Join*

When a node wants to join the multicast, if it is not a leader node, it sends a JOIN-REQ, Group message to its zLdr carrying its address, position, and group to join. The address of the old group leader is an option used when there is a leader handoff and a new leader sends an updated JOIN-REQ message to its upstream zone.

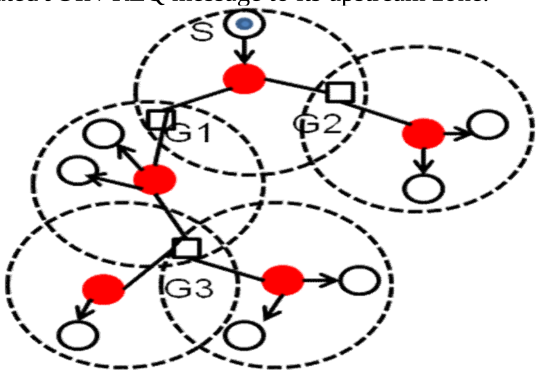

Fig.iv (a) Multicast group joining

If member did not receive the NEW-SESSION message or it just joined the network. If a zLdr receives a JOIN_REQ message is received from a member M of the same Zone, it will compare the depth of the requesting zone is closer to the root zone than the requesting zone, it will add the requesting zone to its downstream zone list; otherwise, it simply continues forwarding the JOIN_REQ message toward the root zone. If new nodes or zones are added to the downstream list the leader will check the root-zone ID and the upstream zone ID. If it does not know the root zone, it starts an expanded ring search. As the zone leaders in the network cache the root-zone ID quickly obtained. With the knowledge of the root zone, if its upstream zone ID is unset, the leader will represent its zone to send a JOIN_REQ message toward the root zone; otherwise, the leader will send back a JOIN_REPLY message to the source of the JOIN_REQ message. When the source of the JOIN_REQ massages receives the JOIN_REPLY, it is a node, it sets the isAcked flag in its membership table and the joining procedure is completed. If the leader of a requesting zone receives the JOIN_REPLY message, it will set its upstream Zone ID as the ID of the zone where the JOIN_REPLY messages to unacknowledged downstream nodes and zones. Through the joining process, the group membership management is implemented in a distributed manner. An upstream zone only need to manage its downstream zones and the group membership of a local zone is only managed by its leader. The zone depth is used to guide efficient tree construction and packet forwarding.

B. *Pseudo Code for Leader*

Join Procedure Leader Join (me; pkt)

me: the leader itself
pkt: the JOIN REQ message the leader received
BEGIN
if (*pkt:srcZone* == *me:zoneID*) then
/* the join request is from a node in the local zone */
/* add the node into the downstream node list of the multicast table */
AddNodetoMcastTable(*pkt:groupID*, *pkt:nodeID*);
else
/* the join request is from another zone */
if (*depthme* < *depthpkt*) then
/* add this zone to the downstream zone list of the multicast table
*/
AddZonetoMcastTable(*pkt:groupID*, *pkt:zoneID*);
else
ForwardPacket(*pkt*);
return;
end if
end if
if (!LookupMcastTableforRoot(*pkt:groupID*)) then
/* there is no root-zone information */
SendRootZoneRequest(*pkt:groupID*);
else if (!LookupMcastTableforUpstream(*pkt:groupID*)) then
/* there is no upstream zone information */
SendJoinRequest(*pkt:groupID*);
else
SendReply;
end if
END

C. *Tree Branch Maintenance*

To detect the disconnection of tree branches in time, if there are no multicast packets or messages to deliver for a period of interval active, the leader of a tree zone will send ACTIVE message to its downstream nodes and zones to announce the activity of the multicast branches. The message is sent through multicast to multiple downstream entities. When a member node or a tree zone fails to receive any packets or messages from its leader or upstream zone up to a period of 2*Interval active, it assumes that it loses the connection to the multicast tree and restarts a joining process.

V. Packet Forwarding

After the multicast tree is constructed, all the sources of the group could send packets to the tree and the packets will be forwarded along the tree. In most tree-based multicast protocols, a data source needs to send the packets initially to the root of the tree. The sending of packets to the root would introduce extra delay especially when a source is far away from the root. Instead, EGMP assumes a bidirectional-tree based forwarding strategy, with which the multicast packets can flow not only from an upstream node/zone down to its downstream nodes/zones, but also from a downstream node/zone up to its upstream node/zone.

