EFFICIENT MULTICAST ROUTING PROTOCOL FOR MANETS

M.Vijayalakshmi, Assoc.Prof., ECE,GNITS,
Hyderabad, INDIA
Email: mvlakshmi_gnits@yahoo.co.in

Dr.D. Sreenivas Rao., Prof., ECE, JNTUCEH,
Hyderabad, INDIA
Email: dsraoece@gmail.com

Abstract: Mobile ad hoc networks (MANETs) have several prominent features because of which MANETs are visualized to support advanced applications. Multicast routing reduces the communication costs of applications. Several multicast routing protocols have been proposed for MANET. While previous MANET multicast protocols focused on the reductions of control overhead, the multicast protocol investigated in this research attempts to reduce the amount of bandwidth used by the network both in terms of control overhead and data rebroadcasts by. Unlike previously proposed MANET multicast algorithms, this new protocol will focus on reducing the amount of unnecessary data rebroadcast by considering QOS constraints like bandwidth, power and end to end delay considering though the creation of a more efficient multicast tree.

Keywords: *Mobile ad hoc networks, Multicasting, EMCR, MAODV.*

I. INTRODUCTION

A mobile ad hoc network (MANET) is an interconnected system of mobile nodes without any centralized coordinator. Every mobile node in MANETs must be able to function as a router and a host to forward the data from one node to another node within the network. MANETs have several prominent features such as flexibility, robustness, rapid deployment, inherent mobility support and highly dynamic topology. Because of these special features, MANETs are visualized to support advanced applications such as military operations, civil applications, and audio, video conferencing and disaster situations. When applications want to send the same data to more than one destination, multicasting is used [1] - [3].Multicasting is a mechanism for data routing, and it allows the group communication in the network. So, Multicasting becomes one of the challenging issues in MANET applications, in which the source node is connected to set of destinations, reduces the communication costs of applications. Several multicast routing protocols have been proposed for MANET. Existing multicast routing protocol can be broadly classified into 2 categories: Mesh-based multicast routing protocols [4] and tree-based multicast routing protocols [5]. The study given in [6] - [11] discuss the complete survey of the current routing algorithms proposed for the wireless MANETs. In MANETs, bandwidth has become one of the most precious resources in the network and to utilize the bandwidth properly in the network, network coding (NC) can be used. NC is an efficient networking mechanism where the transferred data will be encoded and also decoded to maximize throughput of the network and record all the transmission. Decoding of the transmissions is performed at the destination node. So, for the delivery of data, lesser transmissions are sufficient but on the other hand, the large amount of processing has to be performed at the intermediate node and destination node [12].NC maximizes the network capacity and hence is considered as a reliable technique [13]. When NC is used, the data packets can be combined by the intermediate nodes prior forwarding the packets. Hence, NC minimizes the overall number of data transmission and is appropriate for broadcasting purposes [14].It should be note that the conservation of bandwidth is imperative to the success of any wireless network. While previous MANET multicast protocols focused on the reductions of control overhead, the multicast protocol investigated in this research attempts to reduce the amount of bandwidth used by the network both in terms of control overhead and data rebroadcasts by. It can usually be assumed that data transmission consumes more bandwidth than control overhead[15][16][18]. Even a small decrease in data retransmissions should substantially improve network performance. Unlike previously proposed MANET multicast algorithms, this new protocol will focus on reducing the amount of unnecessary data rebroadcast by considering QOS constraints like bandwidth, power and end to end delay considering though the creation of a more efficient multicast tree[17][19][21]. Paper is organized as follows: Section I is Introduction, Section II is about EMCRP, Section III is about simulation and results and conclusions are discussed in Section IV.

II. DESIGN OF PROPOSED EMCR PROTOCOL (EFFICIENT MULTI CAST ROUTING PROTOCOL)

In this work, proposed to design EMCR protocol has three schemes and the QoS constraints like available bandwidth, available power and end-to-end delay are considered to select the routes, that are the routes with sufficient bandwidth, power and delay minimized. The protocol involves three phases .1 Route selection algorithm 2.Link failure detection 3. Route optimization

2.1 Route selection algorithm

1: When a node S_N wants to send data packet to multiple D_N nodes, it defines the three QoS constraints like bandwidth, power and end to end delay

2: Then S_N includes the predefined QoS constraints in a route request message, and broadcasts it, to determine the path towards the D_N.

3: When the SN broadcasts the Req Routes, it predefines' T Limit;

4: When the neighboring nodes receive the Req Routes message, it checks the three constraints;

5: if The three constraints are satisfied then

6: the adjacent node accepts the request and enters the route information in the routing table and sets the route status as observed;

7: end if

8: The adjacent intermediate node sends the route reply, Rep routes to the S_N .

