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# Agent Approach QoS Routing in Manet Based on Fuzzy Priority Scheduler.

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***Abstract: As mobile computing gains popularity, the need for Ad-hoc network will continue to grow. The mobile Ad-hoc network is an autonomous system of mobile wireless nodes connected dynamically without any preexisting infrastructure. Here, the nodes are mobile, hence the network topology changes rapidly and unpredictable over time.Here we proposed the mesh based On Demand multicast Routing protocol (OMDRP), in OMDRP the mesh created by using route request and route reply packets. After the mesh we create the cluster, Clustering is a method which aggregates nodes into groups. These groups are contained within the network and they are known as clusters. In mesh we find the multipaths from source to destinations. In that multipaths again we choose one QoS path depending on minimum delay required to reach the destination. In this paper we use the fuzzy scheduling algorithm to schedule the data packets based on their respective priority index,which will improve the network performance. The presented fuzzy scheduler for mobile Ad-hoc networks,determine the priority of the packets. The proposed fuzzy logic scheduling method is simulated by using Cprogramming language. The propsed scheme is better the without fuzzy priority scheduling system.***

***Key words :*** *MANETs, Multicast,ODMRP, Mesh, Fuzzy,Software Agents.*

## I. INTRODUCTION

Mobile wireless ad hoc networks (MANETs) are a rapidly evolving telecommunications technology. Their popularity is connected with their easy deployment and fast configuration [1]. A mobile ad hoc network is an autonomous collection of mobile devices (laptops, smart phones, sensors, etc.) that communicate with each other over wireless links and cooperate in a distributed manner in order to provide the necessary network functionality in the absence of a fixed infrastructure.

A number of MANET multicast routing protocols have been proposed[2][3]. In this paper we used the on demand multicast routing protocol (OMDRP), ODMRP applies on-demand routing techniques to avoid channel overhead and improve scalability. Using mesh instead of a tree, the drawbacks of multicast trees in mobile wireless networks (e.g., intermittent connectivity, traffic concentration, frequent tree reconfiguration, on-shortest path in a shared tree, etc.) are avoided. A Multicast mesh creation involves two phases ; a request phase and a reply phase. Request phase invokes a route discovery process to find routes to the multicast group. Different routes to the multicast group are setup during the reply phase. After mesh we create a cluster for group communication in this way the network becomes more manageable. Clustering helps aggregate topology information since the number of nodes of a cluster is smaller than the number of nodes of the entire network. After cluster we select receivers and for those receivers we select the designations in same cluster or may be in different clusters. A multicast multipath are found, in those path we select the shortest path which has a low delay to take to reach from source to destination.The transmission of packets is to be performed, for this here we use a fuzzy scheduler. A scheduler should schedule the packets to reach the destination quickly, which are at the verge of expiry. In this paper, we designed and implanted a both with and without fuzzy-based priority scheduler.The fuzzy schedules the data packets based on its priority index.The fuzzy-based scheduling algorithm is coded in C language. Here we used the software agent in routing and also in packet scheduling stages. **Organization of the paper**: Section I provides the introduction on the manet and fuzzy scheduler . Section II discuses an proposed work. In section III, Simulation and Results.Section IV provides the conclusion on the proposed scheme.

## II. PROPOSED WORK

### A. Protocl Description:

Reactive routing techniques, also called on-demand routing. Routes are only discovered when they are actually needed. When a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route. If no route exists, it performs a route discovery procedure to find a

path to the destination. Hence, route discovery becomes on-demand.

### A. *On Demand Multicast Routing Protocol (ODMRP)*

In this paper we use the mesh based on demand multicast routing protocol(ODMRP)[4] instead of tree based multicast routing protocols. There are two basic drawbacks of tree-based protocols. The first drawback is ease of ree structure fragile because of unpredictable topology changes due to mobility of nodes. The second drawback is tree reconstruction delay. So, a new topology concept called Mesh-based[5] was established. It has the possibility to provide multiple paths between any source-receiver pair. In the ODMRP, the mesh creating by Route Request and Route reply Packets.

