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Modified EGMP for Efficient Multicasting over MANETS

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Abstract: **Difficulty in group membership management and multicast packet forwarding over dynamic topologies like Mobile Ad hoc Networks (MANET) prompted for alternative protocols and techniques. Earlier Efficient Geographic Multicast Protocol (EGMP) that uses a virtual-zone-based structure where a network-wide zone-based bi-directional tree is constructed to implement scalable and efficient group membership management was introduced. The position information of each node is used to guide the zone structure development, tree construction and packet forwarding in multicast environment, Even though this method efficiently reduces the control overhead, data transmission overhead, and multicast group joining delays, it introduces new anomalies especially when applied for use with smaller distributed groups, where it may become even less efficient and more expensive to function in MANETs due to changing network dynamics, bandwidth constraints, and high channel access cost. We propose to use a Modified Efficient Geographic Multicast Protocol (MEGMP) that uses concept of zone depth, which is efficient in guiding the tree branch building and tree structure maintenance, especially during node mobility. Nodes self-organizing into zones, zone-based bidirectional-tree-based distribution paths can be built quickly for efficient multicast packet forwarding. The scalability and the efficiency of MEGMP are evaluated through simulations and quantitative analysis.**

Index Terms — Geographic Routing, Mobile Ad Hoc Networks, Multicasting, Protocol.

I INTRODUCTION

A mobile ad hoc network comprises a set of wireless devices that can move around freely and cooperate in relaying packets on behalf of one another. A Manet does not require a fixed infrastructure or centralized administration. Because mobile nodes have limited transmission range, distant nodes communicate through multi-hop paths. Their ease of deployment makes Manets an attractive choice for a variety of applications. Examples include battleground communications, disaster recovery efforts, communication among a group of islands or ships, conferencing without the support of a wired infrastructure, and interactive information sharing.

Multicast is another fundamental routing service in multihop mesh networks. It provides an efficient means of supporting collaborative applications. Multicast routing protocols for Manets vary in terms of route topology, state maintenance, reliance on unicast routing, and other attributes. *Conventional* MANET multicast protocols can be ascribed into two main categories, tree-based and mesh based. Conventional multicast protocols generally do not have good scalability due to the overhead incurred for route searching, group membership management, and creation and maintenance of the tree/mesh structure over the dynamic MANET.

In recent years for scalable and robust packet transmission, geographic routing protocols have been proposed. The existing geographic routing protocols assumes that mobile nodes are aware of their positions and source can obtain destination position through location server. In existing system, EGMP protocol is used for MANET implementation. EGMP usage offers lower control overhead, data transmission overhead, and multicast group joining delay in MANETs. When used with smaller distributed groups, where EGMP may become even less efficient and more expensive to function in MANETs due to changing network dynamics, bandwidth constraints, and high channel access cost.

In this paper, we propose a Modified Efficient Geographic Multicast Protocol, MEGMP, which can extent to a large group size and large network size. The protocol is designed to be comprehensive and self-contained, yet simple and efficient for more reliable operation and consumes less energy when compared to existing one. MEGMP implements concept of zone depth, which is efficient in guiding the tree branch building and tree structure maintenance, especially during node mobility. MEGMP could quickly and efficiently build packet distribution paths, and reliably maintain the forwarding paths in the presence of network dynamics due to unstable wireless channels or frequent node movements.

II RELATED WORK

Location-aided multicasting : In networks that can access the Global Positioning System (GPS), the network provides each node with location and mobility information. Multicast protocols can also use this information to improve protocol robustness and performance. With GPS support, ODMRP can adapt to node movements and can use location and mobility information to estimate route expiration time, while receivers select the path that will remain valid longest. Sources can reconstruct routes in anticipation of route breaks, thereby making the protocol more resilient to node mobility.

