A Performance Analysis of FRRM Routing Protocol in MANETS

Harmandeep Kaur[1] Jabarweer Singh[2]
[1,2]Department of Computer Science and Engineering
[1,2]GZS Campus College of Engineering & Tech. Bathinda, Punjab, India

Abstract— Mobile ad hoc networks (MANETs) are used extensively for applications that require mobility while routing, more importantly for emergency and military operations. Routing information to nodes without a fixed infrastructure and with dynamically changing infrastructure is one of the greatest challenges. Multicasting is a more frequent requirement for such defense operations, which adds on to the level of difficulty while routing. In order to overcome this challenge, a couple of protocols exist in the literature providing various solutions to delivering data to multiple destinations at mobility. However, these strategies are either of greater complexity or the cost is high. In order to overcome this issue, a number of protocols exist in the literature providing various solutions to delivering data to multiple destinations at mobility. However, these strategies are either of greater complexity or the cost is high. In this paper, we present a performance study of FRRM (Familiar route retrieval for multicasting) protocol in MANETs which uses the concept of cache memory to retrieve the familiar routes efficiently. The performance of this protocol is analyzed using NS2 on the basis of three parameters such as packet delivery ratio, throughput and energy consumption.

Key words: Mobile Ad Hoc Network, Multicast Routing, Node Selection

I. INTRODUCTION

A mobile ad hoc network consists of a dynamic collection of nodes with sometimes rapidly changing multi hop topologies that are composed of relatively low bandwidth wireless links. Each node has a limited transmission range; a source to destination path could pass through numerous intermediate nodes. Unlike typical wire line routing protocols, ad hoc routing protocols must address a various types of issues. The network topology can change randomly and rapidly at unpredictable times. Since wireless links usually have poor capacity, congestion is typically the norm rather than the exception. The majority of the nodes depend on batteries, thus routing protocols must limit the amount of control information that is passed between nodes. Multicast routing is the most challengeable task in ad hoc network. Multicasting is the transmission of data grams to a group of hosts identified by a single destination address. Multicasting is intended for group-oriented computing such as applications characterized by the close collaboration of teams with necessities of audio and video conferencing and sharing of text and images. The use of multicasting within network has many benefits. Multicasting reduces the communication costs for applications that send the same data to multiple recipients. Multicasting minimizes the link bandwidth consumption, sender and routing processing and delay in packet delivery. Maintaining group membership information and efficiently delivering the multicast packets to all members is very difficult in wireless network. The majority of applications for MANET technology are in areas where dynamic reconfiguration and rapid deployment are necessary and the wire line network is not available. These include emergency search, military battlefield and rescued operations, classroom where participants share information dynamically using their mobile nodes. These applications lend themselves well to multicast operation. Multicasting can increase the efficiency of the wireless link when sending multiple copies of messages by exploiting the inherent broadcast property of wireless transmission. A number of protocols have been developed for efficient multicast routing like AMRoute, ODMRP, FRRM, PUMA etc. In this paper we analyze the performance of FRRM protocol.

II. TAXONOMY OF MULTICAST ROUTING PROTOCOLS

A number of multicasting protocols have been developed to perform multicasting in an efficient way. These protocols are classified into three categories such as tree based, mesh based and hybrid based protocols.

A. Tree-Based Multicasting

It establishes the shared multicast tree to send the data from source to receiver of a multicast group. There is only a single path between source and destination. It is further divided into two categories such as shared tree-based and source tree-based. Examples of tree based routing are AMRIS, MAODV etc.

B. Mesh-Based Multicasting

There are several alternative paths between source and destination. ODMRP, PUMA, CAMP are mesh based protocols.

C. Hybrid-Based Multicasting

It is the combination of both tree-based and mesh-based approach. It achieves better performance than previous approaches. AMRoute, FRRM and ASTM are examples of hybrid multicast routing protocols.

