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Multicasting in Mobile ad Hoc Network Using Zone Based Structure

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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. These areas in MANET are of large interest. 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. Here it avoids the need of explicitly creating and actively maintaining a tree structure. 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.

I. INTRODUCTION

A Mobile ad hoc network is nothing but the collection of wireless mobile nodes. Thus in a MANET, wireless devices could self-configure and form a network using an arbitrary topology. Mobile ad hoc networks became a popular subject for research in recent years, and various studies have been made to increase the performance of ad hoc networks and support more advanced mobile computing and applications. The network's topology keeps changing with rapidity and unpredictability. This type of network may operate in a standalone fashion, or may be connected to the larger Internet.

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MANET, services are often required by military and emergency applications. multicast mode is useful if a group of clients require a common set of data at the same time, or when the clients are able to receive and store (cache) common data until needed. The The tree-based protocols use a tree structure for more efficient multicast packet delivery. Some of the examples of tree structure are LAM, MAODV, AMRIS, etc. The mesh-based protocols give the robustness with the use of redundant paths between the source and the set of multicast group members, which incurs a higher forwarding overhead.As 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 SourceHome is used to track the positions and addresses of all the sources in the network.

II. MAINTENANCE OF ZONE STRUCTURE

In, RSGM, the zone structure is virtual and calculated based on a reference point. Therefore, the construction of zone structure does not depend on the shape of the network region, and it is very simple to locate and maintain a zone. To further reduce management overhead, a zone needs to elect a leader and be managed only when it has multicast group members.

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

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$$a = [\frac{x - x0}{zone_{size}}] \tag{1}$$

$$b = [\frac{y - y0}{zone_{size}}] \tag{2}$$

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:

$$x_{center} = x0 + (a + 0.5) * zone_{size} \tag{3}$$

$$y_{center} = y0 + (b + 0.5) * zone_{size} \tag{4}$$

IV. ZONE LEADER ELECTION USING ELECTION ALGORITHM

A leader is elected in a zone only when the zone has group members in it to avoid unnecessary management overhead. When a multicast group member M just moves into a new zone, if the zone leader (zLdr) is unknown, M queries the neighbor node in the zone for the leader. When failing to get the leader information, M will announce itself as a leader by flooding a LEADER message into the zone. Our implementation of routing by flooding is quite standard: when a node receives a packet, it broadcasts the packet except if it has seen that packet before. Nodes keep a cache of recently received packets; older packets are replaced by newly-received ones. A node only re-broadcasts a 6packet if that packet is not in the node's cache. In the case that two leaders exist in a zone, e.g., due to the slight time difference of leader queries and announcements, the one with the larger ID will win and be selected as the leader. A zone leader floods a LEADER in its zone every time interval Intvalrefresh to announce its leadership until the zone no longer has any members. If no LEADER message is received within the interval 2 * Intvalrefresh , a member node will wait for a random period and then announce itself as the zone leader when no other node announces the leadership.

V. MANAGEMENT OF ALL MEMBERS AS A GROUP

The group membership is managed at two tiers. RSGM takes advantage of the virtual-zone-based structure to efficiently track the group membership and member positions. In the following description, except when explicitly indicated, we use G, S and M, respectively, to represent a multicast group, a source of G and a member of G.

VI. MOBILITY MANAGEMENT IN ZONE STRUCTURE

The group membership is first aggregated in the local zone and managed by the zone leader. When joining or leaving a group, a member M sends a message REFRESH (groupIDs, posM) immediately to its zone leader to notify its membership change, where posM is its position and groupIDs are the addresses of the groups in which M is a member. M also needs to unicast a REFRESH message to its zone leader every time interval Intvalrefresh to update its position and membership information. A member record will be removed by the leader if not refreshed within 2 * Intvalrefresh . When M moves to a new zone, its next periodic REFRESH will be sent to the zone leader in the new zone. It will announce itself as the leader if the new zone does not have one. The moving node will still receive the multicast data packets from the old zone before its information is timed out at the leader of the old zone, which reduces the packet loss during the moving. For a leader node, if its distance to the zone border is shorter than a distance threshold and the zone is still a member zone, it will hand over its leadership by unicasting a LEADER message (carrying all the current group information) to the neighbor node in its zone which is closest to the zone center. The LEADER message will continue being forwarded toward the zone center until reaching a node which has no neighbor closer to the zone center than itself, and the node will take over the leadership and flood a LEADER within the zone.

VII. NETWORK LEVEL MEMBERSHIP MANAGEMENT

After the membership information is aggregated in the local zone, a source only needs to track the IDs of the member zones that have group members. The leaders of the member zones are responsible for the sending of the zone membership information to the source.

Reports by zone leaders:

The changes in a zone from a member zone to a nonmember zone of G or vice versa are handled by a leader which sends a REPORT message immediately to S to notify the change. The leader can obtain the address and position of S using methods described in Session and initialization and source tracking.

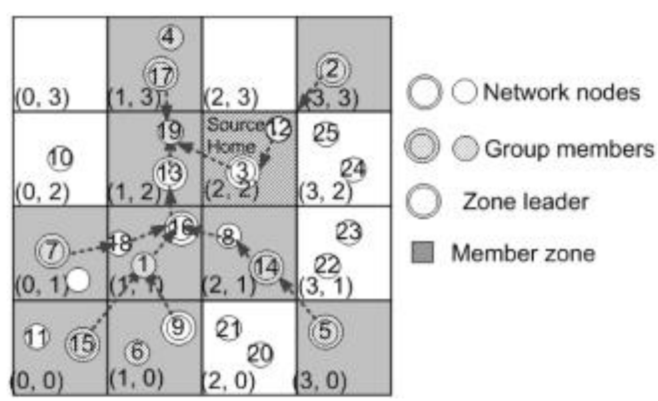

Fig 1.The aggregation of REPORT messages and the virtual-reverse-tree formulation.

