Survey of multicast routing protocol in mobile ad hoc network

Gourav Karwar#1   Divashu Sharma*2

Department of Electronics and Communication, Lovely professional university
Phagwara Punjab, India

Abstract: Multicasting is the ability of a communication network to accept a single message from an application and to deliver copies of the message to multiple recipients at different locations. Multicast routing in wireless networking is the newest technology that works with network groups. Multicast routing plays an important role in point-to-point or multipoint-to-multipoint communications. There are many multicast routing protocols that exist in wireless ad hoc networks. Also comparisons are made between protocols to describe the limitations and advantages.

Keywords: MANET, multicasting, multicast routing protocols.

Introduction:

A MANET is an autonomous collection of mobile nodes communicating over wireless Links. Users can communicate with each other in a temporary manner with no centralized Administration and in a dynamic topology that changes frequently. A MANET is best described as an infrastructure less network, in which mobile nodes dynamically organize themselves and establish routes among themselves on the fly. Each mobile node acts both as a host and as a router and must therefore be willing to forward packets for other network’s nodes. Wireless applications, like emergency searches, rescues, and military battlefields where sharing of information is mandatory, require rapid deployable and quick reconfigurable routing protocols, because of these reasons there are needs for multicast routing protocols. There are basically two types of multicast routing protocol are there in the wireless ad hoc network.

Tree based routing protocols

The tree based routing protocol are highly unstable in the mobile ad hoc network as it need frequent re-configuration in the dynamic network (mobility of nodes). There is only a single path between multicast source and receiver. There are various tree based protocols like multicast extension of ad hoc on demand distance vector (MAODV) and Adaptive demand driven multicast routing protocol (ADMRP).

Mesh based routing protocols

Mesh based protocol is highly stable in mobile ad hoc network. There may exist more than one path between source and receiver. There are many mesh based multicast routing protocols exist in MANET. Examples of mesh
based protocols are on demand multicast routing protocol (ODMRP), Destination driven on demand multicast routing protocol (D-ODMRP) and core assisted mesh protocol (CAMP).

There is one more types of routing protocol hybrid protocol which is a combination of both tree based protocol and mesh based protocol. An example of hybrid protocol are (AM Route) ad hoc multicast routing protocol

Section 1: MAODV (multicast ad hoc on demand distance vector[4]):

It is the extension in the ad hoc on demand distance vector (AODV). A MAODV[4] using broadcast route discovery mechanism called route request (RREQ) and route reply (RREP) messages to discover the multicast route in the network. When a source or node want to join a network/multicast group or it has data to send but doesn’t has a route then it generates route request message. Only the member of the multicast respond or reply for the route request.

When an intermediate node receives a route request but it is not a member of multicast group then it rebroadcast the message to the neighbor until it reach a receiver or of the node of multicast group member. But if the RREQ is not a join request any node of the multicast group may respond. While the RREQ is a broadcast message the nodes set up pointers to establish a reverse route in their route table. On receiving RREQ every nodes updates its routing table.

When a node receives a RREQ it updates its path information into the routing table. The routing table also contains source ID, sequence number, next hop information (distance from source). A reverse path entry may be used when the node respond back to the source. For join route request (RREQs) an additional entry is added in the route table. This entry is not activated unless the route is selected to be a part of the multicast tree. If a node receives a join RREQ for a multicast group, it may reply if it is a member for the multicast group’s tree and its recorded sequence number for the multicast group is at least as great as that contained in the RREQ. The responding node updates its route and multicast route tables by placing the requesting node’s next hop information in the tables, and then unicasts a Request Response (RREP) back to the source node. As nodes along the path to the source node receive the RREP, they add both a route table and a multicast route table entry for the node from which they received the RREP, thereby creating the forward path.

Section 2:

On Demand Multicast Routing Protocol I (ODMRP)[3]

On demand routing protocol is designed to overcome the issues with the typical tree based structure. It provide on demand routing techniques to avoid channel overhead and improve scalability. It uses the forwarding group concept to forward the multicast packet via shortest path from source to destination/receiver or between any member pair to build a forwarding mesh for each multicast group. It uses the soft state approach for continuously maintaining the communication link (a multicast group membership and their associate routes are periodically refreshed which necessitate the flooding of control packet). In on-demand
routing protocol if any node want to leave the group than there is no need to send the control message.

Figure 2. ODMRP

The on demand routing protocol consist of join-data and join-reply phases:

1. **Join-data**: When a source requires sending data but has no route than it broadcast the join data to the overall network to refresh the membership. Then the receiving node store the back ward learning into the routing table and re-broadcasts the packet.

