ZONE BASED TRANSMISSION IN MANETS

A. Kannammal[1], Annie Beunette[2]

Abstract

The increasing challenges in MANET (Mobile Adhoc Network) such as multicast packet forwarding, group maintenance and the path structure over the dynamic topology arises as the size of the network increases. The Geographic Locatable Multicast Protocol (GLMP) proposed in this paper is to resolve the issues that is being faced in large size MANET's. The Virtual tree structure used in the protocol without need of maintaining state information for more group management and packet forwarding in the dynamic network due to unstable node movements. The scalable and efficient group is managed through virtual tree structure and the position of the node is managed through the group management. The message information and data packets are forwarded along the virtual tree paths, but there is no need to explicitly create and actively maintain a structure. This virtual structure efficiently reduces the tree management overhead and support the transmissions.The periodic source information is avoided and efficient source tracking mechanism is designed using the GLMP. The Null-Zone problem is handled by using the BPRT (Back Pressure Restoration Technique) algorithm. It induces the empty packets to flow in the network where the link break and transmission failures are identified.

[1]Research Scholar, [1]Asst.Professor, Department of Computer Science and Engineering, Jayam College of Engg & Technology, Dharmapuri.
[2]Research Scholar, PG Student, Department of Computer Science and Engineering, Jayam College of Engg &Technology, Dharmapuri.
[1]ravikanna.oct@gmail.com, [2]annie.delcasse@gmail.com

I. Introduction

The increase in interest with the usage of MANETs [1], [2] grows in rapid speed of computational techniques and wireless networking techniques.The wireless devices in the MANET could configure itself and forms a structure as a network with the dynamic topology. The topology changes continuously as the nodes joins and leaves the group. It works in a standalone fashion so that each node in the network acts itself as a router. The mobile adhoc network becomes a common hub for many researchers and various studies are made with the new technologies being created in this field. The researchers concentrated to increase performance and support wide variety of applications in it.

The fundamental service for supporting the data exchange between the nodes is Multicasting. It provides information and performs the collaborative [3] task execution among the nodes that is present in the network. The multicast service in MANET's is often required to handle the operations of the large data transmission and huge networks. Since the MANET follows the dynamic topology it poses the large difficulty in designing a reliable and scalable multicast protocol in the presence of dynamic topology.

Many efforts have been put together to develop the multicast routing protocols for MANETs. The protocols that involved in developing the multicast protocols are conventional tree based protocols and mesh based protocols [7]. The tree protocols manage the construction of tree structure for the best efficient multicast packet delivery and it utilizes the network resources efficiently. Even though the tree protocols functions properly it is very difficult to maintain the tree structure in MANET and the tree connection is easy to break and the transmission is not reliable. The mesh based protocols enhance the robustness with the use of redundant paths between the source and set of multicast members, which incurs a higher forwarding overhead.

It is critical to reduce the states to be maintained by the network to support more reliable and scalable transmission. The routing is also being impacted with transmission as the network size grows. So, the location based multicast protocols [4],[5],[6], have been proposed for MANET. The main concept proposed here is that the mobile nodes are aware of their own positions through certain positioning system like (e.g. GPS) and make use of geographic routing [8]to transmit packets along the multicast trees.In such protocols, a multicast packet carries the information of the information of the entire tree. So, there is no need to distribute the routing states [9] in network. These protocols are more robust than that of the conventional based multicast schemes. As the size of the network increases the size of the packet also increases with the header size as it traverses through many nodes [21]. So it makes theses protocols to be used only for the small multicast groups. There is need to efficiently manage the membership [10] of a potentially large group, determine the node positions, efficiently manage the group members and transmit packets in a large group of nodes [21] . The existing small group geographic location based multicast protocols normally address only part of these problems.

In this paper *the Geographic Locatable Multicast Protocol (GLMP)* is proposed, which can scale to a large group size and network size and provide robust multicast packet transmission in a dynamic mobile adhoc network environment. The protocol is designed to simple, so that it can operate more efficiently and reliably. The Virtual Tree Path structure is introduced for more robust and scalable group management and packet forwarding in the presence of high network dynamics due to unstable wireless channels and frequent motion. The information brokrn into packets and control information will be transmitted along efficient tree-like route; however, different from other protocols. So that a robust virtual tree based structure can be formed during packet forwarding with the information provided by the nodes.

The GLMP makes use of node position information to support reliable data forwarding. The protocol is designed to be versitile and self configurable. Instead of addressing only a specific part of the issue, it introduces a girdle based scheme to efficiently handle the group management, and takes advantage of the group management structure to efficiently track the locations of all the Group members without resorting to any data. The girdle structure is also formed virtually and the girdle where a node is located can be calculated based on the node position and a reference origin. The concept of *Root Home* is introduced to track positions and addresses of all the sources in the network.