9: if The time taken by the Req routes to reach the neighboring node exceeds the T limit then

10: The request is ignored by the receiving node.

11: end if

12: if The time taken by the Rep routes to reach the neighboring node exceeds the T limit then

13: This reply is dropped by the SN, and the route entry in the routing table is deleted.

14: end if

15: All the Rep routes received within the T limits are accepted by the S_N.

16: Based on the reply received and its route information, paths are determined from the source to multiple D_N.

i. Available Bandwidth (BW) : Available bandwidth(BW) represents available link bandwidth in the path from source node to the destination node multicast tree. The available bandwidth is calculated by using Eqn. 1.

$$BW = \alpha BW_L + \frac{(1-\alpha)T_{idle}}{T_P} B_{Channel} \quad (1)$$

where

α: is the weight factor and its value lies 0 and 1,

BW_L is the available local bandwidth of the node in the preceding period,

T_{idle} is the channel idle time,

T_P is the time interval period and $B_{Channel}$ is the channel capacity in bits per second.

ii. Available Power (P) The available power of a node in multicast tree is denoted by

$$P = P_{Total} - P_{Consumed} \quad (2)$$

$$P_{consumed} = \frac{P_{Tresold}\, d^n}{K} \quad (3)$$

iii. Available Delay (D) : The delay (D) is the maximum value of delay in the path from source node to destination nodes. The delay of multicast tree is calculated as follows

$$D = N[d_{trans} + d_{proc} + d_{prop}] \quad (4)$$

where, N is the number of links, d_{proc} is the processing delay involved with each packet, d_{prop} is the propagation delay between two nodes and d_{trans} is the transmission delay. Dtrans is calculated by using the following equation,

$$d_{trans} = \frac{N}{T} \quad (5)$$

Where, N is the number of bits and T is the rate of transmission.

Route Request Message:

When a source node needs to communicate with another node, it broadcasts the route request message (Req routes) to its neighboring node.

ABW	E_r	D_y	T_{limit}	$Reqroute$

The format of the (Rep routes) is same as MAODV with an additional QOS constraints. Where, BW represents, the available bandwidth of a node, Er represents the available power of a node, D represents end to end delay, T limit represents the time limit to travel between one node to another and Req route represents the fields of MAODV route request message .

Route Reply Message: When a neighboring intermediate node receives Reqroutes message, it sends the route reply

ABW	E_r	D_y	T_{limit}	$Reproutes$

2.2 Link Failures

During second phase of algorithm Given a particular multicast session, a node can be a source, a receiver, an intermediate node, a source and a receiver, or a receiver and an intermediate node .

Frequent changes in network topology can cause links failures that disrupt communication between nodes. Because of the highly dynamic nature of the network link failures must be detected and fixed quickly.

1.If a router finds that a direct connection between it and its upstream node no longer exists, the host will initiate branch rediscovery.

1.1. Branch rediscovery proceeds in much the same way as does multicast route discovery, except in reverse. (steps from 1.1.1)

1.2 A node looking to rejoin the multicast tree floods the network with a JOIN packet. Each JOIN packet contains the [source, group] pair of the session of interest and the address of the node initiating the branch rediscovery.

1.3 As the JOIN message traverses the network, intermediate nodes mark an entry in their multicast routing tables, set their timers to HOLD_REFRESH_TIME, and store the address of the last hop of the JOIN.

1.4 Nodes that receive a new JOIN message and do not have a valid route to the source decrement the TTL and forward the message if the TTL is greater than zero.

1.5 If the node has a valid route to the source it adds the last hop of the JOIN to its downstream list and unicasts a JOIN-ACK message to the last hop of the JOIN. Nodes forward the JOIN-ACK message until it reaches the lost node.

1.6 The initiator of the JOIN may receive many JOIN-ACK messages, each advertising a different path to the source.

1.7To enable one of these branches, the initiator send a JOIN-OPT message back up the tree.

1.8 The lost node unicasts this JOIN-OPT message to its new upstream node.

1.9 If a node receives a JOIN-OPT message and multicast routing has not been enabled, the node enables routing and forwards the JOIN-OPT message to its upstream node.

1.10. The JOIN-OPT message travels towards the multicast source, enabling forwarding, until it reaches the node that sent the original JOIN-ACK.

Else go to step 2

Branch rediscovery

1.1.1During branch rediscovery nodes MAY notify that they are performing branch rediscovery.

1.1.2 To do this, a node would send a JOIN-NOTIFY message to its downstream nodes. This message is sent just before a host sends a JOIN message and accomplishes two goals.

