

COMPARATIVE EVALUATION OF DSR USING FUZZY LOGIC AND QUALNET

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ABSTRACT

Mobile ad hoc network (MANET) is a collection of wireless nodes that connected themselves to form a wireless network without any fixed infrastructure. The objective of this paper is to model the behavior of MANET using DSR protocol by considering some parameters. These parameters (packet delivery fraction, normalized routing load and packet loss ratio) have been generated by Qualnet Simulator 6.1. The MANET for DSR protocol is estimated to be dependent on fuzzy variables like node density, pause time, mobility, number of packets transferred, and the number of connection. In this paper the behavior of MANET has been analyzed using Fuzzy logic System and Qualnet for DSR (Dynamic Source Routing) protocol and the performance has been compared in terms of PDR, normalized routing load.

Keywords: DSR, fuzzy logic controller, MANET, NRL, Qualnet 6.1

I. INTRODUCTION

Mobile ad hoc network (MANET) [2] is a group of wireless nodes which dynamically connected themselves to form a network without any fixed infrastructure. For forwarding the packets towards the destination, it is necessary for each node implement routing functionality. As a result, the connection between any two nodes forms a multi-hop path assisted by other nodes[5]. The main objective of any routing protocol is to establish routing path between nodes, which provides efficient transmission of data. However, to operate network, each node must be willing to forward packets to other nodes[7,10]. MANET has many useful applications, e.g. disaster relief, military operation, and most recently civilian applications which include environmental monitoring, healthcare etc.

There are many research works which have shown analyze the performance of various protocols, there is still no such approach which can provide help in MANET area to compute the behavior of protocols using the formula or function, with the help of proposed model in this paper, DSR is the right protocol which shows satisfactory outcomes with fuzzy logic controller.

II. DSR PROTOCOL

Dynamic Source Routing (DSR) is a routing protocol for wireless ad-hoc networks. It is common to AODV protocol in that it forms a route on-demand when a sending node requests one [8]. However, DSR uses source routing instead of depending on the routing table at each secondary device. Dynamic source routing protocol

(DSR) is an on-demand protocol. DSR is designed to tighten the bandwidth consumed by control packets in wireless ad-hoc networks by discarding the periodic table-update messages needed in the table-driven approach. The main difference between DSR and the other on-demand routing protocols is that it does not have hello packet and hence it does not require periodic hello packet (beacon) transmissions, which are used by a node to inform its neighbors node of its presence [12]. The basic approach of DSR protocol (and all other on-demand routing protocols) during the route generation phase is to link a route by flooding Route Request packets in the network. The destination node, receiving a Route Request packet, responds by generating a Route Reply packet back to the source, which carries the route traversed by the Route Request packet received [9]. This protocol is mainly based on source routing whereby all the routing information is maintained at mobile nodes. It has only two main phases, which are Route Discovery and Route Maintenance. Route Reply would only be effected if the message has received the intended destination node (route record which is contained in Route Request would be inserted into the Route Reply).

III. FUZZY LOGIC SYSTEM

Fuzzy logic is based on the set of rules which is made by human experience. It is based on the uncertain and approximate reasoning. Fuzzy based methodology is applied in many automated machines like washing machine, refrigerator etc [5]. There are two types of Fuzzy logic inference system (FIS). One is Mamdani type and the another is Sugeno type FIS. Mamdani type system is very popular and is commonly used. Both systems are very similar in their function but the main difference between them is: in Mamdani inference system the fuzzy output is neither linear nor constant and in Sugeno type inference system the fuzzy output is linear or constant. In this paper, mamdani type FIS has been used because it gives non linear and variable fuzzy outputs.

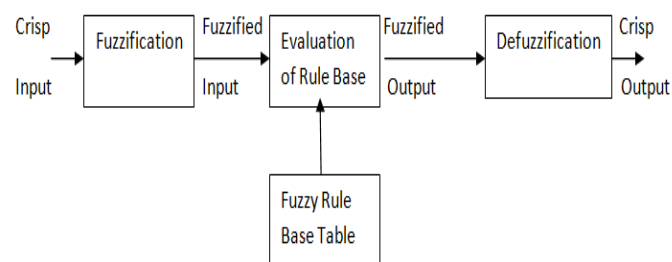


Figure 1: Fuzzy Logic Inference system

The FIS consist of four parts shown in Fig. 1 which are fuzzifier, inference engine, fuzzy rule base and defuzzifier. The function of fuzzifier in FIS is to convert the crisp input data values to the fuzzy sets that are defined through fuzzy rule base. Fuzzy rules can be made through human thinking and can be defined by their membership function. The role of defuzzifier is to convert the output fuzzy sets to a crisp output value.

