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EGMPS: A New robust and Scalable Multicasting Routing Protocol

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Abstract: ***A mobile ad hoc network comprises of a group of wireless mobile centre points dynamically forming a local network without the use of any related network topology or centralized administration. For supporting collaborative applications among a group of mobile user's multicast is a best efficient method as it implements group communication easily. Group communication and scalability are important issues in Mobile Ad Hoc Network (MANETs). These issues can be resolved in terms of group size and network size during design implementation of efficient multicast protocol. In this paper we examine various research paper and techniques in existence for multicast protocol and point out more convincing multicast protocols which consider scalability concepts with its advantages and disadvantages and propose a methodology for EGMPS protocol.***

Keywords: Mobile ad-hoc network *(MANET)*, Multicast routing protocol, group communication, Scalability.

I. INTRODUCTION

A wireless mobile ad hoc network comprises of two or more mobile devices or mobile nodes without any fixed configuration and infrastructure. Such a network is equipped with wireless communication and networking capabilities. However it is challenging to implement efficient and scalable multicast in MANET due to various reason such as group membership management and multicast packet forwarding over a dynamic topology. As we know in such a network, nodes or devices are often not within transmission ranges of each other, each node or devices operates not only as a host but also as a router for packet forwarding function. A wireless Ad hoc network is adaptive and self organizing means that formed network can be deformed on the fly without the need of for any infrastructure or administration. Multicasting [1] is intended for group-oriented efficient communication which involves the transmission of packets to a group of two or more hosts [12][4]. Ad hoc network applications are mainly used in military battlefields communications, disaster mitigation, coordinate task scheduling, emergency search, and rescue sites etc where dynamic information sharing and updating are

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nesseccary. During implementation of Ad hoc network following issues are considered:

Routing: Finding stateless a feasible and accurate path to a destined destination based on criteria such
as hop length, minimum lifetime and power of a wireless link, bandwidth utilization for exchanging the routing information.

Medium Access Scheme: The distributed arbitration for the shared channel for transmission of packets is main and primary responsibility in Ad hoc wireless network.

Multicasting: For improving the efficiency of wireless communication link when sending multiple copies of messages by exploring the inherent broadcast property, multicasting plays an important role.

Quality of Service provisioning: it is the performance evaluation and dedicated services offered by a network to the user which requires negotiation between the host and the network.

Addressing Discovery: Due to the absence of any master or centralized coordinator addressing discovery assume very important and significance role in Ad hoc Wireless Networks because nodes in the network should be able to locate the services that other nodes provides.

Security and Self Organization: The security of communication in this network is very important while self organization is a property that in which network should exhibit organization and maintenance of network by itself.

II. RELATED WORKS

By increasing interest in group communication over mobile Ad hoc networks the conventional multicast network protocols [7][13] normally do not have good scalability, efficiency and reachability over the dynamic topology of MANET. So for better realization and implementation of group communication with one-to-many, many-to-many transmission pattern, multicast protocol is widely efficient method. These protocols consist of the following two main categories:

i) Position Based multicast protocol
ii) Topology based multicast protocol

i) Position-Based Multicast Routing Protocols

The forwarding decisions in position-based routing are usually based on the node's own position, position of the node's direct radio neighbors and position of destination,. As there is no global distribution structure such as a route is required, position-based routing is considered to be very robust to mobility. It actually 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 some 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. [17] Deals with the "Location-Guided Tree Construction Algorithms", where the sender includes the addresses of all destinations in the header of a multicast packet. Additional to this, 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.

ii) Topology based multicast protocol

In Topology-based multicast protocols for mobile ad-hoc networks can be categorized into two main classes: tree-based and mesh-based protocols. In the tree based approaches make a data dissemination tree that contains exactly one path for routing packets from source to destination. Topological information is utilized for its construction and then trees can be further sub-classified into source trees and shared trees. E.g. MZR [16][20] and ADMR [10]. In these protocols, each single source makes its own tree to distribute its packets. Tree based protocols are MAODV [9], AMRIS [6] and for Mesh based protocols are FGMP [3], Core-Assisted Mesh Protocol [8] which are grounded to enhance the robustness with the use of the redundant paths between the source and destination. Building meshes of data paths to make the multicast routes more suitable in topological changes. Mesh contains multiple possible paths from source to destination E.g. ODMRP [14]. The main problems of Topology-based multicast protocols are that difficult to scale to a large network size. In this paper we study protocols and techniques which aim to provide scalability and efficiency of multicast protocol and also propose a new methodology.

III. CLASSIFICATION AND DESCRIPTION OF PROTOCOL

In this section, we will describe the various multicast protocol for ad hoc network.

A) Based on initialization of the Multicasting communication session: On the operation basis Multicast protocols are broadly classified in two types: Source-initiated Protocols and Receiver-Initiated protocols.