A source node is also a member of the multicast group and will join the multicast tree. When a source S has data to send and it is not a leader, it checks the is acknowledgment flag in its membership table to find out if it is on the tree. If it is, i.e., its zone has joined the multicast tree, it sends the multicast packets to its leader. When the leader of an on-tree zone receives multicast packets, it forwards the packets to its upstream zone and all its downstream nodes and zones except the incoming one. To reduce the impact of the joining delay, S will send packets directly to the root zone until it finishes the joining process.

A. Packet Delivery

Multicasting of packets is done to the group members. With the membership management, the member zones are recorded by source S, while the local group members and their positions are recorded by the zone leaders. Multicast packets will be sent along a virtual distribution tree from the source to the member zones, and then along a virtual distribution tree from the zone leader to the group members. A virtual distribution tree is formulated during transmission time and guided by the destination positions. The multicast packets are first delivered by S to member zones toward their zone centers. S sends a multicast packet to all the member zones, and to the member nodes in its own zone through the zone leader. For each destination, it decides the next hop by using the geographic forwarding strategy described in previous topics. After all the next hops are decided, S unicast to each next-hop node a copy of the packet which carries the list of destinations that must be reached through this hop. Only one copy needs to be sent when packets for different destinations share the same next hop node. Thus, the packets are forwarded along a tree-like path without the need of building and maintaining the tree in advance. For robust transmissions, geographic unicast is used in packet forwarding. The packets can also be sent through broadcast to further reduce forwarding bandwidth, at the cost of reliability. When an intermediate node receives the packet, if its zone ID is not in the destination list, it will take a similar action to that of S to continue forwarding the packet. If its zone is in the list, it will replace its zone ID in the destination list with the local members if it is a zone leader, or replace the ID with the position and address of the zone leader otherwise. The intermediate node will find the next-hop node to each destination and aggregate the sending of packets that share the same next-hop node as source S does.

VI. Route Maintenance

In a dynamic network, it is critical to maintain the connection of the multicast tree, and adjust the tree structure upon the topology changes to optimize the multicast routing. In the zone structure, due to the movement of nodes between different zones, some zones may become empty. It is critical to handle the empty zone problem in a zone-based protocol. Compared to managing the connections of individual nodes, however, there is a much lower rate of zone membership change and hence a much lower overhead in maintaining the zone-based tree. As the tree construction is guided by location information, a disconnected zone can quickly reestablish its connection to the tree. In addition, a zone may be partitioned into multiple clusters due to fading and signal blocking. In this section, we discuss our maintenance schemes.

A. Moving Between Different Zones

When a member node moves to a new zone, it must rejoin the multicast tree through the new leader. When a leader is moving away from its current zone, it must handover its multicast table to the new leader in the zone, so that all the downstream zones and nodes will remain connected to the multicast tree. Whenever a node M moves into a new zone, it will rejoin a multicast group G by sending a JOIN_REQ message to its new leader. During this joining process, to reduce the packet loss, whenever the node broadcasts a BEACON message to update its information to the nodes in the new zone, it also unicasts a copy of the message to the leader of its previous zone to update its position. Since it has not sent the LEAVE message to the old leader, the old leader will forward the multicast packets to M. This forwarding process helps reduce the packet loss and facilitates seamless packet transmissions during zone crossing. When the rejoining process finishes, M will send a LEAVE message to its old leader.

To handle leader mobility problem, if a leader finds its distance to the zone border is less than a threshold or it is already in a new zone, it assumes it is moving away from the zone where it was the leader, and it starts the handover process. To look for the new leader, it compares the positions of the nodes in the zone it is leaving from and selects the one closest to the zone center as the new leader. It then sends its multicast table to the new leader, which will announce its leadership role immediately through a BEACON message. It will also send a JOIN_REQ message to its upstream zone. During the transition, the old leader may still receive multicast packets. It will forward all these packets to the new leader when the handover process is completed. If there is no other node in the zone and the zone will become empty, it will use the method introduced in the next section to deliver its multicast table. In the case that the leader dies suddenly before handing over its multicast table, the downstream

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zones and nodes will reconnect to the multicast tree through the maintenance process.

