Performance Analysis of Ad-hoc Routing Protocols in Multicast Environment

S. Aruna[a,*], A. Vanitha[b,1], Dr.A. Subramani[c,2]

Abstract— **Recent advances in mobile computing and wireless technologies are opening up exciting possibilities for the future of mobile wireless networks. An ad hoc mobile network consists of mobile platforms, which are free to move arbitrarily. In MANETs, nodes are mobile and the connectivity between nodes may change frequently due to mobility of nodes. In recent years, a number of new multicast protocols of different styles have been proposed for ad hoc networks. This paper examines eight different multicast routing protocols for ad hoc wireless networks and evaluates them based on a set of parameters. It also provides an overview of multicast protocols by presenting their features and functionality, and compare and discuss their merits and disadvantages.**

Index Terms **— Ad-hoc networks, MANET, Routing Protocol, Multicast**

I. INTRODUCTION

A mobile ad hoc network (MANET) is an autonomous system of mobile hosts (also serving as routers) connected by wireless links, the union of which form a communication network modeled as an arbitrary communication graph [1]. This is in contrast to the known model of a single hop cellular network that meets the needs of wireless communications by installing base stations, access points. In cellular networks, communications between two mobile nodes rely entirely on the backbone cable and fixed base stations. In a MANET, there is no infrastructure, and network topology can dynamically change in an unpredictable manner since nodes are free to move. Multicasting is the transmission of datagram to a group of hosts identified by a unique destination address and thus is aimed at computer-oriented groups. In MANETs, multicast can efficiently support a variety of applications that are characterized by their close collaboration. For example, "community based applications," is expected to attract much attention in the world of data communication in the near future. This is a typical application of ad hoc network, where users are mobile and a community of interest is how demand for use of portable devices. There are many applications of MANETs, "the transfer of email and file" can be considered easier to implement in an ad hoc network environment. "Web services" are also possible if all nodes in the network can serve as a gateway to the world. However, MANETs, having the ability to self-organization can be used effectively on the battlefield. Therefore, if you can combine efficiently the characteristics of a MANET with the utility of multicast, it is possible to conduct a series of planned correspond to groups of applications. With this in mind, this document provides information on the current state of the art in multicast protocols for MANETs and compared with respect to various performance metrics. The paper is organized as follows. Initially summarizes the specific features that are needed to provide multicast in a MANET. Next, cover multicast routing protocols in a MANET in detail, their classification based forwarding mechanism. Open problems in the field of multicast over MANETs that still need attention are described. We conclude this article by providing information about future directions of this research field.

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II. ISSUES IN PROVIDING MULTICAST IN A MANET

Well established routing protocols exist to provide an efficient multicast service in conventional wired networks. These protocols, having been designed for fixed networks cannot keep up with node movements and frequent topology changes in a MANET. As nodes become increasingly mobile, these protocols must evolve to provide an efficient service in the new environment. Therefore, the adoption of multicast protocols existing wired as such to a MANET, which completely lacks infrastructure, it seems less promising. The host mobility increases the protocol overhead substantially. By contrast, the new protocols are proposed and investigated with topics such as topological changes into account. Moreover, the nodes in a MANET based on the batteries; Thusman routing protocols must limit the amount of control information passed between nodes. Most applications are in areas where rapid diffusion and dynamic reconfiguration are necessary and a landline is unavailable. These include military battlefields, sites search and rescue emergency, classrooms, and conventions where participants share information dynamically using their mobile devices. These applications lend themselves well to multicast operation. Furthermore, within a wireless medium is even more crucial to reduce the overhead transmission and energy consumption. Multicasting can improve the efficiency of wireless connections, sending multiple copies of messages, by exploiting the inherent broadcast property of wireless medium when multiple mobile nodes are in transmission range of a node. However, in addition to the problems of any ad hoc routing protocol above, wireless mobile multicasting faces several challenges. The members of the multicast group can move, which prevents the use of a fixed multicast topology. Transient loops may form during reconfiguration of the distribution structure (eg a tree), as a result of mobility. Therefore, the reconfiguration plan should be simple to maintain low overhead channel. As we can see, providing efficient multicast on MANET faces many challenges, including the membership of the group dynamic and constantly updating the route of delivery due to movement of the node.

