Multiple Decision System Based Multicast Routing In Mobile Ad-Hoc Networks

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Abstract— In recent years, MANETs have experienced a rapid growth in the area of mobile computing. MANET is the type of ad hoc network that has no fixed network infrastructure. It consists of mobile nodes distributed arbitrarily. Since, nodes in MANETs are of mobile nature, due to this, routing become one of the most intricate job for the efficient communication. For this, various routing protocols were proposed and it has been analyzed that in conventional work the fuzzy logic was used for calculating path trust with regards to three parameters i.e. energy, delay and bandwidth. However, only these parameters are not efficient enough to obtain the quality output, as it does not determine the packet transmission behavior. And also, the conventional system was not capable enough to handle the more number of parameters. Therefore, in this paper, in order to overcome all of these issues the numbers of parameters are enhanced and a novel system i.e. Multiple fuzzy systems based Multicasting Routing Protocol (MFSMRP), is proposed which is capable of handling more number of parameters. Also, the comparison analysis is performed and the results demonstrate that proposed approach is more efficient than conventional approach in terms of considered parameters i.e. energy, delay, bandwidth, congestion and packet delivery ratio.

Index Terms— MANETS, Fuzzy logics, Ad-hoc networks, Proactive routing protocols (PRP), Reactive Routing protocols (RRP) etc.

1 INTRODUCTION

In recent years, with the miniaturization of mobile end devices, mobile ad hoc networks (MANET) become popular in a wide range of fields. For example, they can be used in military, catastrophes, expedition and so on. A MANET is a type of ad hoc network that can change locations and configure itself on the fly. Because MANETs are mobile, they use wireless connections to connect to various networks. This can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission.

In MANET, the communication between the nodes residing in one another’s wireless transmission range can take place directly. However, nodes lying outside one another’s range use some other nodes to pass the messages. This resulted in a multi-hop scenario, where some intermediary hosts are responsible for transferring the packets from the source node to the destination/target node [1].

MANET does not require any support from fixed infrastructure; it can be accessed when required. In this kind of network, transmission of data packets takes place in a “store-and-forward” method from a source node to an arbitrary target or destination node as demonstrated in Fig 1.

In every network routing is the imperative process in order to achieve effective communications between source and destination node. During routing process, each node must work for itself and must be cooperative for other nodes as well. MANETs are susceptible to different security attacks. Therefore, it is an actual challenge to find a secure end-to-end path in MANETs.

1.1 Classification of MANETs routing protocols

Routes are set up on the basis of different network conditions, thus, routing protocols are broadly classified into three categories [2] which are demonstrated in Fig 2.

Table-driven (or Proactive) Routing Protocols:
Table driven routing protocols are responsible for maintaining the routing information for all the times. The routing information consists of node connectivity to other nodes in the network. These are also called Proactive routing protocols.
(PRP), and every node is enabled to have a steady and clear vision of the network topology by promulgating updates periodically. Thus, a quick decision can be made by the all nodes to forward the specific packets to the destination. Basically, this is achieved at the expense of bandwidth [3]. Various proactive routing protocols are:

- DSDV (Destination Sequenced Distance Vector)
- OLSR (Optimized Link State Routing Protocol)
- WRP (Wireless Routing Protocol)
- FSR (Fisheye State Routing)
- TBRPF (Topology Broadcast based on Reverse Path Forwarding)

Reactive Routing (On-demand) Protocol:
Reactive routing protocols (RRP) are found to be suitable for ad hoc networks, as compared to proactive protocols, due to the ability of creating on-demand routes. However, these protocols are not efficient for managing the topology information of the network in an up to date manner. The most popular routing protocols amongst RRP are the Dynamic Source Routing (DSR) and Ad hoc On Demand Distance Vector Routing (AODV). These protocols allow the nodes to find the optimal on demand route by swamping or flooding the Route Request packets into the network [4].