1.1.3 First, it informs nodes that an upstream node is attempting to rejoin the multicast tree and that they MUST NOT respond to a branch request for the multicast session or forward a JOIN from the originator of the JOIN-NOTIFY.

1.1.4 Secondly, it updates the timers of the downstream nodes. Failing to do this may cause nodes to time out before the link can be repaired. JOIN-NOTIFY messages have the same format as JOIN messages.

End if

2. The router directly transfers the data to upstreaming node

End

3. Link failures in a wireless network may prevent nodes from explicitly leaving a multicast group.

3.1 For this reason a node MUST keep track of which of its downstream nodes are also one-hop neighbors.

3.2Each downstream entry keeps a timer that is updated periodically if the node finds the address in its list of one-hop neighbors.

3.3 If the address cannot be found before the timer expires, the entry is removed.

3.4 If the downstream list is empty and the node does not want to receive multicast data, the node MUST send a PRUNE message to its upstream neighbors.

3.5The timer SHOULD be long enough to allow a JOIN message to reach the node if a link fails and the downstream node is still interested in the session

End

2.3 Route Optimization

1. A member of the multicast tree MAY perform a route optimization if it manages to overhear a TREE-REFRESH message broadcast by a source other than its upstream node.

1.1 If a node overhears such a message it can check the information stored in the message to determine whether, if by joining the new branch, inefficiencies in the network can be reduced

Else

1.2 If a node can determine that it is an only child, it MAY leave its upstream node and join the new node. This move would allow its original parent to prune itself from the multicast tree if it is non-receiver, or allow the node to stop forwarding multicast data if it is a multicast receiver.

2.If a node that is performing the route optimization has a hop count that is larger than or equal to the hop count of the new parent, it unicasts a JOIN-OPT message to the new upstream node and LEAVE -OPT message to its former parent.

2.1Nodes that receive a JOIN-OPT message add the last hop address to their downstream list.

2.2 Nodes that receive a LEAVE -OPT message remove the last hop address from their downstream lists. 2.1.1Before sending the JOIN-OPT message, the node sets its NON_RECEIVER value to zero to prevent the node from attempting a new route optimization before it receives a new TREE-REFRESH message from its new parent that accurately represents the status of the network.

2.1.2 A reduction of redundant control and data packets is possible by using the set of MPR nodes made available from the OLSR routing protocol.

2.1.3 By reducing the number of JOIN messages, routers are able to reduce overhead during link recovery and to eliminate advertisements for faulty routes.

III. Results and Discussions

The performance of the EMCR, and MAODV routing protocols are evaluated. The simulation results are carried out using the Network Simulator (NS 2. 34). The EMCR protocol is compared with existing MAODV protocol through the simulations. The simulation scenario table 1 used for simulation these routing protocols.

The Figure 1 to 4 simulation results acquired by changing number of nodes and traffic remains constant.

Table: 1. Simulation Scenario

S. No.	Network Parameters	Value
1.	Routing Protocols	EMCR, MAODV
2.	Simulation area	1000 X1000
3.	MAC	IEEE 802.11
4.	Number of Nodes	10,20,30,40,50
5.	Traffic Type	CBR
6.	Date Rate	1 Mbps
7.	Speed	20 m/s
8.	Initial Energy	5 Joules
10.	Simulation time	100 sec