### *C. Clustering in MANET*

A successful approach for clustering for dealing with the maintenance of mobile ad hoc networks is by partitionating the network into clusters[6]. In this way the network becomes more manageable. Clustering is a method which aggregates nodes into groups. These groups are contained by the network and they are known as clusters. we created the clusters as shown in figure1.

The following steps have to be followed for forming the cluster[7]

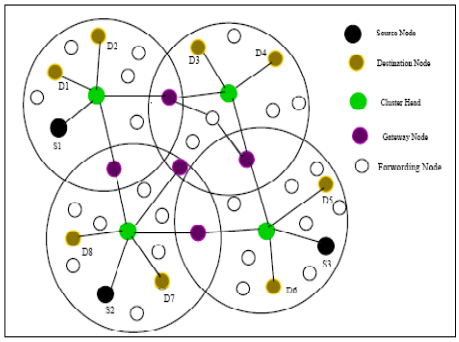


Fig. 1. Clustering in MANET

Step 1: After deployment, the nodes broadcast their id value to their neighbors along with the HELLO message.

Step 2: When all the nodes have discovered their neighbors, they exchange information about the number of one hop neighbors. The node which has minimum mobility is selected as the cluster head. Other nodes become members of the cluster or local nodes. The nodes update the status values accordingly.

Step 3: The cluster head broadcasts the hello message so as to know its members.

Step 4: The members reply with the reply message and in this way clusters are formed in the network.

Step 5: If a node receives more than one hellow messages it becomes Gateway which acts as a mediator between two clusters

In figure1 four clusters are formed, for group communication each group consist number of destinations from different clusters or same clusters. we start transmitting the data from source s1 to Group 1 that contains a destinations D2,D3,D4. The D2 is within the cluster were the source present. So the transmitting path are the S1 -cluster head- D2.Suppose the source and destinations are in Different clusters then data transmitting through the forwarding node Gate way. For example from S1 to D3, the path is S1 Cluster Head –Gate way-Cluster Head-D3.

### *D. Scheduling Methods.*

Without scheduler the packets are scheduled in First in First out (FIFO).For improving the performance of the mobile ad-hoc multimedia networks, a scheduler can be used. A scheduling algorithm determine which packet is delivered next among the packets are in the queues[8]. The scheduling algorithm is placed after routing agent. If the queue is full the scheduler will drops the packets from the queue. The fuzzy scheduling algorithm give the highest priority index to the control packets. And for data packets it schedules the data packets depending on those data rate, Queue length, and expiry time. Figure2 . Shows the priority scheduler for data packets. In this paper we determine the priority index of the data packets by the fuzzy logic concept. The three input variables namely, expiry time of packet, queue length of the node, and data rate of the source, are considered and the application of fuzzy logic to combine these variables and hence find the priority index of the packet is found to be suitable. This led to the design of a fuzzy-based priority scheduler[9]. The most popular defuzzification method is used Centroid ,which returns the center of area under the curve. By cetnroid method of defuzzification ,the crisp output the crisp output η is calculated using the formula

$$\eta = \frac{\sum_{allrules} x_i \mu(x_i)}{\sum_{allrules} \mu(x_i)} \quad (1)$$

where, η is the fuzzy cost, xi is the element and (xi) is its membership function. This is the most widely adopted defuzzification strategy, which is eminiscent of the calculation of the expected value of probability distributions.