III. MULTICAST ROUTING PROTOCOLS

A simple way to provide multicast in a MANET is through flooding. With this approach, data packets are sent through the MANET, each node receiving this packet is transmitted to all its immediate neighboring nodes only once. It is suggested that a network of highly mobile ad hoc, flooding the entire network can be a viable alternative for reliable multicast. However, this approach has considerable overhead because a number of duplicate packets sent and packet collisions occur in a MANET-based multiple access. This section discusses the proposed multicast routing protocols for MANET. For simplicity, we classified into four categories based on how to create paths to group members:

- Tree-based approaches
- Meshed approaches
- Hybrid approaches

A. Tree-Based Approach

Tree-based multicast is a well established concept in wired networks. Most plans to provide multicast in cable networks are shared code or tree base. Different researchers have tried to broaden the approach for providing multicast tree in a MANET. This section provides a summary of some of these approaches.

I) Ad Hoc Multicast Routing Protocol Utilizing Increasing ID Numbers (AMRIS): Amris [3] is a protocol to the letter that builds a shared tree multicast delivery (Figure 1) to support multiple senders and receivers in a multicast session. Amris dynamically allocates an identification number to each node each multicast session. Based on the identification number, a tree of multicast delivery - rooted in a special node with the smallest ID (SID) - is created, and increased identification number as the tree expands from the SID . In general, Sid is the source or the node that initiates a multicast session. The first step in Amris protocol operation is the selection of Sid If a single consignor of a group, the SID is usually the source of the group. In the case of multiple senders, a Sid is selected from the set of senders. SID Once identified, sends a new session to your neighbors. The contents of this message includes multicast SID member ID of the session (MSM-id) and routing metrics. The nodes receiving the message NEW SESSION generate their own msm-IDS, which are larger than the msm-ID of the sender. If a node receives NEW SESSION multiple messages from different nodes, the message remains the best routing metrics and calculates msm-IDS. To join an ongoing session, a control node the new message of the session, a parent determines the lowest msm-id, and unicasts a JOIN-REQ to its potential parent node. If the node TGE father is in the tree of multicast delivery, it responds with a JOIN-ACK. Otherwise, the father attempts to join the multicast tree by sending a JOIN-REQ to his father. If a node can not find any potential parent node, runs a branch of the reconstruction (BR) process to join the tree. BR consists of two subprograms. BR1 is executed when a node has a parent node potential of a group (as mentioned above). If there are no potential parent node, BR2 runs. In BR2, instead of sending a unicast JOIN_REQ a potential parent node, the node sends a JOIN-REQ, which consists of a field investigation to specify the range of the nodes to jump R. After rupture of the link, the node with the highest msm-id is meeting with the tree by running any of the mechanisms of BR. Amris is noteworthy that detects the disconnection of a mechanism for signaling link. Therefore, until the tree is rebuilt, the packets might be dropped.

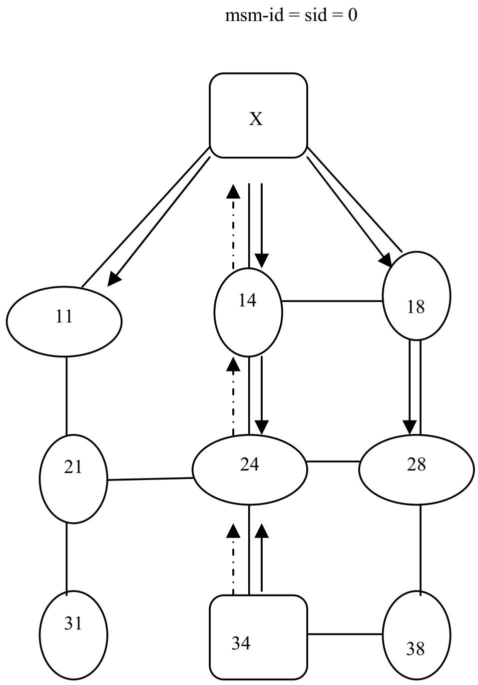
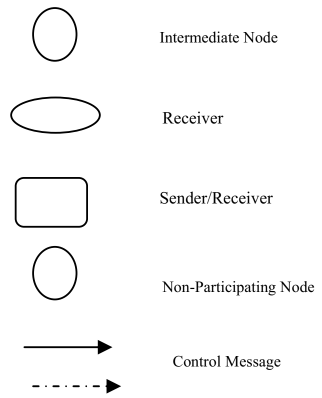