In general the contributions in this work include

-> *Proposing stateless distribution schemes* that data packets and control messages can be sent along efficient *virtual-tree* paths without the need of explicitly building and maintaining a tree structure as in conventional tree-based protocols. This greatly reduces the congestion and increases the reliability and scalability of the protocol

-> Making use of the *position information* to design a scalable and reactive Zone-based scheme for efficient group management, which allows a node to join and leave a group effectively without loss of packets

-> Providing effective *position hunt* of multicast group members, by combining the location service with the membership management to avoid the need and overhead of using a separate location server.

-> Introducing a *Root Home* to track the addresses and positions of the sources, to avoid network-wide periodic flooding of source information.

-> Drafting a layout to take care of the empty Zone problems for both member Zones and the Root Home, which are critical in designing a Zone based protocols with Zones as the neighbourhood locations.

-> Making a detailed quantitative analysis of the per node congestion of and carry out thorough simulations to show the scalability and robustness of the protocol

In the next section of the paper it deals with the related work on MANET multicast related protocols. In the second section the detailed design of the GLMP protocol is explained and in third section the additional issues to be considered are discussed and the fourth section holds the conclusion part.

II. Related works

The summarization of the basic procedures assumed in conventional multicast protocols.

The conventional topology based multicast protocols include tree-based protocols (e.g., [11], [12], [13], [22]) and mesh based protocols (e.g., [14], [15], [23]). The tree based protocols construct a tree structure for more efficient forwarding of packets to all the group members. The Hybrid topology based protocols expand a multicast tree with additional paths that can be used to forward the transmitted multicast data packets when the links get break.

The topology based protocols generally will possess the following three inherent components that make them difficult to scale:

- *Group Membership management*: The group membership changes frequently as each node may join or leave a multicast group randomly, and the management becomes harder as the group size or network size increases.

- *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 protocols accomplish robustness at the cost of extra network resource consumption.

- Multicast packet forwarding. The multicast packets are forwarded along the predefined tree structures, which are prone to wreck over the dynamic topology in a large network with longer paths.

The Construction and maintenance of the conventional tree or mesh structure involve high control overhead over a dynamic network [16], [23]. The GLMP uses a location aware approach for more reliable group membership management and packet transmissions.

Besides the three components included in conventional topology-based protocols, a geographic multicast protocol needs a location service to obtain the positions of the members [17], [22], [23]. The Geographic multicast protocols [21] needs to put the information of the entire tree or all the destinations into packet headers. These packet headers then create a big header overhead when the group size is large.

The scalable Position-Based Multicast protocol [18], [19], [20] are more related to our work, as the two share the essence as GLMN in improving the scalability of location-based multicast by using hierarchical group management.

III. Geographic locatable multicast protocol

In the section the GLMP protocol is described. It supports a two-tier membership management and forwarding structure. A *Zone structure* is built in the *lower tier* based on information and a head is elected on demand when a Zone has group members. The Zone head allotted in the Zone collects all the details of the Zone nodes. In the *upper tier* the heads of the member Zones report the Zone membership to the sources directly along a *virtual reverse-tree-based* path. If a head is ignorant of the source, it could obtain the information from the root home.

Many issues need to be addressed to make the protocol fully working. The issues related to Zone management include: the strategy for electing a Zone head on demand and maintaining the Zone mobility, the handling of empty-Zone problem, and the scheme for Root-Home construction and maintenance, and then need to reduce packet loss during node moving across Zones.

A. Zone creation

In GLMN, the Zone structure (Fig. 1), 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 congestion, a Zone needs to elect a head and be managed only when it has multicast group members.

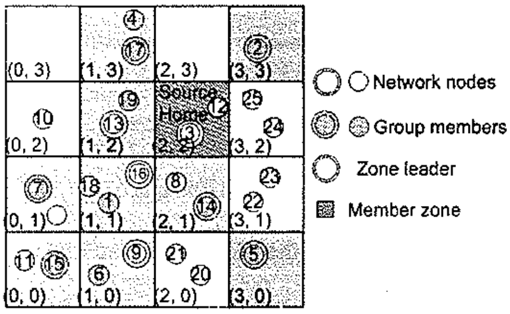

Figure 1. A Reference Zone structure used in GLMN

A node can calculate its zID (a, b) from its pos (x, y) as follows:

a={(x-x0)/Zone size};

b={(y-y0)/Zone size};

