

Implementation of a Tree Based Multicast Routing Protocol in MANET

G.Brindha, Mr.S.Jebakumar Gomer Rajadurai, Dr.K.Ramasamy

Abstract— The Mobile ad hoc network (MANET) is formed by mobile stations inside a restricted area which communicate without the need of access point. In an ad hoc network the mobile nodes agree to serve as both routers and hosts. One of the main challenges of MANET is the design of robust routing algorithms that adapt to the frequent and randomly changing the position of the node. Many type of on demand routing protocols has been proposed and several have been extensively simulated. We proposed Multicast Ad hoc on demand Distance Vector Routing Protocol. MAODV allows each node in the network to send out multicast data packets and the multicast data packets are broadcast when propagating along the multicast group tree. Our main objective is to implement and analyze the MAODV protocol in terms of the latency and the packet delivery ratio (PDR).

Index Terms— Latency, Manet, Multicast, MAODV, PDR, Routing, Tree based protocol.

1 INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring network of mobile routers (and associated hosts) connected by wireless links - the union of which form a random topology. The routers are free to move randomly and systematize themselves at random; thus, the wireless topology of network may change rapidly and randomly (and associated hosts) connected by wireless links - the union of which form a random topology. Such a network may operate in an impartial method, or may be connected to the superior Internet. With the increase of portable devices as well as progress in wireless communication, ad-hoc networking is more important with the rising number of extensive applications. Ad-hoc networking can be applied everywhere where there is little or no communication infrastructure or the existing infrastructure is expensive or difficult to use. Ad hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to the network. The set of applications for MANET is miscellaneous, ranging from comprehensive, mobile, highly dynamic networks, to small, static networks that are inhibited by power sources. Besides the inheritance applications that move from traditional infrastructure environment into the ad hoc framework, a great deal of new services can and will be generated for the new environment. Typical applications include military battlefield, commercial sector, Personal Area Network (PAN) etc.

2 RELATED WORKS

Elizabeth M.Royer et.al [6] extend Ad hoc On Demand Distance Vector Routing (AODV), an algorithm for the operation

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of such ad hoc networks to offer novel multicast capabilities which follow naturally from the way AODV establishes unicast routes. AODV builds multicast trees as needed to connect multicast set members. Control of the multicast tree is distributed so that there is no single point of failure. AODV provides loopfree routes for both unicast and multicast, even while repairing broken links.

Singh, Y. et.al[12] have proposed simulation based experiments are performed to analyze the performance of On Demand Multicast Routing Protocol by evaluating Packet Delivery Ratio, End to End delay and average throughput. These results are compared with AODV and FSR routing protocols by varying number of nodes and mobility. The comparison shows that ODMRP for adhoc networks performs better as compared to AODV and FSR.

Qabajeh, M.M. et.al[13] have proposed a model that searches for QoS paths from a single source to a set of destinations. The physical area is partitioned into equal size hexagonal cells and a leader and backup leader nodes is elected to maintain up-to-date information about the network topology. Efficient routing is performed based on nodes positions to deliver data packets to all the receivers.when it is compared with ODMRP, it gives less packet drop ratio with significant reduction in control overhead.

3 MULTICAST ROUTING PROTOCOLS FOR MANET

Ad hoc wireless networks find applications in civilian operations emergency search and rescue, law enforcement, and war fare situations, where setting up and maintaining a communication infrastructure may be difficult or costly. In all these applications, communication and coordination among a given set of nodes are necessary. Routing protocols that find a path to be followed by data packets from a source node to a destination node used in traditional wired networks cannot be directly applied in ad hoc wireless networks due to their highly animated topology, absence of established infrastructure for centralized administration (e.g., base stations or access points), and bandwidth -constrained wireless links and resource constrained nodes.

Based on the type of operation, multicast protocols for ad hoc wireless networks are broadly classified into two types:

- Source initiated protocols
- Receiver initiated protocols

In the source initiated multicasting protocols, the source uses flooding to search for paths to the receivers of the multicast groups to which it belongs. Here hard or soft state maintenance approaches are used for mesh or tree networks.

In soft state approach the source of the multicast group periodically floods a JoinRequest packet throughout the network. This is a two pass protocol for establishing tree or mesh. There is no explicit procedure for route repair. In the hard state approach there is an explicit route repair procedure that is initiated when a link break is detected.

Multicast routing protocols play an important role in ad hoc wireless networks to provide this communication. It is always, advantageous to use multicast rather than multiple unicast, especially in the ad hoc environment, where bandwidth comes at a premium. There are some issues in designing multicast routing protocols known as Robustness, Efficiency, Control overhead, Bandwidth, Resource management and Quality of service. Limited bandwidth availability, an error prone shared broadcast channel, the mobility of nodes with limited energy resources, the hidden terminal problem and limited security make the design of a multicast routing protocol for ad hoc networks a challenging one.