B. Handling Multiple Clusters

When there is severe shadowing/fading or a hill/building that prevents the radio communication between nodes in a zone, the nodes in the same zone may form multiple clusters as shown in Fig. 4, where the two clusters are not connected in the zone although they are connected through some nodes outside the zone. In this case, two nodes in different clusters can communicate with each other by using unicasting because they are connected on the network topology graph, but an intra zone flooding message initiated in one cluster may not reach other clusters. This problem is also a key problem for zone-based protocols. EGMP handles the zone partitioning problem as follows: If there are multiple clusters in a zone, because these clusters are not aware of the existence of each other, each cluster will elect a leader.

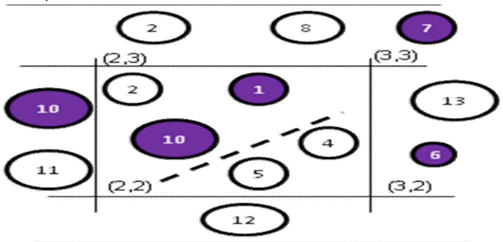


Fig.vi. (b) Multiple clusters in one zone

When an upstream zone leader receives JOIN_REQ messages from multiple leaders of the same zone and the new message is not sent as a result of leader handover (in which case the old leader's address needs to be carried), it detects that the downstream zone has partitioned into multiple clusters. It identifies a cluster by its zID and the leader's address. When sending a packet to the cluster, it uses the leader's position instead of the zone center (in which case the zone ID is carried as the destination) as the transmission reference. Even though the leader may move, its position carried in JOIN_REQ message can still be used as a reference to forward packets to its cluster. When receiving a packet with the position of the leader as the reference, a cluster leader can learn that multiple clusters exist within its zone. In case that not all the clusters of a partitioned zone send JOIN_REQ messages, the upstream zone leader may not be aware of the partitioning of the downstream zone.

When a cluster leader receives a packet destined to its zone but does not match its status, it will send an update message to its upstream zone. For example, when a cluster leader receives a JOIN_REPLY message or a multicast packet but did not send JOIN_REQ message, it will send a LEAVE message to the upstream zone. When receiving messages from multiple leaders of the same zone, the upstream leader can detect zone partitioning.

It will resend the previous message to the target cluster with the position of the zone leader as the destination.

C. Route Optimization

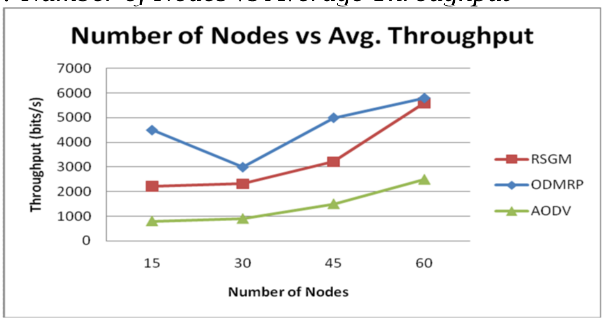
Sometimes a zone leader may receive duplicate multicast packets from different upstream zones. For example, as described in the above section, when failing to receive any data packets or ACTIVE messages from the upstream zone for a period of time, a tree zone will start a rejoining process. However, it is possible that the packet and message were lost due to collisions, so the old upstream zone is still active after the rejoining process, and supplicate packets will be forwarded by two upstream zones to the tree zone. In this case, the one closer to the root zone will be kept as the upstream zone. If the two upstream zones have the same distances to the root zone, one of them is randomly selected.

VII. Performance Evaluations

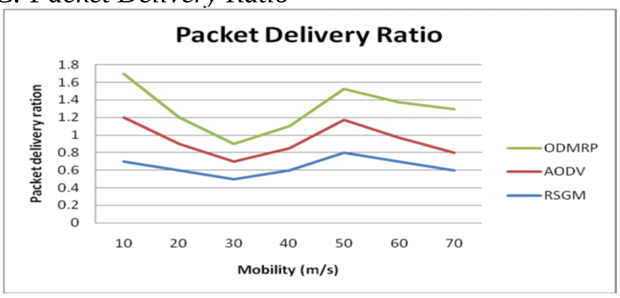
A. Simulation Settings

Simulation time : 200 Sec
Terrain Dimensions : 1000 X 1000 Mt
Number of Nodes : 15-60
Traffic Model : CBR
Node Placement : Uniform
Mobility : 0-10 (m/s)
MAC-Protocol : CSMA MAC
Routing Protocols : RSGM, ODMRP, AODV.