Gossip-based multicasting: Some multicasting protocols use gossip as a form of probabilistically controlled flooding to solve several problems, including network news dissemination. The basic idea of applying gossip to multicasting involves having each member node periodically talk to a random subset of other members. After each round of talk, the gossipers can recover their missed multicast packets from each other. In contrast to deterministic approaches, a probabilistic scheme will better survive a highly dynamic ad hoc network because it functions independently of network topology and its nondeterministic property matches the network's characteristics.

Topology-Based Multicast Routing Protocols **:** Topology-based multicast protocols for mobile ad-hoc networks can be categorized into two main classes: tree-based and mesh-based protocols. The tree-based approaches build a data dissemination tree that contains exactly one path from a source to each destination. Topological information is used for its construction. The trees can be sub-classified further into source trees and shared trees.

Position-Based Unicast and Multicast Routing Protocols: The forwarding decisions in position-based routing are usually based on the node's own position, the position of the destination, and the position of the node's direct radio neighbors. Since no global distribution structure—such as a route—is required, position-based routing is considered to be very robust to mobility. It typically performs best when the next-hop node can be found in a greedy manner by simply minimizing the remaining distance to the destination. However, there are situations where this strategy leads to a local optimum, and no neighbor can be found greedily to forward the packet further, although a route exists. This paper deals with the "Location-Guided Tree Construction algorithms", the sender includes the addresses of all destinations in the header of a multicast packet. In addition, the location of all destinations is included as well. It remains open how the sender is able to obtain the position information, and the scaling limitations.

III EFFICIENT GEOGRAPHIC MULTICAST PROTOCOL

In this section, we will describe the EGMP protocol that ensures the delivery of data from the source to the multicast receivers even in the presence of Byzantine attackers.

A) Protocol Overview

EGMP supports scalable and reliable membership management and multicast forwarding through a *virtual zone-based* structure. In a pre-determined virtual origin, the nodes in the network self-organize themselves into a set of zones and a leader is elected in a zone to manage the membership of local group. The leader serves as a representative for its zone to join or leave a multicast group as required. As a result, a network-wide zone-based multicast tree is built.

The zone-based tree is shared for all the multicast sources of a group. To further reduce the forwarding overhead and delay, EGMP supports bi-directional packet forwarding along the tree structure. That is, instead of sending the packets to the root of the tree first, a source forwards the multicast packets directly along the tree. The multicast packets will flow along the multicast tree both upstream to the root zone and downstream to the leaf zones of the tree. When an ontree zone leader receives the packets, it will send them to the group members in its local zone.

In EGMP, the construction of zone structure is independent with the shape of the network region, and it is very simple to establish and preserve a zone. The zone is used in EGMP to provide location reference and support lower level group membership management. A multicast group can cross multiple zones. With the introduction of virtual zone, EGMP only needs to track the membership change of zones. There is no need to track individual node movement, which significantly reduces the management overhead and increases the robustness of the proposed multicast protocol.

For efficient management of states in a zone, with minimum overhead a leader is elected. As a node use periodic BEACON broadcast to distribute its position to facilitate leader election and reduce overhead, EGMP simply inserts a flag in the BEACON message, which indicate whether the sender is a zone leader. The broadcast message received by all nodes. To reduce the beaconing overhead, instead of using fixed-interval beaconing, the beaconing interval for the underneath unicast protocol will be adaptive. A non-leader node will send a beacon, when it moves to a new zone or every period of $Intval_{max}$. A zone leader has to send out a beacon every period of $Intval_{min}$ to announce its leadership role.

A node neighbor table is constructed without extra signaling. When receiving a beacon from a neighbor, a node records the *flag,* node ID and position contained in the message in its neighbor table. A zone leader is elected through the nodes collaboration and maintained consistently in a zone. When a node appears in the network, it sends out a beacon announcing its existence. Then it waits for an $Intval_{max}$ period for the beacons from other nodes. Every $Intval_{min}$ a node will check its neighbor table and determine its zone leader under different cases:

1) If there is only one of the nodes in the zone has its flag set then that node set is the leader. 2) If there is more than one node in the same zone have their flags set then the node with the highest node ID is elected as leader. 3) The flags of all the nodes in the same zone are unset then the node which is closer to the zone center will announce its leadership role through a beacon message with the leader flag set.