In the receiver initiated multicasting protocols, the receiver uses flooding to search for paths to the sources of the multicast groups to which it belongs. Here also hard or soft state maintenance approaches are used for mesh or tree networks. The tree construction is a three phase process.

3.1 Tree Based Routing Protocols

Wireless networks do not share the robust and high-speed links enjoyed by their wired counterparts. Wireless connections have a small data carrying capacity, a relatively high error rate, and are unreliable when compared to traditional wired connections. Without a backbone network individual host-routers must have the ability to maintain routes and forward data to downstream nodes. At last count, close to a dozen different MANET routing protocols have been proposed

Depending on how the routes connect the multicast members with each other, we can basically distinguish two major categories of protocols based on topology, known as tree based and mesh based protocols. In tree based multicast routing protocols, there is only one path between a source-receiver pair. The main drawback of these protocols is that they are not robust enough to operate in highly mobile environments. There are two types in tree based multicast routing protocols known as:

- Shared tree based protocol
- Source tree based protocol

In shared tree based protocol the state information is maintained per group. These are more scalable when compared to source tree based protocols.

In source tree based protocols the tree is routed at the source whereas a shared tree based multicast protocols, a single tree is shared by all the sources within the multicast group. In source tree based protocols a single multicast tree is main-

tained per source. The increase in the number of sources gives rise to a proportional increase in the number of source trees.

The main problem in a shared tree based multicast protocol is that it heavily depends on the core node, and hence, a single point failure at the core node affects the performance of the multicast protocol.

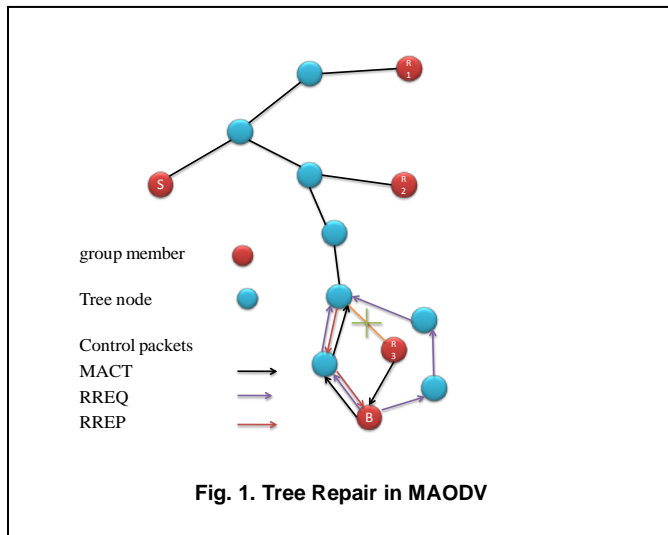
4 MULTICAST AD-HOC ON-DEMAND DISTANCE VECTOR (MAODV)

Multicast Ad-Hoc On-Demand Distance Vector (MAODV) is routing protocol is implemented. It is used to identify multicast routes on demand using a broadcast route-discovery mechanism. A source node originates a Route Request (RREQ) message when it desires to join a multicast group, or when it has data to launch to a multicast group but it does not have a route to that group. Only a member of the desired multicast group may respond to a join RREQ. If the RREQ is not a join request, any node with a fresh enough route (based on group sequence number) to the multicast group may retort.

If an intermediate node receives a join RREQ for a multicast group of which it is not a member, or if it receives a RREQ and it does not have a route to that group, it rebroadcasts the RREQ to its neighbors. As the RREQ is broadcast across the network, nodes set up pointers to establish the reverse route in their route tables. A node receiving a RREQ first updates its route table to record the sequence number and the next hop information for the source node. This reverse route entry may later be used to relay a response back to the source. For join RREQs, an additional entry is added to the multicast route table. This entry is not activated unless the route is selected to be 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.

When a source node broadcasts a RREQ for a multicast group, it often receives more than one reply. The source node keeps the received route with the greatest sequence number and shortest hop count to the nearest member of the multicast tree for a specified period of time, and disregards other routes. At the end of this period, it enables the selected next hop in its multicast route table, and unicasts an activation message (MACT) to this selected next hop. The next hop, on receiving this message, enables the entry for the source node in its multicast route table. If this node is a member of the multicast tree, it does not propagate the message any further. However, if this node is not a member of the multicast tree, it will have received one or more RREPs from its neighbors. It keeps the best next hop for its route to the multicast group, unicasts MACT to that next hop, and enables the corresponding entry in its multicast route table. This process continues until the node that originated the RREP (member of tree) is reached.