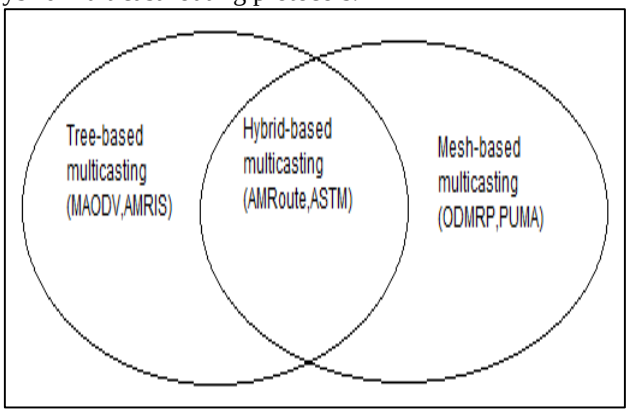


Fig. 1: Multicasting Protocols

III. RELATED WORK

We briefly describe various protocols related to our work. Different protocols have been proposed in the literature. These protocols are classified into tree-based, mesh-based and hybrid-based. ODMRP is a mesh based approach proposed by Galatchi et al. [3].It has two phases such as

route request and route reply. In both phases packets are forwarded by broadcasting. Hence it consumes lot of energy of the network. It is capable for unicast routing. MAODV is a tree based multicast protocol performs loop free routing. It works in route recovery and route maintenance phases similar to AODV. It was proposed by Perkins et al. [4].Its main drawback is less reliability during multicasting. ANMAS (Ad hoc Network Multicasting with Ant System) was proposed by Lee et al. [5] for Mobile Ad hoc Network. This scheme utilizes the indirect communication method of the ants via chemical substance "pheromone" to effectively obtain dynamic topology change information, creating safer multicasting routes and adapts the well-known CBT (Core Based Tree) multicasting algorithm in to the ANMAS framework with proper modifications to make "tolerable" multicasting group in the MANET environment. Simulation results show that ANMAS outperforms ODRMP. The Core-Assisted Mesh Protocol (CAMP) [6] is introduced for multicast routing in MANETs. CAMP generalizes the notion of core-based trees established for internet multicasting into multicast meshes that have good connectivity than trees. A shared multicast mesh is defined for each multicast group; the main aim of using such meshes is to preserve the connectivity of multicast groups even while network routers move regularly. CAMP consists of the preservation of multicast meshes and loop-free packet routing over meshes. It uses cores only to reduce the traffic which is needed for a router to connect with a multicast group; the failure of cores does not stop packet forwarding or the procedure of maintaining the multicast meshes. SRMP [7] protocol constructs a mesh to join group members, providing robustness against mobility. It also offer stable routes on the basis of links availability according to future prediction of links condition and higher battery life paths tending to power conserving. Hybrid Overlay Multicast Routing Protocol (HOMRP) was defined by Chen et al. [8] for MANETs (Mobile Ad hoc Network).Existing mesh-based multicast routing protocols have the major drawback of high control overhead. To overcome these limitations, multicasting and unicast tunnels are integrated for efficient packet delivery. It creates multiple local multicast trees in HOMRP. Every pair of parent node and child node in a local multicast tree is at a distance of one-hop. It utilizes multicasting to send multicast packets in local multicast trees. It will offer efficient data forwarding. Unicast tunnels are used for transmitting packets between local multicast trees. Simulation results show that the packet delivery ratio of HOMRP is 50% better than that of AMRoute and is near to that of ODMRP. HOMRP reduces 18% control overhead compared to ODMRP and lessens 9% end-to-end packet delay compared to AMRoute.

Differential Destination Multicasting (DDM) [9] was described by Ji L. Here source is given the full ability to identify and control membership of the nodes in groups in place of distributing the control to all other nodes. Apart from that variable-length destination headers that are differentially encoded are added in data packets which are used in combination with unicast routing tables to transmit multicast packets towards multicast receivers. This protocol provides the routing choice to the source and stateless mode option. It is one of the most successful schemes for multicasting to small groups among scalable network sizes with dynamic topology. The only drawback of this protocol is that the nodes do not make dynamic familiarity check.

IV. FRRM PROTOCOL

It uses the concept of cache memory to retrieve the routes in order to forward the data to corresponding destinations. The familiarity factor is used for formation and retrieval of routes. Familiarity refers to the fact that there is a track of previous memory about a path. Familiar paths can be retrieved from cache memory to send the data to particular destination. In route discovery process, route request messages are sent and reply messages are obtained from various nodes before forming either the multicast mesh or the multicast tree. If any available routes are familiar to the node the route replies are provided from the cache memory. Using this information multicast trees or meshes can be formed. This means that the process of route discovery terminate at regions where there already exist paths to the destination nodes. The main objective of FRRM is to decrease the routing overhead and improves the routing performance in multicasting process by reducing the flooding of route request packets in the network.

