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Analysis of QoS for DSR Protocol in Mobile Ad-hoc Network using Fuzzy Scheduler

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ABSTRACT:- A mobile ad-hoc network is a self-configuring infrastructureless wireless network of mobile devices connected to each other. The major challenge in an ad-hoc network lies in adapting multicast communication to environments, where the mobility is unlimited and failures are frequent. Such problem increases the delay and decreases the throughput. In order to meet these challenges, this paper presents an algorithm to improve the performance of DSR protocol by using fuzzy logic in MANET. The data packets are served in FIFO order for packet schedulers in wireless adhoc networks. This paper presents a fuzzy based priority scheduler for MANET to determine the priority of the packet using DSR as a routing protocol. Network simulator 2.34 is used to check the performance. The scheduler is evaluated in terms of quantitative metrics such as packet delivery ratio, end to end delay and throughput. The main focus is on proposing a fuzzy approach to multi-packets scheduling in which the scheduling parameters are treated as fuzzy variables.

KEYWORDS:- Mobile ad-hoc network, fuzzy priority scheduler, DSR, NS2.34

I. INTRODUCTION

Mobile Ad-hoc Networks (MANETs) are wireless networks consisting entirely of mobile nodes that communicate on-the-move without base stations. Nodes in these networks will both generate user and application traffic and carry out network control and routing protocols. Rapidly changing connectivity, network partitions, higher error rates, collision interference, bandwidth and power constraints together pose new problems in network control—particularly in the design of higher level protocols such as routing and implementing applications with Quality of Service requirements. The network topology may vary rapidly and unpredictably over time, because the nodes are mobile. The network is decentralized, where all network activity including discovering the topology and delivering messages must be executed by the nodes themselves. Hence routing functionality will have to be incorporated into the mobile nodes.

In the proposed networks as shown in Fig.1, the mobility of nodes and the error prone nature of the wireless medium pose many challenges like frequent route changes and packet losses. Such problem increases packet delay and decrease throughput which degrades the quality of service. In order to make the performance better, the scheduler can be used. C.Gomathy et al. [1] has designed a fuzzy based priority scheduler to determine the priority of the packets. Kumar et al. [2] defined how to improve the end-to-end QoS target in MANET. Mary Bader et al. [3] has focused primarily on routing protocols -how to route packet hop by hop as efficient as possible and medium access control (MAC - how to share the medium efficiently).

This paper deals with a fuzzy based scheduler that improves the QoS parameters in wireless ad-hoc network. Overall end to end performance will be improved using the scheduling algorithm and this algorithm also decides the priority of the packets so that which queued will process next. If scheduling scheme is not used then packets will be processed in FIFO i.e. first in first out manner due to which frequent drop of packet is observed. The disadvantage of this technique is that it cannot differentiate among connections. Hence the choice of scheduling algorithm to determine which queued packet to process next will have a significant effect on overall end to end performance.

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A great deal of research has been done to improve the QoS of MANET. Research paper such as [4] focused on routing protocols to improve link stability, end-to-end delay and bandwidth optimization. Paper [5] proposed an efficient coding scheme for the dissemination of data between MANET nodes. Paper [6][7] compared the performance of various routing protocols with regards to mobility, delay, packet loss and network congestion and [8] discussed the link stability in MANET. Paper [9], used a fuzzy inference system with two input variables and a single output (priority index). The two input variables are channel capacity and data rate; these were used to determine the priority index of packets to be scheduled. Fuzzy scheduling in MANET is discussed in [10] based on buffer size and number of hops suffered by packets.