The activation message ensures that the multicast tree does not have multiple paths to any tree node. Nodes only forward data packets along activated routes in their multicast route tables.



The first element of the multicast group becomes the head for that group. The multicast group head is responsible for maintaining the multicast group sequence number and distributing this number to the multicast group. This 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 for which the node is the group head. Elements use the Group Hello information to update their request table.

Main objective is to reduce the latency, to increase the PDR (Packet Delivery Ratio) and to reduce the bandwidth consumption by reducing the number of forwarders for reducing number of hosts in packet transmission. The same RREQ and RREP messages used in AODV are adapted to be used for tree construction in MAODV. The node creates an entry in its Multicast Route Table, and identifies itself as a group member, but with an unknown group leader address, and without any upstream and downstream next hop. If a node in the tree but not a group member wants to become a group member, it simply changes its identity recorded in its Multicast Route Table, from a router to a group member. Multicast Route Activation (MACT), message is used for grafting a branch to the tree.

4.1 Proactive Approach

We add the reactive connection maintenance feature to the tree maintenance in MAODV implementation. A route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path.

In an on-demand routing protocol, the source node floods the RouteRequest packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest. That is, the route is established when the node wants to join

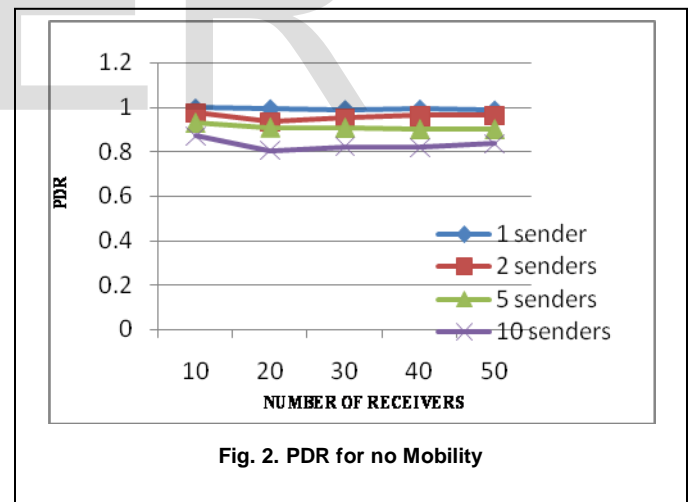
the tree or when the node wants to transmit the message.

To predict the link breakage time of an active link in the tree before the breakage actually happens, then a new connection is pro-actively constructed before the old one actually becomes unavailable, in order to avoid the loss of data packets on that link.

5 EXPERIMENTAL SETUP AND ANALYSIS

The performance of MAODV is analyzed. The number of senders increased as 1, 2, 5 and 10 and the number of receivers are increased as 10, 20, 30, 40, and 50. The PDR (Packet Delivery Ratio) and Latency with no pause time for 0m/s mobility, 1m/s mobility and 20m/s maximum speed are calculated. Latency is the average delay for data transfer from a sender to a receiver. The network simulator ns2.26 is used for implementation. The simulation area is 1500 x 300 meters with 50 nodes. The Physical/Mac Layer IEEE 802.11 at 2Mbps is used in 250 meter transmission range. All receivers join a single multicast group at the beginning of the simulation. Only multicast traffic exists in the simulation. When the multicast group size increased the number of control packets also increased. By increasing the PDR the network throughput also increased. The ratio of the data packets delivered to the destinations to those generated by the CBR sources is known as packet delivery fraction.

The following figures show the analysis results for Multicast Ad hoc on demand Distance Vector Routing protocol.



For single sender the PDR will be high, when the number of sender increased to 10 the PDR is decreased. That is when the number senders increased the PDR will be decreased.

For the single sender the latency is low, when there are 2 senders the delay is increased. As a result when the number of senders increased the delay (Latency) is also increased.

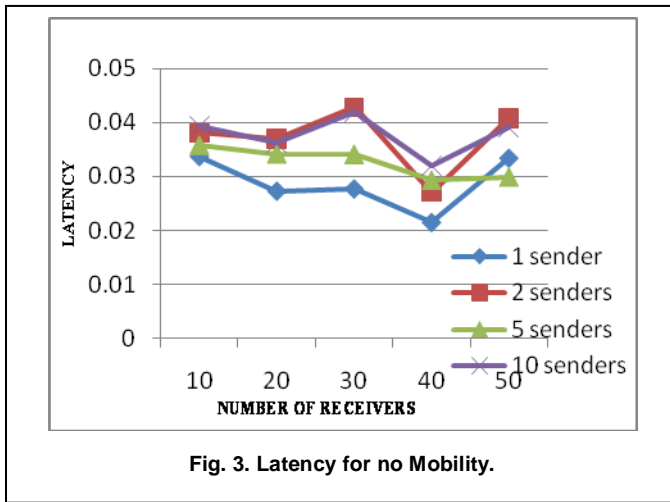


Fig. 3. Latency for no Mobility.