V. SIMULATION RESULTS

We have evaluated the performance of FRRM protocol using simulator NS2. The two ray ground model is used for communication between 50 nodes in the network that are distributed in an area of 1100m*1100m.The specifications of Simulation environment and process involved are shown in table below:

Parameters	Value
Simulation area	1100*1100m
Number of nodes	50
Propagation Model	Two ray ground model
Antenna Type	Omni antenna
Traffic Model	CBR
Transmission Range	250 m
Basic Routing Protocol	AODV
Channel Type	Wireless phy

Table 1: Simulation Result

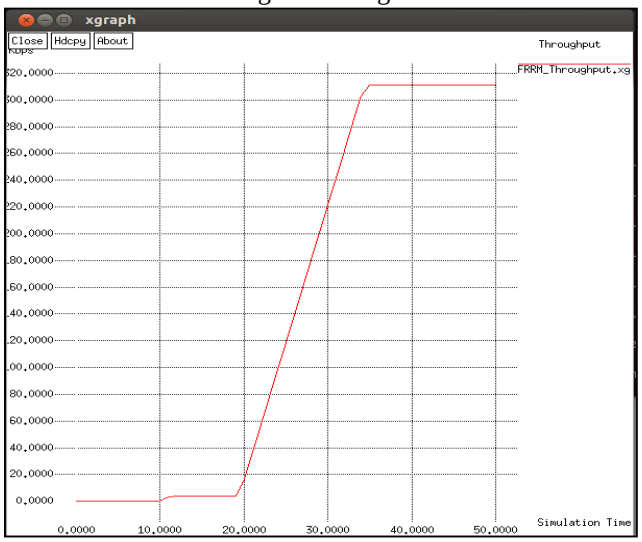
A. Performance Metrics

Protocol performance is evaluated using the following metrics:

- Throughput: It is the ratio of the number of packets received to the number of packets sent.
- Packet Delivery Ratio: It is calculated on the basis of number of data packets received per time. It indicates the efficiency of the scheme in delivering of packets in the network. Higher the packets received ratio aggrades the performance of the network.
- Energy Consumption: This factor is indicator of lifetime of the network. If the network is consuming more energy, less will be its lifetime.
- Performance Evaluation: Figure 1 shows the value for the throughput obtained is 311 Kbps for FRRM. Figure 2 shows the packet delivery ratio of FRRM. The value of packet delivery ratio for FRRM is 98.82 percent. It means that only 1.18 percent packets have been

dropped. Figure 3 depicts that initial energy of network is 70 joules. The remaining energy of the network is 45.3878 Joules at the end of the network.