IV. FUZZY SYSTEM FOR DSR

In this paper fuzzy inference system has five inputs and two outputs. A fuzzy inference system (FIS) have inputs like Node Density (ND), Pause Time (PT), Node Mobility (NM), Number of Packets transferred (NP) and the Number of Connection (NC) and outputs Packet Delivery Fraction (PDF), Normalized Routing Load (NRL) in the case of fuzzy classification. In this paper the Mamdani FIS is taken for DSR. The proposed Inference System is given in fig. 2.

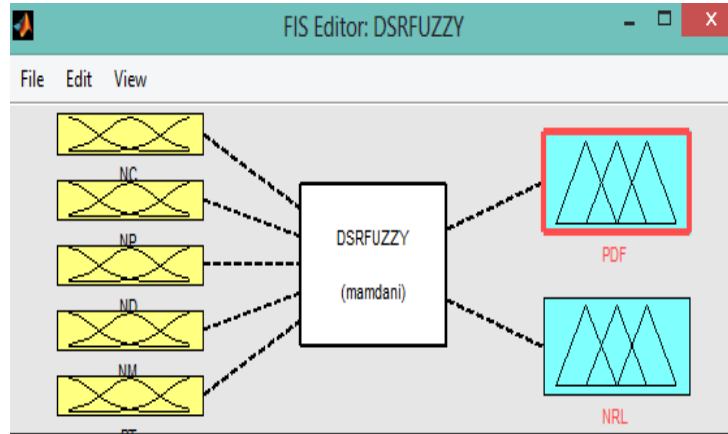


Figure 2: Proposed Fuzzy Logic system for DSR

The rules for this fuzzy based system are as follows.

1. If NC is LOW, NP is LOW, ND is LOW, NM is SLOW and PT is LOW then PDF is POOR and NRL is GOOD.
2. If NC is LOW, NP is MEDIUM, ND is MEDIUM, NM is SLOW and PT is MEDIUM then PDF is POOR and NRL is GOOD.
3. If NC is MEDIUM, NP is MEDIUM, ND is MEDIUM, NM is MEDIUM and PT is MEDIUM then PDF is SATISFACTORY and NRL GOOD.
4. If NC is HIGH, NP is HIGH, ND is MEDIUM, NM is FAST and PT is HIGH then PDF is SATISFACTORY and NRL is GOOD.

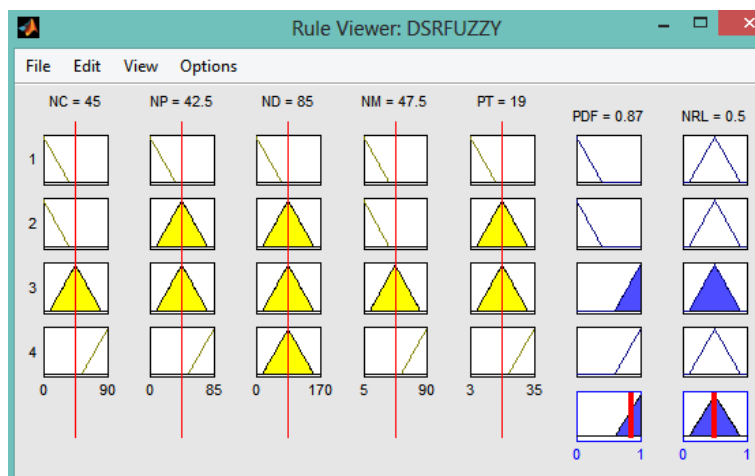


Figure 3: Output of fuzzy system for DSR

V. SIMULATION SETUP

The simulation has been setup through Qualnet Simulator 6.1 over window platform by varying some parameters. Qualnet simulator is a discrete event simulator that is used simulating wired or wireless scenarios from simple to complex conditions. We have used different simulation with different no of nodes connected through wireless subnet. The area of simulation 1500m×1500m has been taken. The simulation time has been taken 300sec. Random way point type mobility model and data rate of 2 Mbps have been used for all simulations. Omni directional antenna is used for all simulations. The performance metrics like Packet delivery fraction, Normalized routing load have been used.