Figure 1. AMRIS Packet Forwarding



II) Multicast Ad Hoc On-Demand Distance Vector (MAODV) Protocol: MAODV routing protocol [4] follows directly from unicast and multicast AODV discovers routes to the letter with a broadcast route discovery mechanism employing the same route request (RREQ) and route reply (RREP) messages that exist in the unicast AODV protocol. A mobile node originates a RREQ message when it wants to join a group, or has data to send to a multicast group, but has no route to that group. Only one member of the desired multicast group may respond to a RREQ join. If the RREQ is not a solicitation to participate, any node with a fresh enough route (based on group number sequence) to the multicast group can respond. If an intermediate node receives a RREQ to join a multicast group that is not a member or that receives a RREQ and do not have a route to that group, which broadcasts the RREQ to its neighbors. As the RREQ is transmitted through the network nodes to establish indicators to establish the reverse route in their routing tables. A node receiving a RREQ first updates its routing table to record the sequence number and next hop information for the source node. This reverse route entry may later be used to transmit a response to the source. To join RREQs, an additional entry is added to the multicast routing table and is not activated unless the route is selected to be part of the multicast tree. If a node receives a RREQ to join a group, you can respond if a member of the multicast group tree and its recorded sequence number for the multicast group is at least as great as that contained in the RREQ. Responding node updates its route and multicast route tables by placing next to the requesting node hop information in the tables, and then a unicasts RREP to the source. As nodes in the path to the source receiving the RREP, they add both a routing table and an entry in the multicast routing table for the node receiving the RREP, thereby creating a way forward (Fig. 2). When a source node broadcasts a RREQ for a multicast group, which often receive more than one answer. The source node keeps the received route with the highest sequence number and least number of hops to the nearest member of the multicast tree for a given period of time, and ignores other routes. At the end of this period, enables the selected next hop routing table multicast and unicast an activation message (MACT) to this selected next hop. The next leap, to get this message allows the entry for the source node in its multicast routing table. If this node is a member of the multicast tree, it spreads the message further. However, if this node is not a member of the multicast tree, it would have received one or more RREPs of its neighbors. It keeps the best next hop for the route to the multicast group, unicast MACT for the next hop, and allows the entry in its multicast routing table. This process continues until the node that originated the RREP chosen (member of tree) is reached. The activation message ensures that the multicast tree does not have multiple paths to any tree node. Note that the nodes transmit data packets only along the active route. The first member of the multicast group becomes the leader of that group, which also becomes responsible for maintaining the multicast group sequence number and spread this number to the multicast group. This update is done through a Group Hello message. The Group Hello contains extensions that indicate the multicast group IP address and sequence numbers (incremented every Group Hello) of all multicast groups to which the node is the group leader. Since AODV maintains "hard state" in its routing table, the protocol has to actively follow and react to changes in this tree. If a member terminates their membership with the group, the multicast tree requires pruning. Links in the tree are monitored to detect a broken link, and the node that is farther from the multicast group leader (downstream of the break) takes the responsibility to repair the broken link. If the tree cannot reconnect to a new leader for the disconnected downstream node is chosen as follows. If the node that initiated the route rebuilding is a member of the multicast group becomes the new leader of the multicast group. On the other hand, if not a member of the group and has only one next hop for the tree, pruning the tree by sending its next hop a prune message. This continues until a group member is reached.