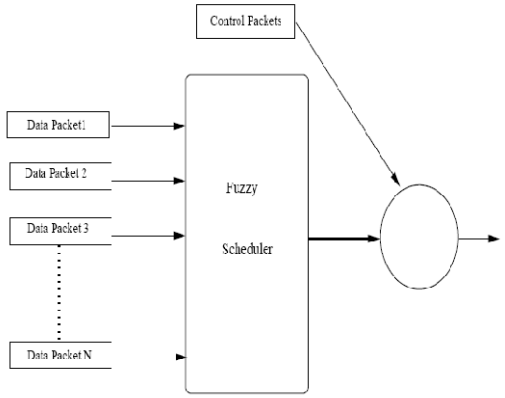


Fig. 2. Priority Scheduler for data packet

### E. Fuzzy Logic Scheduling Scheme

The fuzzy logic implements human experience and preference by using membership functions and fuzzy logic rules[11]. The fuzzy scheduler proposed in this paper, it calculates the priority index of the incoming each packets as shown in figure3. Here, the fuzzy priority scheduler considered as multiple input and single output(MISO). The linguistic variables associated with the input variables are low (L), medium (M), high (H), and. For the output variable, priority index, five linguistic variables are used. They are, low (L), very low (VL), medium (M), high (H), and very high (VH). The membership functions of these variables are shown in the Figure4. (priority index fig) The first step to take the inputs and determine the degree to which the inputs belongs via membership functions. The membership values always between 0 and 1.If fuzzy system has n number of inputs and a single output, here inputs are data rate, Expiry time, Queue Length ,and output is Priority index. The outputs depends upon the fuzzy rules here twenty seven rules are shown in Fuzzy rule table 1.

The some of the rules are illustrate as follows.

1) If (DR is Low ET is Low QL is Low) Then Priority index is Low. 2) If (DR is Low ET is Medium QL is Low) Then Priority index is Very Low 3) If (DR is Low ET is High QL is Low) Then Priority index is Very High

The fuzzy scheduler uses three input variables and one output variable. The three input variables to be fuzzified are, the expiry time, and data rate of the packet and Queue length of the nodes to which the packet is associated with. The inputs are fuzzified, implicated, aggregated and defuzzified to get the output i.e., the priority index.

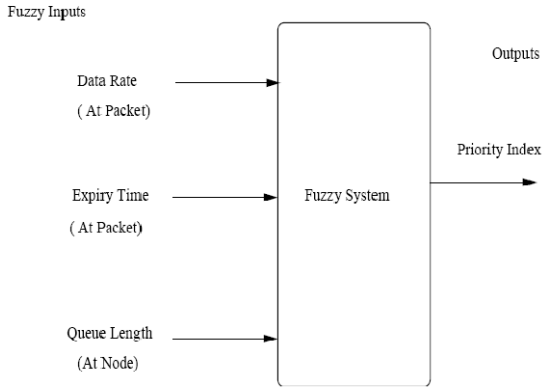


Fig. 3. proposed Fuzzy Scheduler scheme(QoS agency)

### F. Agency:

In this project we use the both static agents and mobile agents for route identification and fuzzy scheduler to improve the Quality Of Service (QoS). These are explained in bellow sections[10].

1) **Route Identification and Management Agency**:

Here we describe the stable route identification agency used in our proposed work. The different agents interactions of this agency is shown in figure 5. it consist of a different agents such as Node Manager Agents (NMA), Mesh Management Agents(MMA), and Route Discovery Agents (RDA). These agents are responsible for collecting and determination network informations. the agency also consist of Data Base that is used for inter agents communication.

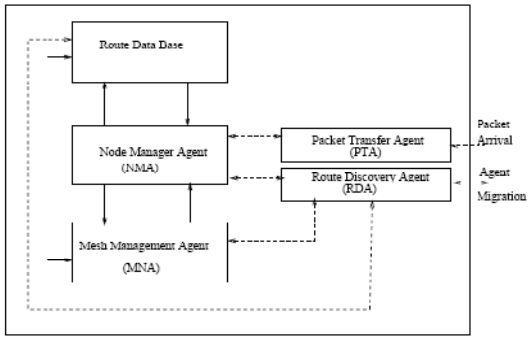


Fig. 5. Route Discovery Agent

**Node Manager Agent( NMA) :** It is a static agent that runs on a node, create the mesh based on Route Request (RP) and Route Reply (RP) packets. The mesh creation based on data base, controls and coordinate the activities of the route identification agency. This agent advertise the route request packets to its neighbors periodically and also updates the data base. By using the Route Request (RP) and Route Reply (RP) packets we create a multicast mesh. This agents

also maintain the mesh ,if any route fails in mesh the agents finds the alternative route. This agent triggers the route discovery agent to find the the routes from source to destinations. The final route is announced to all the nodes in the path between source and destinations.