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VIII. INITIALIZATION OF THE SESSION AND HANDLING SOURCE MOBILITY

In order to join and leave a multicast group, the nodes in the network need to have the source information. As a source can move in a MANET, it is critical to quickly find the source when needed and efficiently track the location of the source node. RSGM incorporates mechanisms for session creation and efficient source discovery.

Initialization of the Session:

A multicast session (G) is initiated and terminated by a source (S). To start a multicast session, S floods an ANNOUNCE (S, posS , groupIDs) message into the network (for reliability, promiscuous broadcasting is used in the flooding), where groupIDs are IDs of the groups (G is one of them) for which S is the source. Upon receiving this message, a node (N) interested in being the group member of G starts the joining process by unicasting to its zone leader a REFRESH message carrying the information of S. After a session begins, S can piggyback its position (posS) to the multicast packets sent out to refresh its position at the receivers. When a member M moves to a new zone, the new leader can obtain the address and position of S from M. To terminate G, S floods an ANNOUNCE message with G removed from its group ID list.

Handling Source Mobility:

A source can move during the session time. The position of the source that is piggybacked with the packets, while other nodes including the ones that newly join the network must resort to some explicit source location or update mechanism to get the position. Periodic network-wide flooding of source information is used for this purpose. To avoid being a bottleneck, increase survivability, and improve transmission efficiency, the Source Home will not serve as the gateway for data traffic to the source. The issues related to the management of Source Home are: 1) Creation and maintenance of the Source Home with reliability, uniqueness, and consistency; 2) Efficient information update to the Source Home.

IX. MULTICAST PACKET DELIVERY

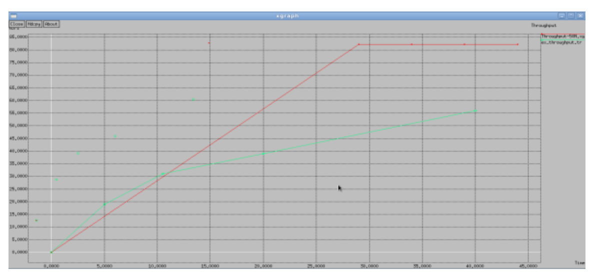
Multicasting of packets is done to the group members. With the membership management, the member zones are recorded by source S, while the local group members and their positions are recorded by the zone leaders. Multicast packets will be sent along a virtual distribution tree from the source to the 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 unicasts 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 nexthop 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.

X. COMMUNICATION WITHIN SELECTED NODES

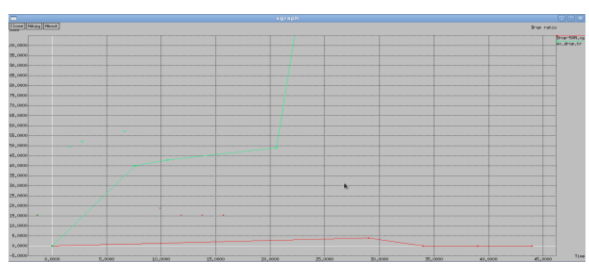
Instead of transmitting the information to all the members in a group in a zone structure, selective communication is achieved. This facility is provided by giving a prompt to the user during the beginning of the communication. The user can select the zones as well as the nodes of the zones to which the communication has to be made. This is possible only when the user is already available of the nodes to which they have to communicate with. This gives better performance results

XI. SIMULATION RESULTS

The performance of this paper may be analyzed by many factors. The main factors which are used are throughput, drop ratio, packet delivery ratio, received ratio.



(a) Throughput



(b) Drop ratio

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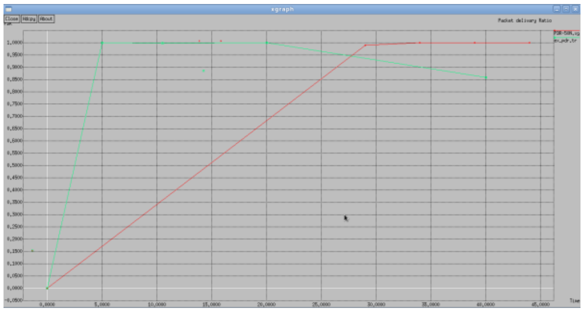
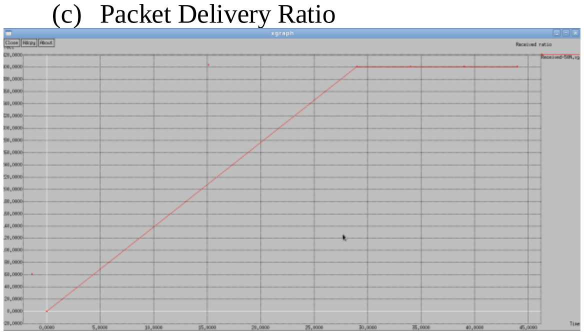


(c) Packet Delivery Ratio



(d) Received Ratio

XII. CONCLUSION

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 for simple management and robust forwarding. 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 SPBM and ODMRP under different moving speeds, node densities, group sizes, number of groups, and network sizes. The necessary comparisons are also made. .Our studies indicate that geometric information and virtual infrastructures can be used together to achieve much more reliable and scalable multicast packet delivery in the presence of constant topology change of MANET.

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