B) Multicast Packet Delivery

In this section, we explain how the multicast packets are forwarded to the members.

(i) Packet sending from the source

After multicast tree is constructed, all 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 bi-directional 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 *isAcked* 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 ontree zone receives multicast packets, it forwards the packets to its upstream zone and all its downstream nodes and zones except the incoming one.

When a source node S is not on the multicast tree, for example, when it moves to a new zone, the *isAcked* flag will remain unset until it finishes the rejoining to G through the leader of the new zone. To reduce the impact of the joining delay, S will send packets directly to the root zone until it finishes the joining process.

(ii) Multicast data forwarding

In our protocol, only LDR maintain the multicast table, and the member zones normally cannot be reached within one hop from the source. When a node N has a multicast packet to forward to a list of destinations ($D1;D2;D3; : : :$), it decides the next hop node towards each destination (for a zone, its center is used) using the geographic forwarding strategy. After deciding the next hop nodes, N inserts the list of next hop nodes and the destinations associated with each next hop node in the packet header. Then N broadcasts the packet *promiscuously* (for reliability and efficiency). Upon receiving the packet, a neighbor node will keep the packet if it is one of the next hop nodes or destinations, and drop the packet otherwise. When the node is associated with some downstream destinations, it will continue forwarding packets similarly as done by node N.

IV. MODIFIED EFFICIENT GEOGRAPHIC MULTICAST PROTOCOL(EGMP)

EGMP uses a virtual-zone-based structure to implement scalable and efficient group membership management. A network wide zone-based bidirectional tree is constructed to achieve more efficient membership management and multicast delivery. The position information is used to guide the zone structure building, multicast tree construction, and multicast packet forwarding, which efficiently reduces the overhead for route searching and tree structure maintenance. Several strategies have been proposed to further improve the efficiency of the protocol. Making use of the position information to design a scalable virtual-zone-based scheme for efficient membership management, which allows a node to join and leave a group quickly. Geographic unicast is enhanced to handle the routing failure due to the use of estimated destination position with reference to a zone and applied for sending control and data packets between two entities so that transmissions are more robust in the dynamic environment Supporting efficient location search of the multicast. Group members, by combining the location service with the membership management to avoid the need and overhead of using a separate location server. An important concept zone depth, which is efficient in guiding the tree branch building and tree structure maintenance, especially in the presence of node mobility. Nodes self-organizing into zones, zone-based bidirectional- tree- based distribution paths can be built quickly for efficient multicast packet forwarding.

(i) Framework Setup:

Routing in a communication network is the process of forwarding a message from a source host to a destination host via intermediate nodes. A wireless ad hoc network consists of mobile nodes (MNs) with wireless communication capabilities for specific sensing tasks. Modify mobility and driver partition which apt to node placement under zone process thus creates the framework for our proposed protocol. Mobility describes the node movement and the driver initializes position of each and every nodes. Each and every protocol developed under three states which are initialization, packet event section and finalization. Some more function which consists of edge calculation, report generation etc... These functions executed under several instances which are depend under the nodes position. In EGMP, making use of the position information to design a scalable virtual-zone-based scheme for efficient membership management, which allows a node to join and leave a group quickly. Geographic unicast is enhanced to handle the routing failure due to the use of estimated destination position with reference to a zone and applied for sending control and data packets between two entities so that transmissions are more robust in the dynamic environment.