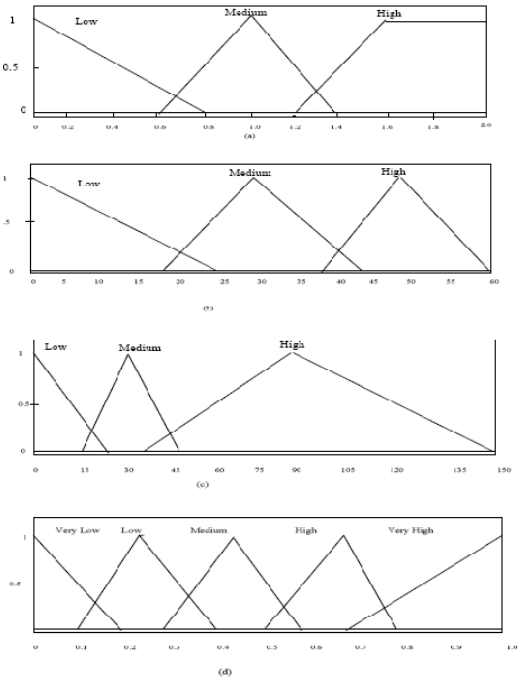


Fig. 4. Member Functions a) Data rate in Mbps b) Expiry time in msec c)Queue length d) Priority index.

TABLE I
FUZZY RULE TABLE

| Case | Data Rate | Expiry Time | Queue length | Priority Index |
|---|---|---|---|---|
| 1 | Low | Low | Low | Low |
| 2 | Low | low | Medium | Low |
| 3 | Low | low | High | Very Low |
| 4 | Low | Medium | Low | Very Low |
| 5 | Low | Medium | Medium | Very Low |
| 6 | Low | Medium | High | Very Low |
| 7 | Low | High | Low | Low |
| 8 | Low | High | Medium | Very Low |
| 9 | Low | High | high | Very Low |
| 10 | Medium | Low | Low | Medium |
| 11 | Medium | Low | Medium | Medium |
| 12 | Medium | Low | high | Low |
| 13 | Medium | Medium | Low | Medium |
| 14 | Medium | Medium | Medium | Medium |
| 15 | Medium | Medium | high | Low |
| 16 | Medium | High | Low | Medium |
| 17 | Medium | High | Medium | Medium |
| 18 | Medium | High | High | Medium |
| 19 | High | Low | Low | Very High |
| 20 | High | Low | Medium | Very High |
| 21 | High | Low | High | High |
| 22 | High | Medium | Low | High |
| 23 | High | Medium | Medium | Medium |
| 24 | High | Medium | High | Medium |
| 25 | High | High | Low | High |
| 26 | High | high | Medium | High |
| 27 | High | High | High | Medium |

**Route Discovery Agent (RDA) :**It is a mobile agent, this agent migrate through the network in search of destinations when a route discovery process is initiated. It collects the Queue length of the nodes along the available paths from source to destinations, and it also collects the end to end delay between the nodes of that paths. Finally this agent selects the best path which as a low delays and updates the data base. This agent also creates clusters for group communication, and choose cluster head based on which node has low mobility.

**Mesh management agent(MMA):** It is a static agent that monitor the link connecting to neighbors in regular intervals of time. And it is always updating the data base. It checks the delay between the nodes for best path choosing.

**Route Data Base:**It consist of information of the node i .e node id, node neighbors, node queue length ,end to end delay between nodes. this data base is used for updating the route and maintain.

2) **Fuzzy Agency**:This agency is used for finding the priority index of the incoming packets based on packet parameters such as expiry time and data rate and node parameter like Queue Length. This agency consist of only one agent that is fuzzy scheduler and management agent.(FSMA). As shown in figure6.

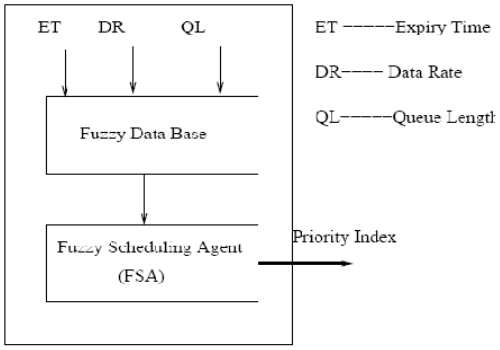


Fig. 6. Fuzzy Agency.