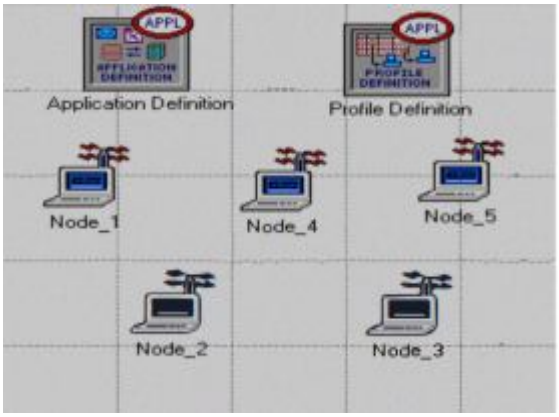

Fig.1 A proposed model of ad hoc network

II. DSR PROTOCOL

A. DSR Protocol

Dynamic source routing (DSR) is a routing protocol for wireless mesh networks. However, it uses source routing instead of relying on the routing table at each intermediate device. This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node. To return the Route Reply, the destination node must have a route to the source node. If the route is in the Destination Node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the Route Request message header. In the event of fatal transmission, the Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node. The erroneous hop will be removed from the node's route cache; all routes containing the hop are truncated at that point. Again, the Route Discovery Phase is initiated to determine the most viable route. The basic approach of this protocol (and all other on-demand routing protocols) during the route construction phase is to establish a route by flooding Route Request packets in the network. This protocol uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach.

B. Packet Scheduling Scheme

To improve the quality of service of MANET, a scheduling scheme is required. This is an algorithm that determines the order in which a thread or data flow can access the available resources. Packets from various flows arrive at a node, and the scheduler is used to treat individual flow fairly in order to improve the quality of service. Some of the conventional available scheduling algorithms are FIFO, Priority Queuing (PQ) and weighted fair queuing (WFQ); these algorithms are

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designed to improve the QoS of a network [11]: In FIFO: various packet flows are kept in the buffer until they are ready to be processed by the queue. Packets that arrived first at the queue are served first and any other packet that arrives later will have to wait in the queue until all previous packets have been served. If the average packet arrival rate is greater than queue processing rate, the queue will not be able to cope with the intensity of packet arrivals, thus congestion will occur. Hence packets will be discarded by the queue either because the queue buffer is already full or it has exceeded the waiting threshold in the queue.

III. FUZZY SCHEDULER SCHEME

A. Fuzzy Logic

Fuzzy systems are defined with a strong mathematical basis. Fuzzy systems are rule based systems. It is a rule base system which consists of a set of IF-THEN rules. The rules are statements in which some work is characterized by continuous membership functions. Fuzzy model is made up of blocks comprises of a knowledge base fuzzifier, knowledge base defuzzifier and an inference engine as shown in Figure 2.

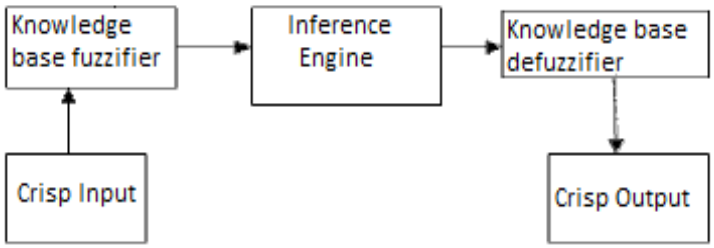

Fig.2 Basic Fuzzy System

B. Fuzzy Algorithm

There are two basic approaches or algorithm used in fuzzy logic. The first one is Mamdani and second is Sugeno, both the algorithms are developed for fuzzy concept. In this paper we use the Mamdani algorithm for developing the concept of fuzzy scheduler in dynamic source routing protocol. The description of Mamdani algorithm is given below.

Loop \\ System is running for ever
For each DSR packet queue, the queue does the following:
Step 1*: For each ready packet P (a packet which is in packet queue and eady to transmit)*
Feed it into the rule base schedule System engine.
Consider the output of fuzzy system having priority of packet P.
Step 2*: Execute the packet with highest priority until any scheduling event occurs (a running packet finishes, until a new packet arrives)*
Step 3: *Update the DSR queue*
END
END loop

C. Fuzzy Based Scheduler

The proposed fuzzy scheduler had two input variables and a single output which is the priority index of each packet. In this model, all the inputs considered contributes to congestion (both internally and externally), unlike previous fuzzy

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scheduling schemes. The two inputs of the fuzzy model are data rate and channel capacity of the individual nodes that the packet is associated with as shown in Figure 3. The inputs are fuzzified, implicated, aggregated and defuzzified to obtain the crisp value which is the output i.e. priority index.