Fig. 1: Through



put Analysis

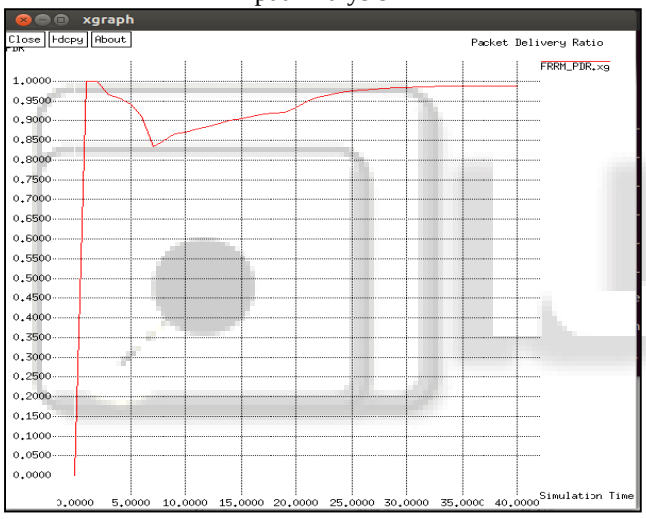


Fig. 2: PDR Analysis

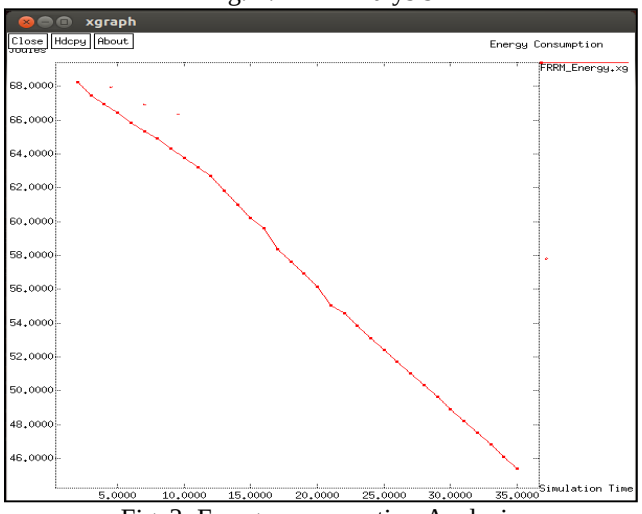


Fig. 3: Energy consumption Analysis

VI. Challenges in FRRM

In FRRM, the familiar routes are retrieved in the network as a part of multicasting technique. In case of multicasting, the request packets are flooded to quite a few portion of the network. So it consumes less energy as compared to broadcasting process. But this protocol has one drawback. When source wants to send data to new destination whose route is not available in cache memory. In that case, source floods route request messages to find route to new destinations. This process consumes lot of energy in the network. In future, this problem can be overcome by using probabilistic techniques or by modifying the way the packets are being forwarded in the network.

VII. Conclusion

In this paper, we have discussed the FRRM protocol. The performance of FRRM is evaluated on the basis of throughput, energy consumption and packet delivery ratio. The simulation results show that the value of throughput for FRRM is 311 kb/s, packet delivery ratio is 98.82 percent and remaining energy of FRRM is 45.82 joules. The challenges in FRRM are also given in this paper.

References

[1] Arti, Dr. S. Tyagi, "Study of MANETs: Characterstics, challenges, applications and security attacks," IJARCSSE, May, 2013.
[2] M. Ghasemi and M.Bag-Mohammady, "Classificationof multicast routing protocols for Mobile Ad Hoc Networks," International Conference on ICT Convergence (ICTC), Jeju Island, pp. 789-794,2012.
[3] Sung-Ju Lee, Mario Gerla, Ching-Chuan Chiang, "On-Demand Multicast Routing Protocol," IJERA, 2008.
[4] Elizabeth M. Royer and Charles E. Perkins, "Multicast Operation of the Ad-hoc On-Demand Distance Vector Routing Protocol," 5th annual ACM/IEEE International conference on Mobile Computing and Networking (MobiCom), p.p 207 – 218,August (1999).
[5] Se-young Lee, Hyeong Soo Chang, "An ant system based multicasting in mobile ad hoc network," IEEE Conference on Evolutionary Computation, pp. 1583-1588, Vol. 2, 2005
[6] J. J. Garcia-Luna-Aceves and E. L. Madruga, "The core-assisted mesh protocol," in IEEE Journal on Selected Areas in Communications, vol. 17, no. 8, pp. 1380-1394, Aug 1999.
[7] G.S.Sreehar, Dr.A.Damodaram, "Mesh based and Hybrid based multicast routing protocols for mobile ad hoc networks,' IJCSET, vol. no. 2,April ,2012.
[8] Chaung-Kai Chen, Kuochen Wang and Lung-Sheng Lee, "A hybrid overlay multicast routing protocol for mobile ad hoc networks," 2005 International Conference on Wireless Networks, Communications and Mobile Computing, pp. 784-789,2005.
[9] DE Morais Cordeiro, Carlos, Hrishikesh Gossain, and Dbarma P. Agrawal,"Multicast over wireless mobile ad hoc networks: present and future direction," IEEE, vol.17 ,no.1, pp.52-59,2003.
[10] S. S. Kumar, V. Parthasarathy and P. Malini, "Familiar route retrieval for multicasting in MANETs," International Conference on Science Engineering and Management Research (ICSEMR), Chennai, pp. 1-5, 2014.