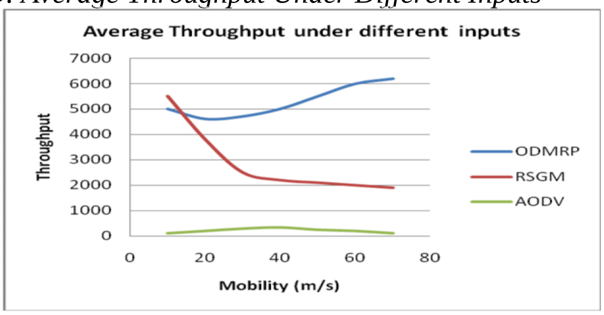
B. Number of Nodes vs Average Throughput



C. Packet Delivery Ratio



D. Average Throughput Under Different Inputs



VIII. CONCLUSION

A zone-based bidirectional multicast tree at the upper tier is designed to achieve more efficient multicast membership management and delivery. A zone structure at the lower tier is used to realize the local membership management. A scheme to handle the empty zone problem is also developed which is challenging for the zone-based protocols. The position information is used in the protocol to guide the zone structure building, multicast tree construction and multicast packet forwarding. As compared to traditional multicast protocols, this scheme allows the use of location information maintenance and can adapt to the topology change more quickly. The simulation result shows that the protocol can achieve higher packet delivery ratio in a large-scale network. In this paper multicasting using zone based structure is successfully achieved. This is done with the help of RSGM protocol. In RSGM, stateless virtual transmission structures are used. Both data packets and control messages are transmitted along efficient tree-like paths without the need of explicitly creating and maintaining a tree structure. Scalable membership management is achieved through a virtual-zone-based two-tier infrastructure. A Source Home is defined to track the locations and addresses of the multicast sources to avoid the periodic network-wide flooding of source information, and the location service for group members is combined with the membership management to avoid the use of an outside location server. This system reduces the maintenance overhead and leads to more robust multicast forwarding due to the topological changes. To be more specific, RSGM has much higher packet delivery ratio than AODV and ODMRP under different moving speeds, group sizes, number of groups, and network sizes.

REFERENCES

[1] X.Xiang, member, IEEE, X. Wang, member, IEEE, and Y.Yang, fellow, IEEE, “Supporting Efficient and Scalable Multicasting Over Mobile Adhoc Networks”, IEEE Transactions on Mobile Computing (2012).
[2] Ms.Deepali R. Gadbail, Prof. S. S. Dhande,” Efficient and Scalable Multicasting Over Mobile Adhoc Networks”, International Journal of Scientific & Engineering Research volume 3, issue 6, june-2012 1 issn 2229-5518.
[3] Mr.C.Narasimha and Mrs.B.Jalaja Kumari, M.Tech “Efficient and Secured Multicasting Over MANET’s through EGMP”, International Journal of Advanced Research in Computer Science and Software Engineering , Volume 2, Issue 5, May (2012) ISSN: 2277 128X.
[4] M.Subhaa and M.Manoranjanib, “Modified Efficient Geographic Multicast Protocol in Multicasting Over Mobile Adhoc Networks for QoS Improvements”, International Journal of Computer Applications (IJCA), 2010, issn: 0974-1925, volume iv, issue 2, (2011).
[5] Natarajan Meghanathan ,” Survey of Topology-based Multicast Routing Protocols for Mobile Ad hoc Networks” International Journal of Communication Networks and Information Security (IJCNIS) Vol. 3, No. 2, August (2011).
[6] V. Sunitha, N. Venkatesh Naik,” A Zone Based Bidirectional Multicast Tree architecture over MANET” ,Asian Journal of Computer Science and Information Technology (2012) 348–352.