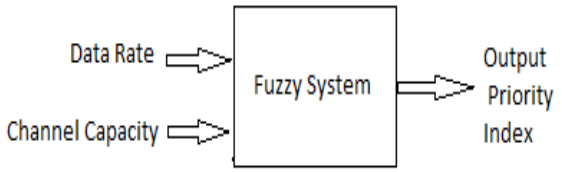

Fig 3. Fuzzy Scheduler

A modified rule-based fuzzy scheduler that deals with both task priority and its execution time is presented in this section. A fuzzy-based decision maker (FDM) has a modified rule-based fuzzy scheduler that deals with both task priority and its execution time is presented in this section. A fuzzy-based decision maker (FDM) has been proposed to compute the new priority (Pn) of all packets according to the packets priority (Po) and its expiry time (Ex), as shown in Table 1. The measured variables are inverted into suitable linguistic variables. In this application, the following linguistic variables are used for priority (Po), and new calculated priority (Pn); Very Low (VL), Low (L), Medium (M), High (H), and Very High (VH). The fuzzy sets definitions for expiry time (Ex) are Low (L), Medium (M) and High (H). The proposed fuzzy decision maker is a collection of linguistic rules which describe the relationships between measured variables (Po & Ex), and calculated output (Pn).

CC / DR	L	M	P
Expiry time(Low)			
L	L	L	VL
M	VL	VL	VL
H	L	VL	VL
Expiry time(Medium)			
L	M	M	L
M	M	M	L
H	M	M	M
Expiry time(High)			
L	VH	VH	H
M	H	M	M
H	H	H	M

Table 1: Fuzzy Rule Base
Dr-Data Rate, CC-Channel Capacity

The rules are defined with care and are shown in Table 1.
To illustrate the first rule, it can be interpreted as follows:
"If expiry time is low, data rate is low, and channel capacity is low, then priority index is low." Since in this rule, data rate and channel capacity are low and packets are associated with low delay, the priority index is set to be low. The ninth rule is interpreted as: "If expiry time is low, data rate is high, and channel capacity is high, then priority index is very low." In this rule, even though the expiry time remains the same, the data rate and channel capacity are high, priority index is set to be very

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low. Similarly, the other rules are framed. The priority index, if very low, indicates that the packets are associated with the highest priority and will be scheduled immediately. If the index is very high, then packets are with the lowest priority and will be scheduled only after high priority packets are scheduled. The degree to which an element belongs to given set is called degree of membership. The membership functions are shown in fig 4.