1) Source-Initiated Protocols

Events that occur through source initiated protocol uses soft state approach. In this approach, the multicast tree or mesh is periodically updated through control packets. In this type of protocols, multicast group main source periodically floods a join request packet throughout the network and this packet is propagated by other nodes in the network and finally reaches all the receivers of the group. In this strategy, a node that want to join a group should respond with a join reply packet which will propagated through the reverse path of that followed by the Join request packet. Communication between the nodes is done by joint propagation path of join request and join reply path. This refers to a two-pass protocol for establishing the tree or mesh.

2) Receiver Initiated Protocols

In this protocols approach, the receiver uses the flooding to search the paths to the sources of the multicast groups to which it belongs. Tree or mesh construction occurs in three states. In first, the receiver floods a join request packet, which will propagate by other nodes. In most of the cases the sources of the multicast group and nodes are already part of the multicast tree are requested to respond to the Join request and join reply packet, indicating that they would be able to send data packets for that particular multicast group.

B) Application Based: Now based on the application multicast ad hoc networking protocol also broadly classified into two types: Application-independent multicast protocol and Application-dependent multicast protocols. Application-dependent multicast protocols are used for specific applications while Application- independent are used for conventional multicasting applications.

C) Based on Topology: Tree based [9] [6] [20] and Mesh based [3] [8] [14] network are two main classification that based on Topology. In tree based multicasting protocols, there exist only a unique and single path between a sender-receiver pair, while in Mesh based multicasting protocol there will be more than one path between sender and receiver. Tree based protocols are efficient whereas Mesh based protocols are more robust due to the availability of multiple paths between the sender-receiver. Tree oriented multicasting is a well established concept implement in several dedicated wired multicast protocol to achieve high multicast efficiency.

For above mentioned and discussed classification we are briefly examined the various protocol as well:

A) Multicast Routing Protocol Based on Zone Routing (MZRP): In this protocol [3] there is flooding of control packets by each node which searches for members of the multicast group is controlled by the zone routing technique. In this technique, each node is related with the routing zone. A pro-active approach is used inside the zone while a reactive approach is used across zones. This protocol is combination of on-demand and table driven routing approaches and also superior than ZRP protocol on reduction of control overhead basis.

B) Bandwidth-Efficient Multicast Routing Protocol (BEMRP): Mobile Ad-hoc networks function on a highly bandwidth environment, and hence bandwidth utilization is one of the key criteria for multicast protocol

C) Associatively-Based Ad Hoc Multicast Routing (ABAM): ABAM [5] is an on-demand source-tree initiated multicasting protocol in which a path from sender to receiver is constructed based on link stability. Therefore this multicast protocol is adaptive to the moving network mobility.

D) Weight Based Multicast Protocol (WBM): A weight-based multicast (WBM) [18] protocol implements the idea of weight when deciding upon the entry point. In this multicast tree, before joining a multicast group, a node takes into consideration not only the number of newly forwarded nodes, but also the distance between the source node and itself in the multicast tree. Due to weight concept there is increase in flexibility for a receiver to join either the nearest node in the multicast tree or the nearest node.

E) Differential Destination Multicast Routing Protocol (DDM): DDM [11] is a stateless multicasting routing protocol that generally avoids maintaining multicast states in the nodes. It is applicable where group size is small and implements in a soft state mode to maintain the tree. Since it does not maintain the multicast state, it uses less memory resources as well as due to the centralized admission control policy security is assured. DDM uses periodic control packet transmissions from the receiver nodes to the source node.

F) Multicast Ad Hoc On-Demand Distance Vector Routing Protocol (MAODV): MAODV [9] is an extension of AODV protocol because it adds multicast capability to the AODV protocol. It implements the features of multicast, unicast, and

broadcast with a unique concept of sequence numbers to ensure the most accurate and recent route to the multicast group.

G) Preferred Link- Based Multicast Protocol (PLBM): For forwarding Join Query packets this protocol uses a preferred link approach which is an extension of the PLBR protocol. The primary ideas for PLBM [15] is the selection of the set of links to neighbor nodes, called preferred links, and the use of only those links for forwarding of Join Query Packets.

H) On Demand Multicast Routing Protocol (ODMRP): It is mesh-based multicast routing protocol in which mesh is formed by a set of nodes called forwarding nodes which are usually responsible for forwarding data packets between a sender-receiver pair [17]. Forwarding nodes maintain the message cache which is used to identify duplicate data packet and duplicate control packet.

I) Neighbor Supporting Ad Hoc Multicast Routing Protocol (NSMP): Another mesh based multicast protocol which does selective and localized forwarding of control packets [19]. In this protocol, to initialize the mesh, the source floods the control message throughout the network. In this protocol the maintenance of the mesh has been done by local route discovery concept.