**Fuzzy Data Base:** It consist of information of the packet parameter such as a expiry time ,data rate ,and node information such as Queue length.

**Fuzzy Scheduling Agent (FSA):**This is a static agent, and acting at the node and using for packet scheduling i.e. which packet is scheduled first based on fuzzy data base parameter maintained in Fuzzy data base. The proposed scheme Algorithm is as follows.

**Algorithm:** QoS based DSR protocol using fuzzy agent

**Begin**

**Mesh Creation and maintaince**

**step 1:**Randomly deploy the mobile nodes.

**step 2:**Mesh Creation by Send Route Request Packet Route Reply Packets with the help of Route Identification and Management Agencies.
**step 3:**If RR packet Sequence No. is duplicate At the node then Discard the packet. Else Receive the Packet
**step 4:**If mesh fails then multicast Routing Agent finds the alternate path, is available paths in Mesh.
**Cluster Creation for Group comunication**
**step 5:**The nodes broadcast their id value to their neighbors along with the HELLOW message.
**step 6:**If the node within cluster has a Low Mobility , then Choose as a Cluster Head else Other nodes become members of the cluster.
**step 7:**If a node receives more than one hellow messages it becomes Gateway which acts as intermediate node.
**Data Transmission**
**step 8:**Find the Feasible Multipaths from Source to Destinations
**step 9:**Find the QoS path based on low Delay
**step 10:**If QoS path is not found ,then update the route data base.
**step 11:** Start Sending the packets from source to destinations using QoS path.
**Fuzzy scheduler**
**step12:**Apply the fuzzy priority scheduler at selected path.
**step 13:**The data rate, expiry time Queue length are the fuzzy scheduler inputs.
**step 14:**calclate the priority index of the data packets by using fuzzy scheduler.
**End.**

## III. SIMULATION AND RESULTS

This proposed multicast routing protocol (ODMRP) has been implemented by using the C language. we used the simulation parameters are shown in table 1 . The following metrics are used for the calculation of fuzzy scheduler.

**A. simulation parameters**

a) **Packet delivery ratio:**

Packet delivery ratio is the ratio of the number of data packets actually delivered to the destinations to the number of data packets supposed to be received. This number presents the effectiveness of the protocol.

$$\text{Packet Delivery Ratio} = \frac{\text{No. of packets that are received}}{\text{No.of packets sent.}} \quad (2)$$

b) **Average end-to-end delay of data packets:**

It represents the average value of the time that the received data packets take to reach the destination from their origin. This parameter includes the time the nodes stay in the internal queues, the retransmissions, and the forwarding through multiple intermediate nodes.

c) **Agent Control Overheads:**

It is defined as the ratio of bandwidth utilized by mobile agents to the available bandwidth.

| Parameters | Values |
|---|---|
| Network Area | 100x100 meters |
| Number of nodes | 10 to 50 |
| Mobility Mode | Random waypoint |
| Speed of mobile nodes | 5-15 m/s |
| Distribution of nodes | Random |
| Communication range | up to 1o meter |
| Packet Size | 512 |
| Data Rate of Packet | 0-2 Mbps |
| Expiry Time of the Packet | 0-70 msec |
| Queue Length at nodes | 20-100 |
| Learning constant($\alpha$) | 0.1 |

TABLE II: SIMULATION PARAMETERS

**B. Performance evaluation Using C language**

The fuzzy scheduler is implemented bu using C language. we first assign the input variable then finding the priority index of the packets by applying fuzzy logic and using agents in our proposed work. Then the calculated priority index is used for the scheduling the data packets, which are the highest priority that means that packet to expire. Here we give the highest priority to the control packets.

a) **Simulation Results:**

i) **Mobility Vs Packet delivery ratio:**

Figure 9 shows the mobility Vs Packet delivery ratio .Packet delivery ratio of ODMRP as a function of mobility speed. The size of multicast group is varied to examine the scalability of the protocol. The result indicates that ODMRP delivers high portion of data packets in most of our scenarios. As the number of members increases, the forwarding group mesh creates richer connectivity among members. The mesh makes the protocol scalable and robust to speed. In this simulation transmission rate at 2mbps, the mobility will be taken from 0 to 100 in kmph As the mobility speed is increasing, the PDR is start decreasing slowly in with FPS but PDR is decreasing rapidly as compared to FPS .