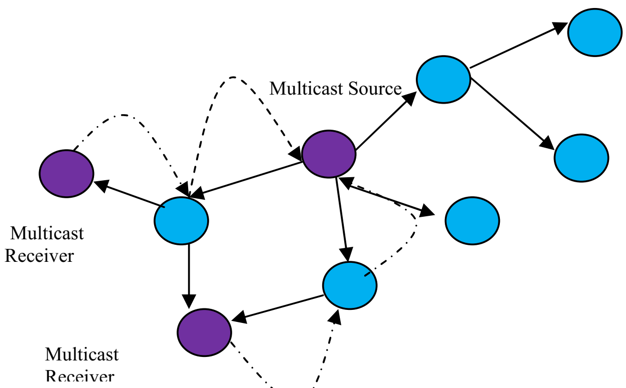
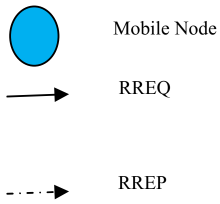


Figure 2. Route Discovery in MAODV Protocol



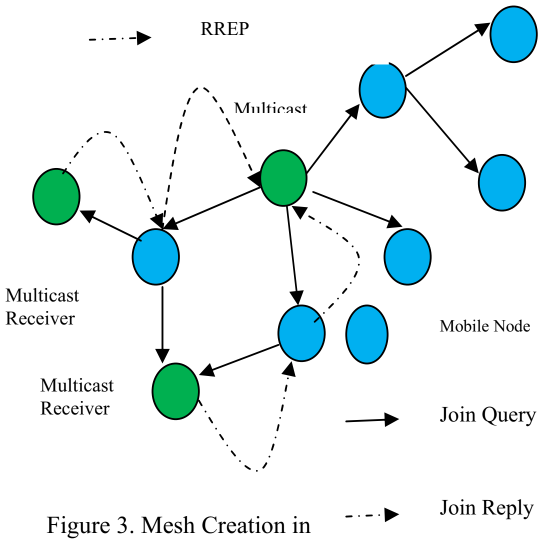


Figure 3. Mesh Creation in ODMRP

Once separate partitions reconnect, a node receives the final group for the information of multicast group Hi group containing different leader of the information you have. If this node is a member of the multicast group, and if a member of the partition that the group leader has the lowest IP address, you can start the reconnection of the multicast tree.

B. Mesh-Based Approach

In contrast to an approach based on trees, mesh-based multicast protocols can have multiple paths between any source and receiver. Existing studies show that tree-based protocols are not necessarily the most suitable for MANET multicast on a network, where frequent changes in topology. In such an environment mesh-based protocols seem to outperform tree-based proposals due to the availability of alternative paths that allow multicast datagrams to be delivered to recipients, even if the links do not. This section provides a summary of some of the mesh-based approaches to provide multicast in a MANET.

I) On-Demand Multicast Routing Protocol (ODMRP): ODMRP [7] is a mesh protocol uses a concept of group sending (only a subset of nodes forwards multicast packets). A soft state approach is taken in ODMRP to maintain multicast group members. No explicit control message is required to leave the group. In ODMRP, group membership and multicast routes are established and updated by the source of demand. When a multicast source has packets to send but no route to the multicast group, transmitting a control packet of Income and consultation across the network. This package of income-query periodically broadcast to update the membership information and update routes as shown in the figure. 3. When an intermediate node receives a packet of Income-consultation, which stores the source ID and sequence number in its cache to detect duplicate messages. The routing table is updated with a corresponding node ID (ie, backward learning) from which the message has been received. If the message is a duplicate and the TTL is greater than zero, which is relayed. When a packet Income-query reaches a receiver, which creates and broadcasts a Join-Reply to its neighbors. When a node receives a Join-reply, it checks if the ID of next hop node of the entries matches its own identification. If it does, the node realizes that it is on the way to the source and therefore the group of the expedition, and sets the forwarding group flag (FG_FLAG). It then transmits its own Join-response based on the matching entries. The next hop node ID field contains the information from its routing table. Thus, each group member propagates the Join-Reply until it reaches the multicast source via the selected (shortest) path. This process constructs (or updates) the routes from sources to receivers and creates a mesh of nodes. After setting a transmission group and the process of building the route, a source can multicast packets to receivers via selected routes and forwarding groups. While a node has data to send, the source periodically sends query packets to update Income-group transmission and routes. Upon receiving the multicast data packet, a node sends only when there is a duplicate and the setting for the multicast group FG_FLAG has not expired. This procedure minimizes traffic overhead and prevents sending packets through stale routes. In ODMRP, no explicit control packets should be sent to join or leave the group. If a multicast source wants to leave the group, simply stops sending Join-Query packets since it does not have data to send to the multicast group. If the receiver does not want to receive a multicast group, which sends the Join-response for that group. Nodes forwarding group are demoted to the lymph nonforwarding if not updated (no Join-Replies received) before timeout.

