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Authors: Saivikas reddy Bedudhuri[1]

Affiliations: Ajay roy[1]

Orcid ids: 0000-0002-7761-1366[1]

Contact e-mail: saivikasreddy95@gmail.com

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Comparison AODV and DSDV MANETS Routing Protocols Using Fuzzy Logic

Ajay Roy, Sai Vikas Reddy, Chakradhar Reddy

School of Electronic and Electrical Engineering

Lovely Professional University, Punjab

Email: koushik.15737@lpu.co.in¹ and ajoy.22652@lpu.co.in

and ²saivikasreddy95@gmail.com

Abstract

Mobile ad hoc network is a type of ad hoc wireless networks which has become highly important in wireless communication. This network has composed of a set of wireless nodes and mobile phones and computer can play role of these nodes. Routing in these networks is complex and difficult because there is no fixed topology and nodes are freely displaced. In these networks, each node plays role of a router. Military networks, crime management networks etc. can be among the examples of mobile ad hoc network. One of the most important issues in ad hoc networks is routing. There are different types of routing protocols such as AODV and DSDV routing protocols. This report analyses and evaluates these two protocols with fuzzy logic and NS-2 simulator. This report is organized as follows: previous works, relates to concepts mentioned in this paper, the designed fuzzy system, results of simulation are mentioned.

Keywords: AODV, DSDV, Fuzzy system, NS-2, MATLAB software

I. Introduction

Ad hoc networks are classified into two groups including mobile ad hoc network and intelligent sensor network. Mobile ad hoc network has composed of wireless nodes. Nodes are freely displaced. In other words, this network has dynamic topology. Figure 1 shows an mobile ad hoc network.

Figure 1 mobile ad hoc network.

Routing is difficult in this network. In order to send data soundly and with low delay to destination, routing protocols should be used. DSDV and AODV protocols are of the popular protocols which are evaluated and compared with different nodes size. DSDV routing protocol performs routing with Bellman–Ford algorithm. Each node has a routing table which is updated continually and periodically. The inputs which are located in routing table include the number of nodes for reaching destination, sequence numbers for reaching destination which is generated by the destination node and is the destination address [2, 5]. Data packets are transferred to nodes with routing table. Preventing creation of loop is one of the features of this protocol. AODV routing protocol This protocol discovers route with request approach. In other words, this protocol finds routes with RREQ, RREP and RERR

messages. When the source node wants to send data to destination, source node first broadcasts messages called RREQ to its neighbour nodes. When the RREQ message reaches destination node, the destination node will send its response to the source node from the same previous path with RREP message and it means that the route has been found from source to destination and the source node can send its data. One of the features of this protocol is that it performs routing action only if necessary. ADOV protocol uses a routing method and acts similarly to DSR [6, 7, 8]. As mentioned above, the source node first broadcasts its route request among neighbours and the node forwards its response message into the source node. Figure 2 shows message broadcasting procedure. This figure has 8 nodes in which node A has role of source and H has role of destination. Node a broadcasts route request among the neighbouring nodes and also neighbouring nodes route request source node to another node.

Figure 2 Mobile ad hoc network message broadcasting procedure

When request message reaches node H or destination node is found, the destination node forwards the response message to node A and the source can send its data. Figure 3 shows response of destination node to the source node. Sending route request from node a (source) Sending node H response (destination) to sphere a (source).

Figure 3 Response of destination node

II. Fuzzy system

Fuzzy models based on Zadeh's compositional rule of inference. The fuzzy system use the raw data to make calculation on whatever the input is given and it begins with an introduction of fundamental ideas of fuzzy conditional (if-then) rules. A collection of fuzzy if-then rules formulates the so-called knowledge base, which formally represents the knowledge to be processed during approximate reasoning.