With center position (xc, yc) ZoneId (a,b) can be calculated as:

xcenter=1/4*x0 +(a + 0.5)* Zone size;

ycenter=1/4*y0 +(b + 0.5)* Zone size:

B. Group authentication and management

The group membership is first aggregated in the local Zone and managed by the leader. When tagging or untagging from a group, a member M sends a message REFRESH (groupIDs, posM) immediately to its Zone leader to notify the change in group membership, The position and group address is represented as posM and groupIDs . The group member M also needs to send a REFRESH message to its Zone leader at every time interval

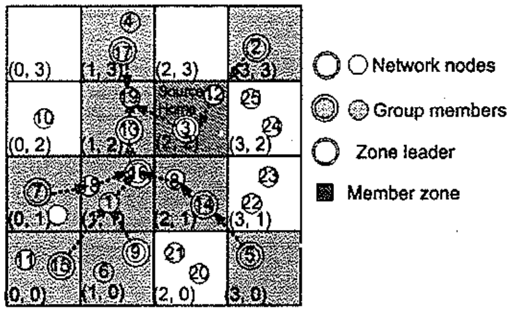

Figure 2. The aggregation of REPORT messages and the virtual reverse tree formation

As compared to local messages, control messages sent at the network tier would generally traverse a long distance. To minimize congestion we make use of an aggregation scheme (Fig. 2), which reduces control overhead by aggregating the control messages sent to the same destination.

C. To begin a session

All nodes in a MANET, the source also moves. Authentication to join or leave a group requires the information of the source. It is very necessary to track down the source when needed and find its location . GLMN incorporates mechanisms for session creation and efficient source discovery.

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 , where groupIDs are IDs of the groups (G is one of them) for which S is the source.

D. Dilivering packets

A source needs to send the multicast packets reliably to the members. The source keeps track of all the member Zones and the Zone leader keeps track of the local members. A virtual tree like path is used to send Multicast packets from the source to the zone members and from the zone leader to group members. A tree is formulated virtually during transmission time and guided by the destination positions.

E. Back pressure restoration technique

The problem of the link failure in the system must be eliminated. This will cause degradation in the QoS (Quality of Service) in the system as well as pull down the performance of the system .To deal with this problem *Back Pressure Restoration Technique (BPRT)* is used. The BPRT is used to intimate the failure to the sender so that it will stop sending the message until the link failure is restored / recovered by using another alternative path. Once the path is recovered or restored either by a new path or by the original path, the sender is soon informed and the sender will start to send messages again.

In order to select paths and alternate paths from source to destination the following rules are to be followed.

Rule 1 : If the paths are of same difference, then

1. Distance of selected path and the load on the selected path is minimum.
2. The load on the in between nodes is greater than the opening bandwidth.
3. The distance to reach the destination using the in between-nodes is the lowest.

Rule 2 : If additional path's are of same difference, then,

1. If two paths of the same length is chosen then the path with least load is taken into consideration.
2. If both the paths have the same load then choose one by any chance.

Rule 3 : If the paths are not of similar length, then

1. Arrange the possible paths from the lowest to the highest value of load and distance.
2. Take the sum of the distance of the nodes on the path in the list and finally select the path with lowest sum. If two or more paths have the same distance than Load > Distance of path is taken into consideration.

IV . Conclusions

In this paper, we have designed a Geographic Locatable Multicast Protocol. In GLMP stateless virtual transmission structures are used for simple management and vigirous data forwarding. The transportation of data and control messages are in the form of efficient tree-like paths without the need to maintain a structure. Membership management is obtained through a virtual-Zone-based two-tier architecture. A Root Home keeps track of locations and addresses of the multicast sources to avoid the periodic network-wide flooding of data, The tracking of group members is combined with the membership management to avoid the use of an outside location server. The position information used in GLMN reduces congestion and leads to more robust multicast forwarding when there is a change in position. Empty-Zone problem which is challenging for the Zone-based protocols is handled and the link failure is also restored efficiently using Back Pressure Restoration technique.

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Author's Biography :

Annie Brunette : born on March 13th, 1984. Received her B.E degree from Visvesvaraya Technological University , in the year 2007. Then she worked as a lecturer at New Horizon College of Engineering , Bangalore from 2008- 2009. Currently persuing her M.E at Jayam College of Engineering and Technology, Dharmapuri.

A. Kannammal born on May 5th , 1981. She received both her B.E degree and M.E degree from Anna University . She did her B.E from Adhiparasakthi Engineering College and M.E from Government Engineering College , Tirunelveli. Currently she is working as an Asst. Proferssor at Jayam College of Engineering and Technology ,Dharmapuri.