J) Forwarded Group Multicast Protocol (FGMP): Based on group multicasting protocol for forwarding control and data packets it uses mesh-based multicast routing protocol. It is a receiver initiated multicast routing protocol which uses soft state maintenance scheme which makes it more robust as compared to the tree based multicast protocols [3].

IV. DISCUSSION

By the help of Table 1 summary the characteristics of the various multicast routing protocols for Ad Hoc Wireless Networks discussed. It helps in characterizing and identifying the qualitative, robust and scalable behavior of multicasting protocols. However, a quantitative comparison study in terms of their performance under a wide range of parameters such as connectivity and size of the network, mobility of nodes, number of multicast sources, and multicast group size requires extensive analytical and / or simulation studies.

Multicast Protocol	Multicast Topology	Initialization	Maintenance Approach
MZRP	Source-tree	Source	Hard state
BEMRP	Source-tree	Receiver	Hard state
ABAM	Source-tree	Source	Hard state
WBM	Source-tree	Receiver	Hard state
DDM	Source-tree	Receiver	Soft state
MAODV	Source-tree	Receiver	Hard state
PLBM	Source-tree	Receiver	Hard state
ODMRP	Mesh	Source	Soft state
NSMP	Mesh	Source	Soft state
FGMP	Mesh	Receiver	Soft state

V. PROPOSED METHODOLOGY

On the basis of above discussed protocols and studies it is clear that EGMP supports scalable and reliable membership management and multicast data packet forwarding through a two-tier virtual zone-based structure. To make it more reliable and widely implementable there is strong need to secure the EGMP protocol and to provide security to this protocol there is several mechanism or technique available such as DSA, ECDSA, RSA, Chinese Remainder theorem and many more. By combining network security mechanism EGMP converts to EGMPS. In EGMPS (Efficient Geographic Multicast Protocol Secured), the zone structure is virtual and based on a reference point. The zone structure construction does not depend on the shape of the network region and hence it becomes easy to locate and maintain a zone. The zone is used in EGMPS to support lower-tier group membership management and provide location reference. A multicast group can travel and moved across multiple zones. With the introduction of virtual zone, EGMPS does not need to identify individual node movement but only needs to know the membership change of zones, which significantly increases the robustness and reduces the management overhead of the proposed multicast protocol.

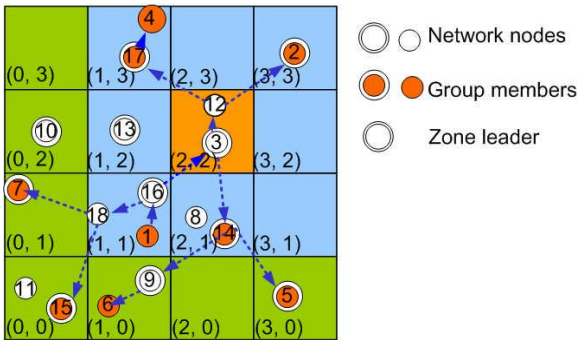

Fig 1: Zone structure and multicast session example

At the upper tier, the leader serves as a representative for its zone to join or leave a multicast group as required. This results in building a network wide zone-based multicast tree. Location information will be integrated with the structure and used to guide the zone construction, group membership management, packet forwarding for efficient and reliable management, and transmissions multicast tree construction and maintenance. The Proposed system concentrates on the issue of strategies for election and maintenance of a zone leader through secured voting process with minimum overhead using ECDSA algorithm for the authentication of votes among the nodes.

VI. CONCLUSION

There is an increasing demand and a big challenge to design more scalable and reliable multicast protocol over a dynamic ad hoc network (MANET). In this paper, we studied the existing protocols and proposed methodology ie. EGMPS for MANET. In EGMP a zone-based bidirectional multicast tree is built at the upper tier for more efficient multicast membership management and data delivery, at the lower tier to realize the local membership management the intra zone management is performed. The position information is used in the protocol to guide the zone structure building, maintenance, multicast tree construction and multicast packet forwarding. As compared to conventional topology-based multicast protocols, the in EGMP use of location information significantly reduces the tree

construction and maintenance overhead and also enables quicker tree structure adaptation to the network topology change. Additionally, EGMPS makes use of secured voting process for election of zone leaders by using secured ECDSA algorithm.

Compared to a classical protocol, both geometric multicast protocols EGMP could achieve much higher delivery ratio in all circumstances, with respect to the variation of mobility, node density, group size, and network range.

Our proposed system indicates that for efficient management of states in zone, a zone leader with minimum overhead is elected. Zone leader is elected through secured voting process. A node with the highest number of votes i.e. the node with highest number of neighbours is elected as zone leader .Our simulation results demonstrate that EGMPS has low energy consumption, high packet delivery ratio, and high throughput and low 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 EGMP, it has significantly lower control overhead, multicast group joining delay and data transmission overhead.

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