III. Related Work

Studies have been conducted so far to evaluate and analyse routing protocols in ad hoc networks some of which we describe here. Morshed et al. in their paper compared AODV and DSDV protocols with different parameters. In their test, they showed that AODV protocol was better than DSDV routing protocol for real time applications. Mohapatra et al. in their paper analysed function of several routing protocols on ad hoc network and studied delay, throughput and packet delivery. Odeh et al. analysed and compared function of two protocols i.e. DSR and AODV. Criterion for their comparison was data packet size. They found that DSR protocol had better function for packet of below 7 bytes. Boukerche et al. studied and compared AODV, PAODV, CBRP, DSR, DSDV protocols and found that DSR and CBRP routers had higher power compared with other protocols .in this project here we have analysed things by using fuzzy logic by taking of the outputs of both AODV and DSDV like throughput, packet dropping etc.

IV. Proposed Methodology

Fuzzy system

Fuzzy systems are able to make decision and control a system The term “system” is usually understood as a set of interacting components with well-defined structure and organized as an intricate whole that can be distinguished from the “external” environment. A system communicates with the environment through so-called inputs and outputs. Fuzzy systems are structures based on fuzzy techniques oriented towards information processing, where the usage of classical sets theory and binary logic is impossible or difficult. In the literature, terms such as fuzzy system, fuzzy model, system based on fuzzy rules, fuzzy controller, or fuzzy associative memory are used interchangeably depending on the application type. Their main characteristic involves symbolic knowledge representation in a form of fuzzy conditional (if-then) rules. The following Figure shows general diagram of MANET model with fuzzy system. The most important idea in use of fuzzy system which has been shown in Figure is that verbal words are transferred to fuzzy system and the fuzzy system expresses efficiency of the protocols under different conditions considering the signs which have been shown with verbal words.

Figure 4 Function of Fuzzy system

In the fuzzy system, we have used rules as Relation 1 to model the concepts [9].

$$\text{if } x_1 \text{ is } A_1^1, \dots, x_m \text{ is } A_m^1 \text{ then } y = B^1 \quad (1)$$

Utilized membership functions are triangular, yet they have different number of variables. This difference roots in natural quiddity of parameters such as degree of anemia.

- The sophistication of natural world which leads to an approximate description or a fuzzy system for modeling.
- Necessity of providing a pattern to formulate mankind knowledge and applying it to actual systems.

Thus, the following procedure is considered to define expert fuzzy system:

- Defining input-output sets which accept normalized input-output pairs.
- Generating if-else fuzzy rules based on input output pairs.
- Creating fuzzy rule base.
- Implementing fuzzy system based on fuzzy rules.

Input–output parameters of the fuzzy systems

As mentioned before, 1 factor of the number of nodes has been used in this system for evaluation of two AODV, DSDV routing protocols as input parameter and based on this input factor, effect of the factor on two AODV, DSDV routing protocols is studied but as mentioned above, other factors such as nodes searching speed, number of packets etc. are also effective on evaluation of two AODV and DSDV routing protocols. As a result, it is not possible to determine efficiency of two AODV and DSDV routing protocols under different conditions but attempt has been made to calculate efficiency of two AODV and DSDV routing protocols with a fuzzy system using this single factor for taking suitable measures. Therefore, the above fuzzy system has four outputs which show efficiency of two AODV and DSDV routing protocols based on different input states. In this research, FIS tools were used in Matlab software to determine efficiency of test technique and its general diagram is shown in Figure 5.

Figure 5 General model of fuzzy system for the evaluation of both AODV and DSDV routing protocols

This system has 1 input field which relates to factor affecting evaluation of two AODV and DSDV routing protocols and three classes i.e. low, normal and high

verbal words have been assigned to each factor and 4 output fields which show efficiency of two AODV and DSDV routing protocols and the output has been classified into three groups and low, normal and high verbal words have been assigned to each factor. In Figures 6 and 7, one of the membership functions of input and output parameters is shown.