ii) **Multicast group size Vs Packet delivery ratio:**

Figure 10 shows the Multicast group size Vs Packet delivery ratio. The number of senders is taken from two to five, the mobility at 5-15 m/s and the multicast group size is varied from 2 to 20 members. Here the number of receivers increases the number of forwarding group node also increases, this in turn increases the connectivity of the links. So this further increases the PDR with FPS as compared to the without FPS.

iii) **Agent overhead Vs Number of nodes:**

As the number of nodes increases ,more number of mobile agents are used to find the stable route and finding the packet priority index. Thus the agent overhead ratio increases with increase in the mobile nodes.this is shown in figure 11.

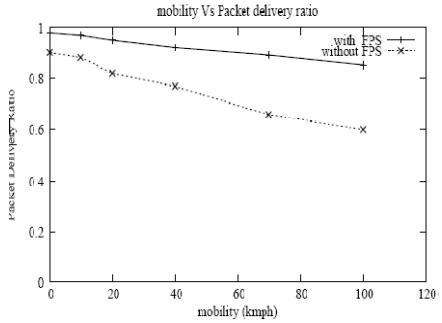


Fig. 7. Mobility Vs Packet delivery rati**o**.

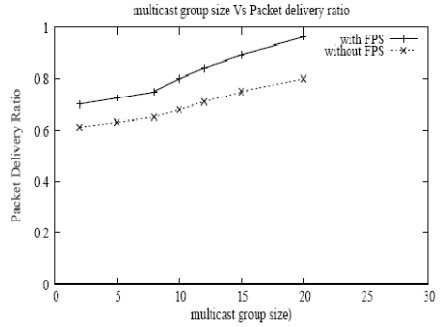


Fig. 8. Multicast group size Vs Packet delivery ratio

iv) **Number of nodes Vs End to END DELAYs:**
The end to end delay indicates how long it took for a packet to travel from the source to the destination. For low dense networks ,the ODMR gives the low end to-end delay. The average ned-to-delay increases with increasing the number of nodes. The figure 12 shows the the Number of nodes Vs end-to-end delay.

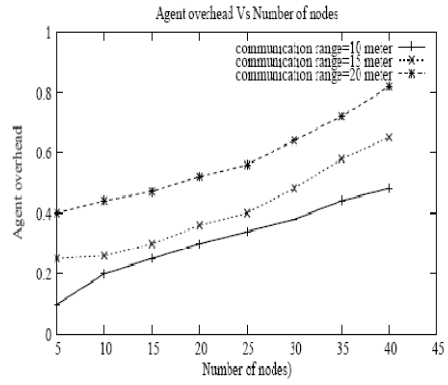


Fig. 9. Agent overhead Vs Number of nodes

IV. CONCLUSIONS

In this paper, we have analyzed the performance of the fuzzy-based priority scheduler for data traffic and evaluated the effect of inclusion of this scheduler with multicast mesh based routing protocol ODMRP.

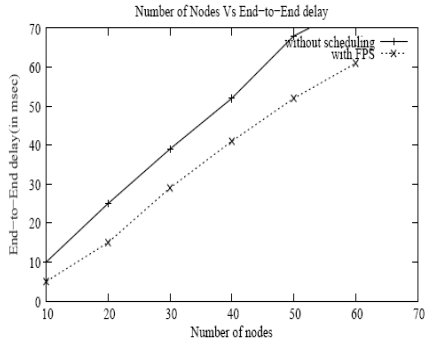


Fig. 10. Number of Nodes Vs End-to-End delay.

So in this paper we Proposed the both with and without fuzzy scheduling algorithm. The fuzzy scheduler finds the priority index of the queued packets. It combines the input parameters such as data rate, expiry time, and queue length for finding the priority index. Without fuzzy scheduling the packets are scheduled in first in first out. Here we used the software agents for both in routing and fuzzy priority scheduling stages.

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