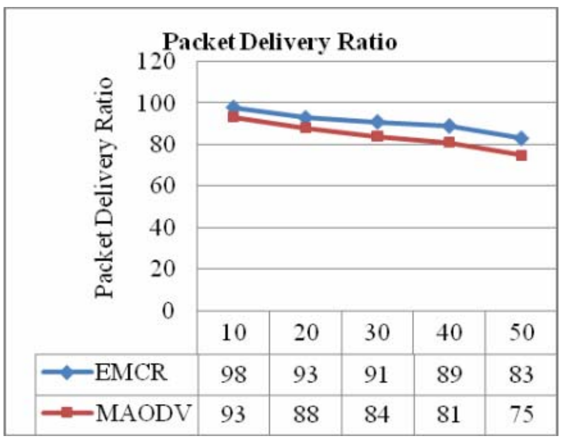

Figure 1. Packet Delivery Ratio Vs Number of Nodes

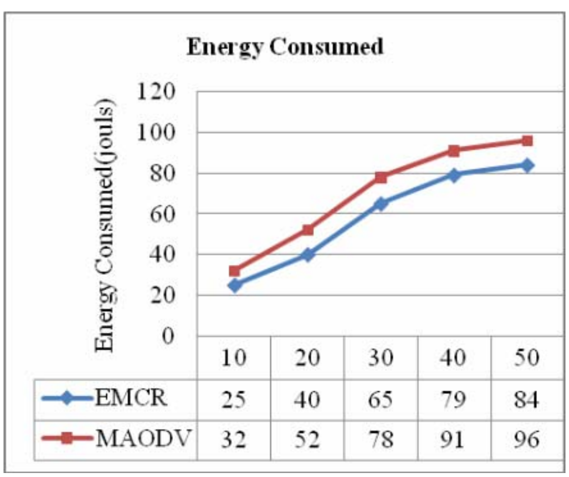

Figure 2. Energy Consumed Vs Number of Nodes

Figure. 1. Shows that the Packet Delivery Ratio of EMCR and MAODV protocol by varying number of nodes. From the simulation results EMCR protocol has higher packet delivery ratio than MAODV protocol.

Form the figure. 2, it shows that energy consumption of EMCR and MAODV protocols when number of nodes is varied. The EMCR is less energy consumption than MAODV protocol. The EMCR protocol is more energy efficient.

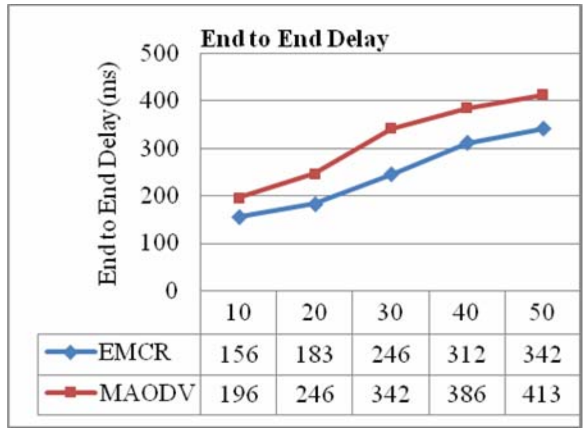

Figure 3.End to End Delay Vs Number of Nodes

The figure 3. shows that end delay is increasing with increasing nodes. The end to end delay of EMCR, protocols less when compare to MAODV by varying number. of nodes i.e. from 10 to 50 nodes and node speed remains constant.

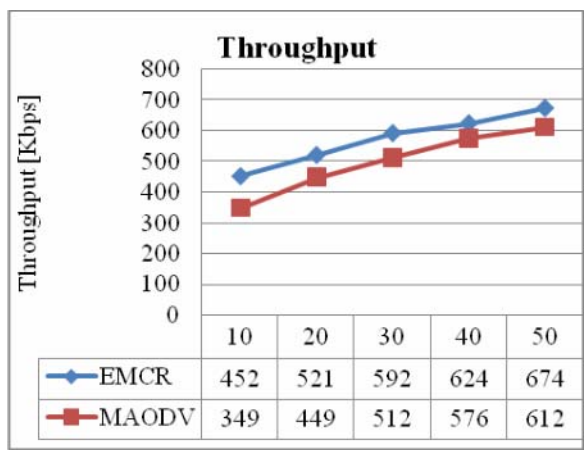

Figure 4. Throughput Vs Number of Nodes

IV. CONCLUSION

Form the figure.4. It shows that throughput is increasing with increasing nodes. Throughput for EMCR, MAODV protocols by varying number of nodes i.e. from 10 to 50 nodes and node speed constant. The EMCR protocol has good throughput when compare with MAODV protocol.

REFERENCES

[1] Siva Ram Murthy and B. S. Manoj."Chapter 3 Ad Hoc Wireless Networks, "in Ad Hoc Wireless Networks: Architectures and Protocols, pp. 213-245.

[2] Luo Junhai, Xue Lin and Ye Daniye, "Research on Multicast Routing protocols for Mobile Ad Hoc Networks, "in Elseveier Computer Networks, Vol. 52, pp. 988-997. 2008.

[3] Su W, Lee S and 1.Gerla M., "On-demand multicast routing protocol in multi hop wireless mobile networks(ODMRP), "in Springer Link Mobile Networks and Applications, Vol. 7, pp. 441-53, 2002.

[4] E.M Royer and C. E Perkins, "Multicast adhoc on demand distance vector (MAODV) Routing. "Internet Draft, draft-ietf-draft-MAODV-OO.txt 2000. 6

[5] S. Badarnch and M Kadich, "Multicast Routing protocols in Mobile Ad Hpc Networks: A comparative Survey and Taxonoly, "in EURASIP Journal of f'I1reless Communication and Networking. pp. 1-42. Vol. 2009.