2. **Join-reply**: Finally when the query reaches a receiver creates a join_ reply and broadcast it to the neighbors. Node receiving the join_reply checks whether the next node ID in the join-reply matches its own. If yes, it is a part of the forwarding group then set its FG-flag and broadcast its join-reply built upon the matched entries.

Now the join reply is propagated by each forwarding group member until it reaches the source via shortest path. Routes from source to receiver build a multicast mesh of nodes is called forwarding group.

Destination driven on demand multicast routing protocol (D-ODMRP)[1]:

It is the extension in on demand multicast routing protocol (ODMRP). The design objective of D-ODMRP is just to improve the multicast forwarding efficiency. To achieve this goal the path to reach a multicast destination (source to receiver) is biased towards those path passing through another multicast destination. If number of paths are available it select path which is of least extra cost. In other words, D-ODMRP is used to reduce the number of nodes to be added in the forwarding group. D-ODMRP introduces the destination driven features in to the existing on demand process of multicast forwarding structure. D-ODMRP modifies the regular route request flooding process for building a multicast tree by intensely add a deferring time at each intermediate node to forward the every route request based on how far this intermediate node is away from the last multicast group member visited by the received route request.

Figure 3. DODMRP

The larger the distance is more will be the deferring time. so, on considering this deferring time the route request introduce the least extra cost are travel faster than the others which have larger deferring time. As a result cost
effective forwarding structure can be created. No extra overhead is created as compare with the existing on demand routing protocol. D-ODMRP is the advancement in the existing on-demand multicast routing protocol [3] and greatly improves the multicast forwarding efficiency. D-ODMRP is consists of three phase. These three phases repeat themselves periodically as the multicast source keeps sending multicast packet into the network.

1. Join query/route request
2. Join reply/route reply
3. Data forwarding

When a source has to send data but it has no route then it send join query to establish a route between source and destination. D-ODMRP also work on the forwarding group concept which means only a subset of nodes will fo rward data from source to destination. Only a multicast member will respond to the query and if the join query is the simple request then all nodes will respond to them. Finally when the query reaches a receiver creates a join reply and broadcast it to the neighbors. Node receiving the join-reply checks whether the next node ID in the join-reply matches its own. If yes, it is a part of the forwarding group then set its FG-flag and broadcast its join-reply built upon the matched entries.

Now the join reply is propagated by each forwarding group member until it reaches the source via shortest path. Routes from source to receiver build a multicast mesh of nodes is called forwarding group.

Section 3:
Ad-hoc multicast routing protocol (AM Route)[4]

AM Route is a hybrid approach used in wireless ad-hoc network. It has two faces: Tree and mesh. Basically hybrid approach is a combination of both tree based and mesh based protocol. By using mesh face, AM Route identifies and designates certain nodes as logical cores that are responsible for initiating the signaling operation and maintaining the multicast tree to the rest of the group members. A non-core node only responds to messages from the core nodes and serves as a passive agent. The selection of a logical core in AM Route is dynamic and can migrate to any other member node depending on network dynamics and group membership. AM Route does not address network dynamics and assumes the underlying unicast protocol to take care of it.

The second part of this protocol is a mesh. All node in the multicast group start to creating mesh between them. When a source has to send data it broadcast join request to all the core nodes in the network. Only some selected nodes will respond to this query rest of all will only pass query to the destination. After query reached a destination/receiver a join reply will generate and unicast back to the same path as it is in the case of join query. When a mesh has been created between core nodes then it will going for tree building process.

The core node will start to send Tree_create message to all of the core nodes in which mesh has been settled. Every Tree_create message receiver will forward message to all
multicast mesh link except the parent one. Then the Tree_create message is discarded and Tree_NAK is been sent back to the parent. If there is node wants to leave the group, it is try to send a JOIN NAK message to nodes that have connection with him.

The main disadvantages of this protocol are that a temporary loop has been created in the network which will degrade the network performances.

**Conclusion**

We propose a multicast routing protocol in mobile ad-hoc network. Basically there are two types of multicast routing protocol exist in mobile ad-hoc network. A tree based multicast routing protocol has a poor connectivity because there is only a single path is there between sources to destination. However mesh based multicast routing protocol has a richer connectivity between source and destinations as these are in the network in which mesh is made. As we find that among these routing protocols destination driven on demand multicast routing protocol is best one in terms of connectivity and data packets delivery ratio.

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