(ii) Input Configuration:

The design phase is a multi step process which focuses on system creation with the help of user specifications and information gathered in the above phases. It is the phase where the system requirements are translated to operational details. System has to be designed for various aspects such as input, output etc. Based upon edge calculation the nodes are placed. According to our proposed protocol we configure some input parameters some are simulation time, Mac protocol, radio type, number of nodes, etc…

V. RESULTS AND DISCUSSIONS

We implemented the MEGMP protocol using Global Mobile Simulation (GloMoSim) library. The simulations were run with 32 nodes randomly distributed in an area of 950m x 950 m. The nodes moved following the modified random waypoint mobility model. The moving speed of nodes are uniformly set between the minimum and maximum speed values which are set as as 1 m/s (with pause time as 100 seconds) and 20 m/s, respectively, except when studying the effect of mobility. Each simulation lasted 200 simulation seconds. A simulation result was gained by averaging over six runs with different seeds. We focus on the studies of the scalability and efficiency of the protocol under the dynamic environment and also in consideration with the energy and power utilization of nodes. The performance of the proposed MEGMP algorithm is evaluated via glomosim simulator. Performance metrics are utilized in the simulations for performance comparison:

Packet arrival rate: The ratio of the number of received data packets to the number of total data packets sent by the source.

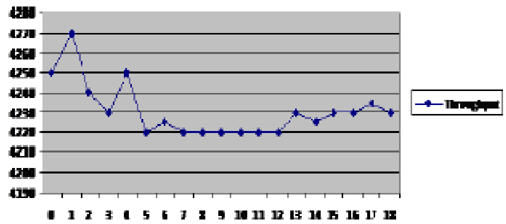

Figure 1. Packet arrival rate of Proposed Protocol

Average end-to-end delay: The average time elapsed for delivering a data packet within a successful transmission.

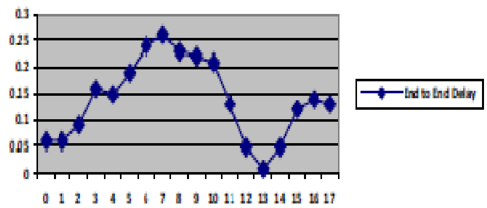

Figure 2. Packet arrival rate of Proposed Protocol

Collision rate: The average Collision rate for the entire data transmission from source to destination is much controlled and reduced when compared to the existing protocol.

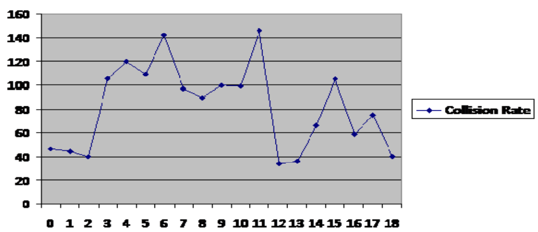

Figure 3. Collision Rate of Proposed Protocol

Communication overhead: The average number of transmitted control bytes per second, including both the data packet header and the control packets.

Energy consumption: The energy consumption for the entire network, including transmission energy consumption for both the data and control packets.

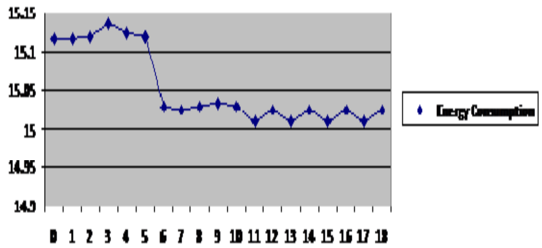

Figure 4. Energy consumption of Proposed Protocol

VI CONCLUSION

Compared to conventional topology-based multicast protocols, the use of location information in EGMP significantly reduces the tree construction and maintenance overhead, and enables quicker tree structure adaptation to the network topology change. The scalability of EGMP is achieved through a two-tier virtual-zone-based structure, which takes advantage of the geometric information to greatly simplify the zone management and packet forwarding. In this paper, we propose MEGMP makes use of geographic forwarding for reliable packet transmissions, and efficiently tracks the positions of multicast group members without resorting to an external location server. MEGMP has efficient energy consumption, high packet delivery ratio, and low control overhead and multicast group joining delay under all cases studied, and is scalable to both the group size and the network size. Compared to the geographic multicast protocol SPBM and EGMP, it has significantly lower control overhead, data transmission overhead, and multicast group joining delay.

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