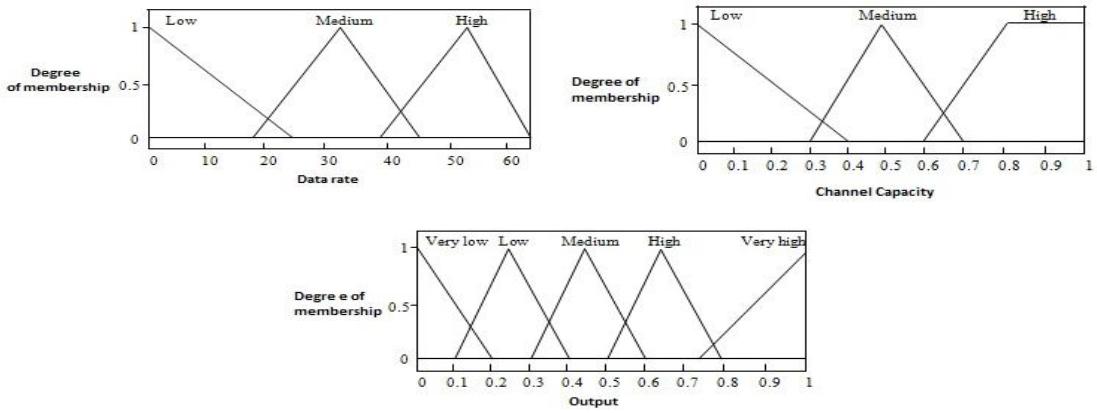

Fig 4. Membership Functions

IV. PERFORMANCE EVALUATION

A. Simulation Setup

The network simulator NS2.3 [12][13] provides scalable simulations of wireless networks and helps to analyze and evaluate the performance of the proposed fuzzy schedulers. In this simulation 50 mobile nodes move with a rectangular field of 1500m×300m in size. The rectangular field is chosen so that the average hop distance between any two nodes will be larger than that of a square field with the same area. The duration of each run is 900 simulated seconds. The mobility model used is random waypoint model [14]. The radio model used is the two ray model [15]. The mobility rates used with different pause time are as 0, 45, 90, 180, 270, 540, 720 and 900 seconds. The maximum moving speed is 20mps. Traffic source are CBR UDP. Each packet is 512 bytes long, thus resulting 2kbps data transfer rate for each session.

B. Results and Evaluation

1) Packet Delivery Ratio: It is the ratio of the number of data packets actually delivered to the destination to the number of data packets supposed to be received. This shows the effectiveness of the protocol.

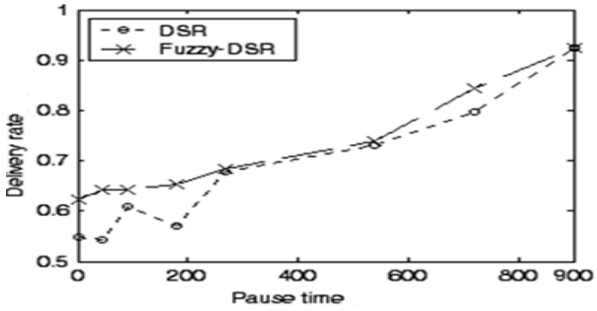

Fig 5(a). Delivery Rate vs. Pause Time

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2) *Average end-to-end delay:* It indicates how long it took for a packet to travel from the source to the application layer of the destination.

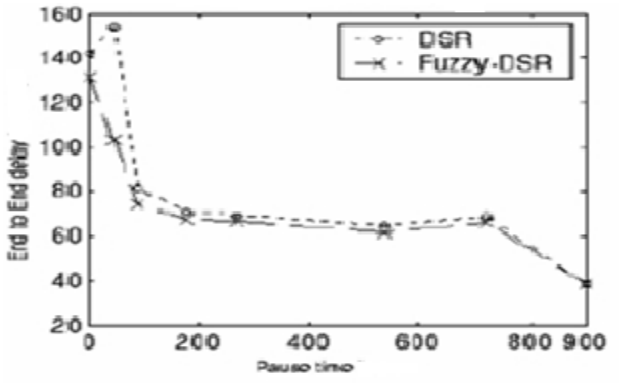

Fig 5(b). End-to-end Delay vs. Pause Time

3) *Dropped Packets:* The dropped packets are the data packets that are dropped during the link breaks and collision.

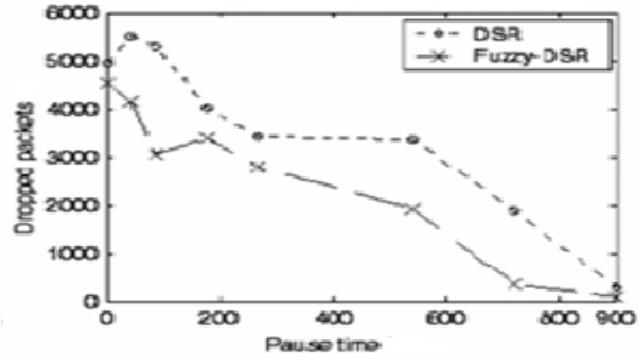

Fig 5(c). Dropped Packets vs. Pause Time

V. CONCLUSION

In this paper, a technique based on fuzzy concept for mobile ad-hoc network is presented which analyze the performance of the fuzzy based priority scheduler for QoS parameters in mobile ad-hoc network. It combines the input parameters such as channel capacity and data rate to find the priority index. The fuzzy scheduler attaches a priority index to each packet in the queue of the node. The crisp value is calculated based on the inputs such as queue length, data rate and expiry time of the packets which are delivered from the network. From the results above it is seen that packet delivery ratio in case of fuzzy DSR is better than simply DSR. Average end to end delay and dropped packets are also improved and shows better results when fuzzy DSR is used.

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