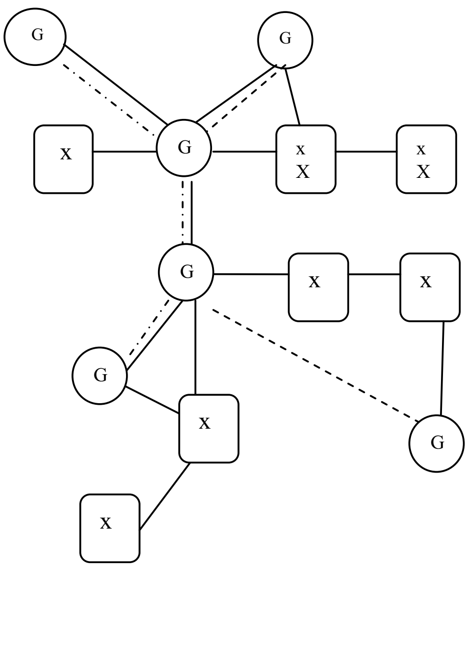
II) Core-Assisted Mesh Protocol (CAMP): Core-assisted mesh (CAMP) [8] supports multicasting by creating a shared mesh for each multicast group. Meshes created to help keep connectivity to multicast users, including mobility of the node. Take concepts of CBT, but unlike the CBT in which all traffic flows through the hub, the central nodes of CAMP are used to limit the control traffic needed for receivers to join multicast groups . The basic operation of the field includes the construction and maintenance of the mesh of multicast to a multicast group. It is assumed that a mapping service that provides routers with the addresses of groups identified by their names. This also implies the availability of routing information from a unicast routing protocol. Each router maintains a routing table (RT) built with the unicast routing protocol. This table is modified by CAMP when multicast group has to be inserted or removed. Based on RT, a multicast routing table (MRT) is built, which consists of a set of groups known to the router. A router can update its MRT based on the topological changes or messages received from its neighbors. CAMP classifies nodes in the network in three modes: single, double, and non-members. A router joins a group in simple mode if it intends only to send the traffic received from the specific nodes or neighbors to the rest of the group, and has no intention of sending packets of the group. A member of the duplex forward multicast packets for the group, while the nodes that are not members need not be in the mesh of multicast delivery. CAMP uses a receiver initiated method for routers to join a multicast group. If a router wishing to join a group of neighbors has multiple faces that are members of the multicast group, it simply changes MRT and directly announces to its neighbors that it is a new member of the multicast group with multicast routing update. If you have neighbors who are members of the multicast group, or propagates a request to join a multicast group of "core" or attempts to reach a member by expanding your search of the ring. Any router that is a regular member of the multicast group and has received the application for membership is free to join to transmit an acknowledgment (ACK) to the source router. A router can leave a group if you have hosts that are members of the group and has no neighbors for whom it is an anchor, ie, as long as there is no need to provide efficient routes for the dissemination of packets in the mesh multicast groups. The cores are also allowed to leave the multicast group, if there are routers used as anchors.

C. Hybrid Approach

Multicast protocols in MANETs provide discussed so far relate to both efficiency and robustness, but not both simultaneously. The tree-based approaches provide high data transmission efficiency at the expense of low strength, while the mesh-based approaches provide better robustness (link failure may not trigger a reconfiguration) to expense of higher costs of sending and increased network load. Therefore, it is possible that a hybrid multicast can achieve better performance by combining the advantages of both approaches on trees and mesh. This section discusses some of the different hybrid approaches to provide ad hoc multicasting.