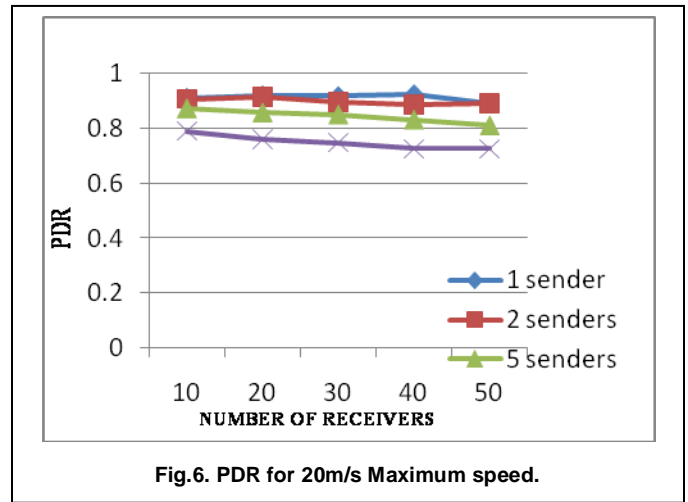


Fig.6. PDR for 20m/s Maximum speed.

In fig.5 and fig.7 the latency for 1m/s and 2m/s is calculated and the graph is plotted.

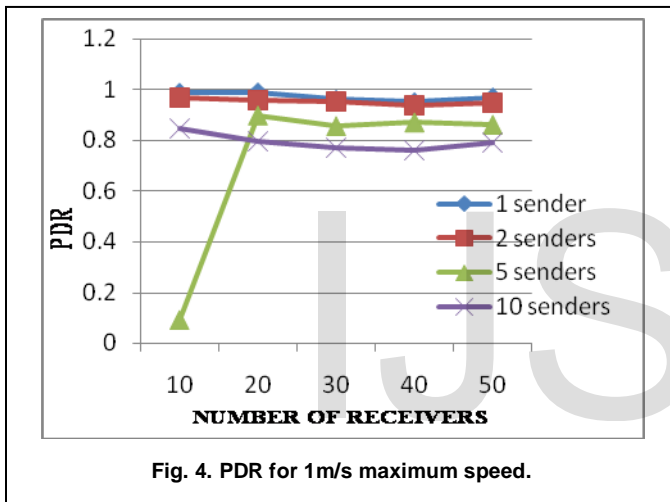


Fig. 4. PDR for 1m/s maximum speed.

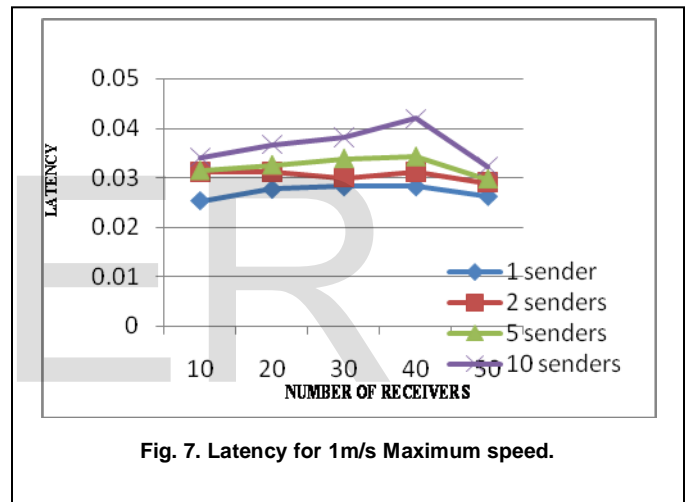


Fig. 7. Latency for 1m/s Maximum speed.