[6] A Boukerche, B Turgut, N Aydin, M Z. Ahmad, Ladislau Bini and Damla Turgut, "Routing protocols in ad hoc networks: A survey, "in Elsevier Journal of Computer Networks. Vol. 55.pp. 3031-3080. 2011.

[7] R C Biradar and S S. Manavi, "Review of Multicast Routing protocols in Mobile Ad Hpc Networks. "in Elsevier Journal of networks and Computer Applications. Vol. 32, pp. 221-239.2012.

[8] Lue Junhai, Ye Danxia, Xue Lin and Fan Mingya, "Survey of Multicast Routing protocols for Mobile Ad Hpc Networks. "in IEEE Communications, Surveys and Tutorials, Vol. 11, No. I, pp. 78-91, First Quater 2009.

[9] J M Vella and S Zammit, "A Survey of Multicasting over Wireless Access networks, "in IEEE Communications, Surveys and Tutorials, Vol. 15, No. 2, pp. 78-91, Second Quater 2013.

[10] E Alolaibi and B Mukharjee, "A survey on routing algorithms for Wireless Ad Hoc Mesh Networks, "in Elsevier Computer Networks, Vol. 56. pp. 940-965. 2012.

[11] B. Nagalakshmi. D. Venkatesh and K Ramesh. "Probability Scheme With Network Coding Technique in Wireless Ad Hoc Networks: Reducing the Number of Transmissions with Enhanced Security, "in International Journal of Advanced Research in Electrical. Electronics and Instrumentation Engineering, Vol. 2, Iss. 6. pp. 2320-2325.June 2013.

[12] M Hay, B Saeed. Chung-Horng Lung. Thomas Kunz. and Anand Srinivasan. "Network Coding and Quality of Service for Mobile Ad Hoc Networks. "in Int.J Communications, Network and System Sciences, Vol. 7. pp. 409-422. 2014.

[13] S Yang. J Wu and M Cardei, "Efficient Broadcast in MANETs Using Network Coding and Directional Antennas. "in IEEE INFOCOM 2008, pp. 1-6. 2008.

[14] Li Xu. Liu Tianjian, Liu Ying and Tang Yan, "Optimized Multicast Routing Algorithm based on Tree Structure in MANETs, "in China Communications. pp. 90-99. Feb. 2014.

[15] Y S Yena, H C Chaoc. R S Changd and A Vasilakos. "Flooding-limited and multi-constrained QoS multicast routing based on the genetic algorithm for MANETs. "in Elsevier Mathematical and Computer Modelling, Vol. 53, pp. 2238-2250. 2011.

[16] K Chi , X Jiang and S Horiguchi, "Network coding-based reliable multicast in wireless networks. "in Elsevier Computer Networks. Vol. 54. pp 1823-183, 2010.

[17] N C Wang. "Power-aware dual-tree-based multicast routing in mobile ad hoc networks, "in lET Communications. Vol. 6, Iss. 7. pp. 724-732, 2012.

[18] J A Torkestani and M R Maybodi, "Mobility based multicast routing algorithm for wireless adhoc networks . A learing automata approach. "in Elsevier Computer Communication. Vol. 33. pp. 721-735. 2010.

[19] J A Torkestani and M R Maybodi. "A link stability based multicast routing protocol for wireless mobile adhoc networks, "in Elsevier Journal of network and computer applications. vol. 34. pp.1429-1440. 2011.

[20] Li Layuan and Li Chunlin. "A QoS multicast routing protocol for clustering mobile ad hoc networks. "in Elsevier Computer Communications, Vol. 30. pp. 1641-1654. 2007.

[21] Ozkasap, Z Genc and E Atsan. "Epidemic-based reliable and adaptive multicast for mobile ad hoc networks."in Elsevier Computer Networks. Vol. 53. pp. 1409-1430. 2009.

[22] R C Biradar. S S Manavi and M Reddy "Link stability based multicast routing in MANET. "in Elsevier computer Networks. Vol. 54, pp. 1183-1196. 2010.

[23] R C. Biradar. S S. Manvi. "Neighbour supported reliable Multipath multicast routing MANETs. "in Elsevier journal of Network and Computer Application, Vol. 35. pp. 221-229.2011.

[24] C Cheng, H Eric Hsiao-Kung Wu, Gen Huey chen. "Stable Backbone hosts and stable multicast routes in two tier mobile Ad hoc networks."in IEEE Transactions on vehicular Technology, Vol. 58, No. 9, Nov 2009.

[25] S Baolin and Li Layuan, "QoS-aware multicast routing protocol for Ad hoc networks. "in Journal of Systems Engineering and Electronics. Vol. 17. No. 2. pp. 417-422, 2006.