VI. SIMULATION PARAMETERS

Table 1- Simulation Parameters for DSR routing protocol

Parameters	Value
Simulator	Qualnet 6.1
No. of node	20,40,60,80,100,120
Simulation time	300sec
Mobility model	Random way point
Pause time	3,9,15,21,27,33sec
Data rate	2Mbps
Radio type	802.11b radio
Antenna model	Omni directional
Item size	512 bytes
Node Mobility	10,20,30,40,50,60 m/sec
Channel frequency	2.4GHz
No. of connection	6,10,14,18,22,26
Number of packets	2,4,6,8,10,12 sec
Simulation Area	1500m×1500m
Battery Model	Linear

VII. PERFORMANCE METRICS

In this paper following metrics for the evaluation of performance have been used:

- Packet Delivery Fraction: Packet Delivery Fraction is defined as the ratio of data packet delivered to destination to those generated by the CBR source.
- Packet Loss Ratio (PLR): Packet Loss Ratio is defined as the ratio of total number of data packets which fail to reach the destination node to the number of data packets sent by source node during the simulation process. Packet Loss Ratio is inversely proportional to the Packet Delivery Ratio [11].
- Normalized Routing Load (NRL): Normalized Routing Load is defined as the ratio of total number of routing packets transmitted (including forwarded routing packets also) to the total number of data packets received at the destination nodes [7].

VIII. RESULT AND ANALYSIS

Table 2 shows the output of fuzzy logic for given input inputs in terms of PDF and NRL

Table 2: Output of fuzzy logic for given input

INPUT					OUTPUT	
Node Density	No. of Connection	No of Packet transferred	Pause Time	Node Mobility	Packet Delivery Fraction	Normalized Routing Load
20	6	2	3	10	0.139	0.50
40	10	4	9	20	0.160	0.50
60	14	6	15	30	0.191	0.291
80	18	8	21	40	0.500	0.50
100	22	10	27	50	0.907	0.50
120	26	12	33	60	0.813	0.50

To compare the performance of DSR with fuzzy value and Qualnet values given below

Table 3: Results for the Packet Delivery Fraction

No of Nodes	Fuzzy Value	Qualnet Value
20	0.139	0.745
40	0.160	0.976
60	0.191	0.842
80	0.5	0.473
100	0.907	0.384
120	0.813	0.312

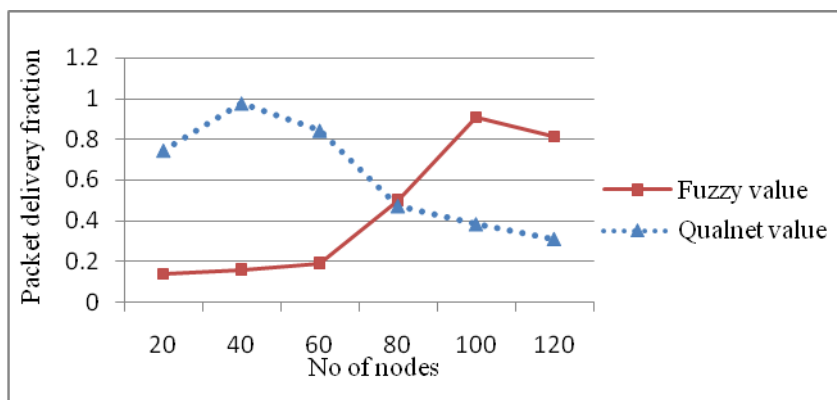


Figure 4: Packet Delivery Fraction comparison

Table 4: Results for the Normalized Routing load

No of Nodes	Fuzzy Value	Qualnet Value
20	0.5	0.195
40	0.5	0.142
60	0.291	0.103
80	0.5	0.097