Figure 6 Member function related to input of the no. of node

Figure 7 Member function related to delay of AODV

Member function delay of dsdv

Member function of throughput of dsdv

Construction of rules database

A simple method for generation of fuzzy rules is clustering of input features with specified number of fuzzy membership functions (for example, triangular membership function and assignment of verbal words to each cluster). With the classified space for each model, one way for generation of fuzzy rules is to consider all possible combinations of antecedents (input features) and this method has been also used in this research.

. Fuzzy if–then rules

rules as follows:

1. If (Nnode is normal) the (Delay_AODV is middle) (Delay_DSDV is max) (Throughput_ AODV is max) (Throughput_DSDV is max).
2. If (Nnode is max) then (Delay_ AODV is min) (Delay_DSDV is max) (Throughput_AODV is max) (Throughput_DSDV is min).
3. If (Nnode is min) then (Delay_AODV is max) (Delay_DSDV is min) (Throughput_AODV is min) (Throughput_DSDV is min).

. Simulations and statement of results of fuzzy system

V. Result and discussion

As mentioned above, MATLAB software which is a suitable medium for simulation of such systems has been used. Simulation of two cases of tests with 20 and 30 nodes is given in Figures 8A and 8B we then showed results obtained from effect of the number of node on output as 2D which has been obtained in the simulation model.

Figure 8 Simulation with 20 nodes

Figure 8B. Simulation with 30 nodes

Simulation of 35 nodes

Results of fuzzy expert system for two outputs of delay and throughput are given in Table 1. The results for two protocols which have been tested with nodes 10, 20, 30, 35, 40, 55 and 65 are shown in Figure 10A and 10B. The obtained results show that AODV protocol has lower delay signed fuzzy system for the number of different nodes are exactly mentioned in Table 1. Now, we have evaluated and simulated two AODV and DSDV routing protocols for the number of similar nodes with NS-2 software in order to show performance and reliability of the proposed fuzzy system by comparing results of executing fuzzy system and NS-2 software with each other.

Table 2 Simulation Setup

Parameter	Values
Channel type	Channel/Wireless channel
Number of nodes	10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65
Simulation time	150 sec
Area of simulation	500x500
Routing Protocol	AODV, DSDV
Mac Type	802.11
Data Type	TCP/FTP
Interface queue type	Queue/Drop Tail

Figure. 12. Layout of nodes with 20 nodes in which node number zero is source and node number 1 is destination

The forwarded packets

In this Section, condition of the packets which have been generated, dropped and transferred are shown with different nodes with both protocols. Figure 13 shows the generated packets, dropped packets and transferred packets for AODV protocol with different nodes. For example, a test has been done on 10 nodes in this Figure. There are 4038 TCP packets and 13 packets have been transferred from source to destination is 4025. Considering this Figure, it can be said that with increasing the number of nodes, the number of packets forwarded from source to destination increases. Figure 14 shows the generated packets, the dropped packets and transferred packets for DSDV protocol with different nodes. For example, there are 4726 TCP packets in the test which has been performed on 10 nodes and the number of the dropped packet is 41 and also the number of transferred packet from source to destination is 4685.

Fig. 13. The forwarded packets with AODV protocol

Figure 14 Generated packets and the Dropped packets

VI. Conclusion

In this report, fuzzy system has been designed to analyses both DSDV and AODV protocols in MANET and to prove truth of the fuzzy system, we compare results by comparing two protocols with NS-2 software and the results show that the designed fuzzy system has suitable efficiency for proposing and selecting one of these two routing protocols principally and logically under different conditions and based on different applications. Generally, AODV

protocol has better performance than the DSDV protocol in terms of the data transfer rate per second and delay rate with increasing the number of node in the network. Generally, we can say that goal of designing the fuzzy system in this report is to help ordinary user select type of the routing protocol only based on information of ordinary user (even if the user has no accurate information about routing protocols of MANET networks) and only based on personal discernment of the user regarding the number of nodes based on application of network as verbal words (high low-medium).

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