I) Multicast Routing Protocol Special (AMRoute): The

Special Committee Multicast Routing Protocol (AMRoute) [11] creates a bidirectional tree, shared by senders and receivers of only one group as the nodes of the tree of data distribution. The protocol has two main components: the creation of the mesh and the tree configuration (Fig. 5). The creation of mail identifies and designates certain nodes as logical cores, and these are responsible for initiating the operation of the signaling and maintenance of the multicast tree with the rest of the group. A non-essential node only responds to messages from the main nodes and serves as a passive agent. The selection of a core logic in AMRoute is dynamic and can migrate to any node of another member in terms of the dynamics of the network and membership in the group. AMRoute not analyze the dynamics of the network and assumes that the underlying unicast protocol takes care of it. To create a mesh, each member begins identify itself as a core and packages JOIN_REQ emissions increase the lifetime (TTL) to find other members. When a nucleus JOIN_REQ receives from a core in a different mesh for the same group, it responds with a JOIN_ACK. A bi-directional tunnel is created between the two cores, and one of them is selected as a core following the merger of the mesh. Once the mesh has been set, the kernel starts the process of creating trees. The core sends out regular messages TREE_CREATE over incidents of links on your screen. The use of unicast tunnels, the messages are sent only to TREE_CREATE group members. Members of the group that receives a message unduplicated TREE_CREATE forwarded to all mesh links except the entry, and marks the incoming and outgoing links and the links of the trees. If a relationship is not going to be used as part of the tree, TREE_CREATE_NAK TREE_CREATE is discarded and sent back to inbound links. A member node you want to leave a group can do so by sending a message to its neighboring nodes JOIN_NAK. AMRoute virtual mesh links used to establish the multicast tree, which helps keep the tree from the multicast delivery unchanged with changes in network topology, as long as the routes between the main nodes and tree limbs available through links in the mesh. The main disadvantage of this protocol is that it may have loops and temporary trees can create optimal host mobility.



G – Group Member/Router

X – Non-group Member

Link

Virtual multicast tree

Figure 4. AMRoute Virtual Multicast Tree

D. COMPARISON OF MULTICAST ROUTING PROTOCOLS

The basic idea behind defining multicast routing protocols for MANETs is to form a path to group members with minimal redundancy, and various protocols have been deviced to achieve this goal using different mechanisms. Therefore, the following table compares the prominent multicast protocols over MANETs under several metrics.

Protocols	**Multicast Topology**	**Loop Free**	**Dependence on Unicast Protocol**	**Periodic Message**	**Control Packet Flooding**
AMRIS	Tree	Yes	No	Yes	Yes
MAODV	Tree	Yes	Yes	Yes	Yes
ODMRP	Mesh	Yes	No	Yes	Yes
CAMP	Mesh	Yes	Yes	Yes	No
AMRoute	Hybrid	No	Yes	Yes	Yes

Table-1: Comparison of Ad-hoc Multicast Routing Protocols

E. CONCLUSION

Within the wired network, well-established existing routing protocols to provide efficient multicast service. The adoption of cable multicast protocols for MANET, which are devoid of infrastructure, it seems less promising. These protocols, having been designed for fixed networks can not keep up with node movements and frequent topology changes due to host mobility and protocol costs can increase substantially. By contrast, the new protocols that operate on-demand are being proposed and investigated. Existing studies show that the tree based on demand protocols are not necessarily the best choice for all applications. In a hostile environment, where changes in the topology of the network frequently, the mesh-based protocols seem to outperform tree-based protocols because of the availability of alternative paths that allow data grams multicast be delivered to all or most multicast receivers, although some links. Among the tree-based approaches and the base mesh, we can find hybrid protocols suitable for medium mobility network drawing on both a tree and a mesh structure. We have provided a detailed description of the current state of the art in multicast protocols for MANETs and compared with several criteria.

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