100	0.5	0.084
120	0.5	0.078

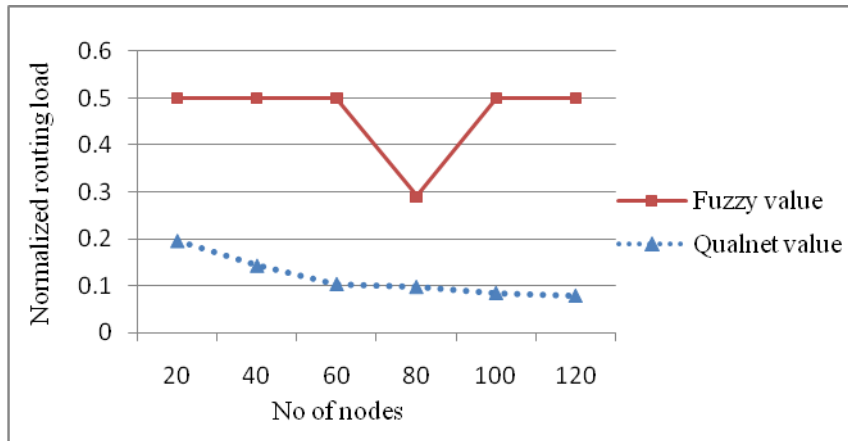


Figure 5: Normalized Routing Load comparison

Table 5: Results for the Packet Loss Ratio

No of Nodes	Fuzzy Value	Qualnet Value
20	0.861	0.254
40	0.840	0.239
60	0.809	0.157
80	0.5	0.526
100	0.093	0.615
120	0.187	0.688

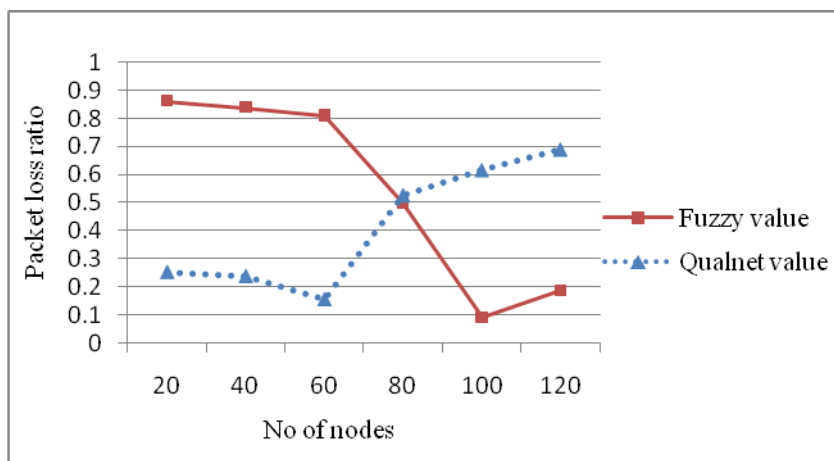


Figure 6: Packet Loss Ratio comparison

Table 2 given the fuzzy values and Qualnet values of packet delivery fraction. The simulation has been done by varying No of nodes. These values found after simulating the Qualnet and tuning the fuzzy logic controller. Figure 4 shows the comparison between fuzzy values and Qualnet values of packet delivery fraction and shows that as the no nodes increases fuzzy logic value is better than Qualnet values. Table 3 given the fuzzy values and Qualnet values of Normalized routing load. Figure 5 shows the comparison between fuzzy values and Qualnet values of normalized routing load. Here fuzzy value is better. Table 4 given the fuzzy values and Qualnet values of packet loss ratio. Figure 6 shows the comparison between fuzzy values and Qualnet values of packet loss ratio. Packet loss ratio is inversely proportional to packet delivery fraction.

IX. CONCLUSION

This paper presents a fuzzy logic based and Qualnet based comparison. This facilitates generate of effective results, MANET will be able to gain the advantages of the Fuzzy Inference system that provides some direction that how to achieve better result. By using the model, it is found that input parameters influences output parameters. By using the proposed model, if number of connection, number of packets, node density node mobility speed and pause time is increased in proper ratio then, performance of DSR can be enhanced, if performance of DSR is increased then MANET is able to have low signal loss, high energy nodes environment.

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