There are several reactive routing protocols:

- AODV (Ad hoc On Demand Distance Vector)
- DSR (Dynamic Source Routing)
- TORA (Temporally Ordered Routing Algorithm)
- CBRP (Cluster-Based Routing Protocol)
- LAR (Location-Aided Routing)

Hybrid Routing Protocol:
Hybrid protocols combine local proactive and global reactive routing to increase the effectiveness and scalability. A proactive scheme may, for example, be used for the nodes that lie close to the MHS, while distant nodes are traveled by reactive mode. Hybrid protocols can occasionally, associate itself with some type of hierarchy that can either be based on the node neighbors or on logical network partitions.

The widely used hybrid routing protocols for MANETs is [5]:

- The Zone Routing Protocol (ZRP)

2 LITERATURE REVIEW
In recent years, MANETs have experiences a rapid growth in the area of mobile computing. This reasons for this escalation is the abundance of economic and widely available wireless devices. Therefore, it attracted the researchers to dig deeper on Ad Hoc Networks."

In paper [7], the dynamic energy efficient routing algorithm i.e. ECL-AODV was proposed in which cross layer interaction was given for using the energy related data from physical and MAC layers. The nodes with less remaining energy were avoided in the proposed algorithm. By enhancing the mobile nodes’ lifespan, the routing algorithm chooses optimal route from perspective of maximum remaining energy path as route stability’s part. For conserving the mobile nodes’ energy, the RTS/CTS transmission was a significant step.

In paper [8], the author focuses on various routing protocols utilized broadly in MANETs. The suitable on-demand routing protocols must be integrated in order to identify the optimal routes among source and destination so that the Ad-Hoc Networks can be operated in an efficient manner. The paper majorly focuses to analyze the different performance parameters such as, data packet delivery fraction, control packet and end to end delay. Particularly, the routing protocols based on position have the ability of routing the messages more efficiently to their destinations on the basis of destination node position, which the location service provides.

In LAR, the significant performance parameters of MANETs can be enhanced.

In [9], to make the routing decision, author had taken three parameters into account: bandwidth, mobile speed and hop-count. Fuzzy logic system is implemented for the uncertainty of data of the route in ad-hoc networks.

Author, in [10], endeavoured to control qualms problems for conserving the resources of network utilizing fuzzy logic tool. In this paper, the route’s every available network metric was transformed to single metric i.e. communication cost or fuzzy cost. The routes which consist of least fuzzy cost will be regarded as the best route and data has to be transferred via this route from source node to the receive’s set. With the help of NS-2 and MATLAB, the simulation was performed and the obtained results represented that novel protocol (EFMMRP) is more efficient than ODMRP and MAODV with regard to following parameters: packet delivery delay, control overhead and packet delivery ratio.

3 PRESENT WORK
In MANETs, the nodes are of mobile nature, thus, the routing has been considered as one of the challenging tasks in this network. Various researches had proposed several routing protocols, though, they consist of some limitations.

As analyzed from the literature review, in the conventional work i.e. EFMMRP, fuzzy logic was used in order to calculate path trust in terms of three parameters i.e. energy, delay and bandwidth. These considered parameters describe the capability of the network.

However, only these parameters are not efficient enough to obtain the quality output, as on the basis of these parameters the packet transmission behavior cannot be determined. Therefore, it is required to consider the other parameters also that can define the packet transmission behavior.

Though, in the conventional work, the single fuzzy system was utilized that cannot handle the more number of inputs as the system can become complex. Therefore, in order to
increase the number of parameters, it is also required to upgrade the existing system or to use any new approach that must be capable of handling the more number of inputs.

4 PROPOSED WORK

As it is clearly stated in the above section that conventional system is not efficient enough to achieve quality output as it consists of limited parameters and single fuzzy system and thus the new system is required for the efficient routing. Therefore, in the proposed work the numbers of parameters are increased and two parameters are considered i.e. Congestion and PDR, which defines the packet transmission behavior of the nodes. Thus, the total numbers of parameters considered in the proposed work are:

1. Energy
2. Delay
3. Bandwidth
4. Congestion
5. Packet Delivery Ratio

As, it is also mentioned that conventional fuzzy system was not capable to handle the more number of parameters, therefore, a new approach i.e. MFSMRP (multiple fuzzy systems based Multicasting Routing Protocol) is proposed that is capable of handling the aforementioned number of parameters and consequently leads to efficient routing.