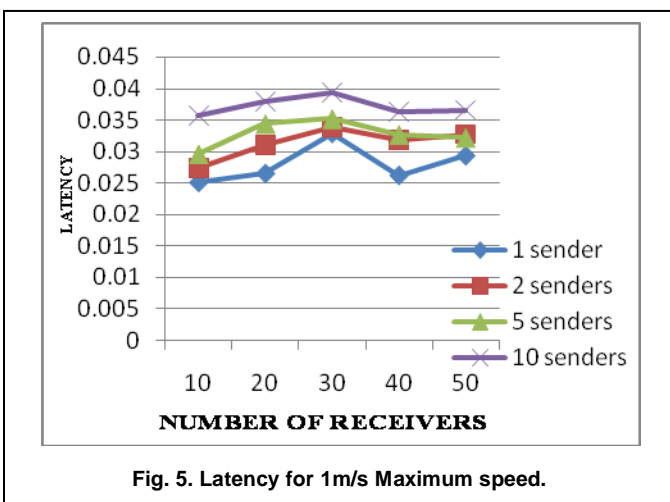


Fig. 5. Latency for 1m/s Maximum speed.

6 CONCLUSION AND FUTURE WORK

Many of the proposed multicast routing protocols have been simulated using ns/2. Because of the data forwarding problem, such metrics as throughput, end-to-end delay and the percentage of received packets are difficult to measure. In order to improve the packet delivery ratio and to decrease the latency MAODV protocol is used. When the multicast group size is increased (in the form of more multicast senders) the packet delivery ratio is decreased. The average packet latency will be remarkably constant across all scenarios. Since bandwidth and power are limited in MANETs, they should be taken into consideration in routing/multicasting protocols. The development of a simulation for the ns/2 simulation would be extremely useful. In future it is planned to construct the bandwidth efficient multicast trees in MANET with the objective of minimizing the number of forwarders.

REFERENCES

[1] Broch, J.; Maltz, D. A.; Johnson, D. B.; Hu, Y.-C. and Jetcheva, J.; A Perfor-

- mance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols., Proceedings of the 4th Annual ACM/IEEE International Conference on Mobile Computing and Networking (MOBICOM.98), Dallas, TX, USA, October 1998, pages 85-97.
- [2] Cheng, E.; "On-Demand Multicast Routing in Mobile Ad Hoc Networks.", M. Eng. Thesis, School of Computer Science, Carleton University, January 2001.
- [3] Kunz, T.; "Reliable multicasting in MANETs", Contractor Report, Communications Research Centre, Ottawa, Canada, July 2003
- [4] Perkins, C. E. and Royer, E. M.; "Ad-hoc On-Demand Distance Vector Routing", Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications (WMCSA.99), New Orleans, LA, USA, February 1999, pages 90-100
- [5] Royer, E. M. and Perkins, C. E.; "Multicast Operation of the Ad-hoc On-Demand Distance Vector Routing Protocol", Proceedings of the 5th Annual ACM/IEEE International Conference on Mobile Computing and Networking (MOBICOM.99), Seattle, WA, USA, August 1999, pages 207-218.
- [6] Royer, E. M. and Perkins, C. E.; "Multicast Ad hoc On-Demand Distance Vector (MAODV) Routing", IETF, Internet Draft: draft-ietf-manet-maodv-00.txt, 2000.
- [7] Zhu, Y.; "Pro-active Connection Maintenance in AODV and MAODV.", M. Sc. Thesis, Department of Systems and Computer Engineering, Carleton University, August 2002.
- [8] R. Bagrodia, M. Gerla, J. Hsu, W. Su, and S.-J. Lee. "A performance comparison study of ad hoc wireless multicast protocols", Proc. of the 19th Annual Joint Conf. of the IEEE Computer and Communications Societies, March 2000, pages 565 -574.
- [9] E. Cheng, "On-demand multicast routing in mobile ad hoc networks", M.Eng. thesis, Carleton University, Department of Systems and Computer Engineering, 2001.
- [10] T. Kunz, "Multicasting: From fixed networks to ad-hoc networks", to appear in the Handbook of Wireless Networks and Mobile Computing, John Wiley & Sons.
- [11] Singh, Y. Chaba, Y. ; Jain, M. ; Rani, P." Performance Evaluation of On-demand Multicasting Routing Protocols in Mobile Adhoc Networks" proceedings of the IEEE conference on March 2010.
- [12] Qabajeh, M.M., Abdalla, A.H. ; Khalifa, O. ; Qabajeh, L.K."A tree-based QoS multicast routing protocol for MANETs" on 4th international conference on may 2011.
- [13] H. Lim and C. Kim. "Multicast tree construction and flooding in wireless ad hoc networks", Proc. Of the 3rd ACM Int. Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems,
- [14] S. Paul. "Multicasting on the Internet and its Applications", Kluwer Academic Publishers, ISBN 0792382005, June 1998.
- [15] E. Royer and C. E. Perkins. "Transmission Range Effects on AODV Multicast Communication." To appear in ACM Mobile Networks and Applications, special issue on Multipoint Communication in Wireless Mobile Networks.