5 METHODOLOGY

In order to overcome the drawback of the conventional single fuzzy system, the novel approach i.e. MFSMRP (multiple fuzzy systems based Multicasting Routing Protocol) is proposed in this work.

1. In MFSMRP, the two fuzzy logic systems are used to handle the existing as well as enhanced number of parameters.
2. The fuzzy system 1 takes the three inputs i.e. delay, bandwidth and energy, whereas, the fuzzy system 2 takes the enhanced inputs i.e. Congestion and PDR.
3. After taking the input, both the fuzzy systems i.e. Fuzzy system 1 and Fuzzy system 2 calculates the cost values i.e., cost 1 and cost 2 respectively.
4. Now, the next node for the routing is selected on the basis of calculated cost, however, in the proposed system, both the fuzzy systems calculates two cost values, therefore, in order to consider the cost value, the weight based cost finalization is implemented.
5. In weight based cost finalization, the weight W1 and W2 is calculated which must satisfy the following conditions:
   W_1 + W_2 = 1;
   W_1 and W_2 must have value between 0 to 1.
6. Finally, the optimal path is selected for the routing on the basis of obtained weighted value.

6 RESULTS AND DISCUSSIONS

As described in the aforementioned section that MFSMRP approach is proposed to handle the enhanced number of parameters i.e. energy, delay, bandwidth, congestion and PDR. This proposed approach is implemented and the results obtained after implementation is discussed in this section:

![Network Structure](image)

The fig 4 represents the network structure of the proposed approach which consists of total 40 nodes in it. It is shown that the network covers the area of 800* 800 which is represented along x-axis and y-axis. The input parameters which have to be concerned are nodes, packets, speed with which the packet will be delivered to another node and the output parameters to be calculated will be energy, delay, bandwidth, congestion and PDR.
The graph in fig 5 depicts the packet delivery ratio of proposed and conventional approach with respect to changing number of nodes. The packet delivery ratio of the system should be high as it leads to an efficient system and it is clearly observable from the graph that proposed approach i.e. MFSMRP has higher packet delivery ratio than traditional one i.e. EFMMRP which implies that MFSMRP is the efficient approach.

The comparison of proposed and conventional approach’s packet delivery delay with respect to changing mobility speed is depicted in graph of fig 7. The higher packet delivery delay leads to inefficient system, and it is comprehensible from the graph that proposed approach i.e. MFSMRP is efficient than traditional approach because packet delivery delay of MFSMRP is low as compared to EFMMRP.

Thus, all the results demonstrate that proposed approach leads to an efficient system and the obtained values of packet delivery ratio and packet delivery delay of proposed and traditional approach with respect to different mobility speed is represented in table 1.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Packet delivery ratio (%)</th>
<th>Packet delivery delay (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td>EFMMRP</td>
<td>MFSMRP</td>
</tr>
<tr>
<td>5</td>
<td>94</td>
<td>99.178125</td>
</tr>
<tr>
<td>10</td>
<td>88</td>
<td>97.209375</td>
</tr>
<tr>
<td>15</td>
<td>85</td>
<td>95.653125</td>
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<td>20</td>
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<td>25</td>
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<td>93.05625</td>
</tr>
<tr>
<td>30</td>
<td>65</td>
<td>92.16875</td>
</tr>
</tbody>
</table>

From the table 1, it is clearly observable that proposed approach i.e. MFSMRP has higher packet delivery ratio with respect to the varying mobility speed in contrast to conventional one, and the higher PDR leads to efficient system. On the other hand, the packet delivery delay of the MFSMRP is low than EFMMRP, and high packet delivery delay leads to inefficient system. Thus, the proposed system is efficient in terms of both the parameters.
7 Conclusion

In this paper, the numbers of parameters are increased so that the transmission behavior of the system can also be determined along with the capability behavior of system. Thus, total numbers of parameters considered in the proposed work are: energy, delay, bandwidth, congestion and PDR. And in order to handle the increased number of parameters, the MFSMRP system is proposed that can handle the more number of parameters. The proposed approach is compared with the conventional approach in terms of packet delivery delay and packet delivery ratio and the obtained results demonstrates that MFSMRP is more efficient than EFMMRP as it has high packet delivery ratio and less packet delivery delay which consequently leads to efficient routing.

References