Design and Implementation of Fuzzy Secure Location Aided Routing (FS-LAR) in MANETs

Y.V.S.Sai Pragathi[#1], Dr.S.P.Setty*[2]

[#1]*Associate Professor, CSE Department, SCETW, Osmania University, Hyderabad, India.*

[*2]*Professor, CSE Department, Andhra University, Vishakhapatnam, India*

Abstract—*MANET is a collection of mobile nodes connected by wireless links without infrastructure. Due to inherent properties of MANETs like limited resources, energy consumption has increased when security is incorporated in LAR. Transmission range is found as the influencing parameter responsible for the increase in the energy consumption. According to IETF draft, static values are not suitable for dynamic environments. A soft computing technique fuzzy logic is used to fine tune the output variable transmission range by taking network size and simulation area as input variables. From the results, it is observed that energy consumption is minimized in FB-S-LAR when compared to S-LAR.*

.

Keywords — MANET, LAR, S-LAR, Fuzzy Logic, Transmission Range, Soft Computing.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a set of mobile devices that can send data with each other without the use of a predefined infrastructure. Soft computing is a new trend in computing which compares with the remarkable ability of the human mind to reason and learn in an environment of uncertainty and imprecision. According to IETF draft, static values are not suitable for dynamic environments. In RFC, static value of transmission range is 250 meters. Due to dynamic nature of MANETs, static value of transmission range have to be increased depending on the network size and mobility of the nodes which results in increased energy consumption [1][2].

The rest of the paper is organized as follows: Related work is discussed in section II, reactive routing protocol "S-LAR" is discussed in section III, fuzzy inference system is discussed in section IV, simulation environment and results are presented in section VI and finally concluded with section VII.

II. LITERATURE REVIEW OF RELATED WORK

Hideyuki Takagi, in the paper entitled, "Introduction to fuzzy systems, neural networks and genetic algorithms", illustrates the core features of fuzzy systems, neural networks, and genetic algorithms. The focus is on two aspects, the similarities among the three technologies through the common keyword of nonlinear relationship in a multidimensional space; ii. How to use these technologies at a practical or programming level [4].

K Narasimharaju in the paper entitled "Design and implementation of fuzzy logic approach for fine tuning of configuration parameters in AODV to enhance the performance in MANETs", improves the performance of mobile Ad hoc networks and tuned the AODV parameters using fuzzy logic [5]. From the simulation results fuzzy logic based parameters provided a better performance than fixed parameter approach in AODV.

III. ROUTING PROTOCOL.

A. *LAR*

Location aided routing is one of the reactive routing protocol where a source node estimates the current location range of the destination node based on last reported location information. During the route discovery process, the route request messages are flooded in limited region known as expected zone which is expected to have the current location of the destination node [3][8].

B. *Secure LAR*

Secure Location aided routing protocol (S-LAR) is implemented using ECC cryptography. It is observed that the energy consumption has been increased due to the increase in the control overhead. In order to reduce the energy consumption transmission range is optimized using fuzzy inference system [7][9][10].

IV. FUZZY INFERENCE SYSTEM

A Fuzzy Inference System (FIS) maps an input space to an output space using fuzzy logic. FIS uses a collection of fuzzy membership functions and rules, instead of Boolean rules, to reason about data. Fuzzy logic is a suitable way to be applied in mobile ad hoc network routing decision [4][5].

A membership function is a mathematical formation of representing a fuzzy set. In our simulation the Fuzzy logic controller inputs are network size and simulation area. Output of fuzzy logic controller is transmission range [6]. The description of inputs in fuzzy tool is as shown in the Fig. 4.

The fuzzification process transforms the crisp values into fuzzy sets by using the membership functions as shown in Fig. 5. The linguistic variables for input are characterized by a term of three fuzzy sets (Low, Medium, High) [11] [12].

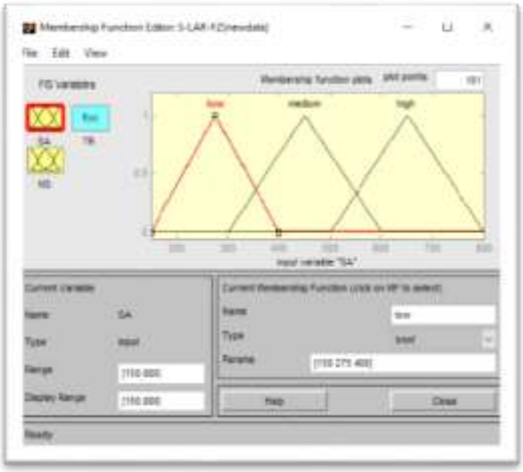

Fig. 4 Fuzzy Input Membership Functions

Rule Base for fuzzy logic controller to combine the input parameters is shown in figure below.

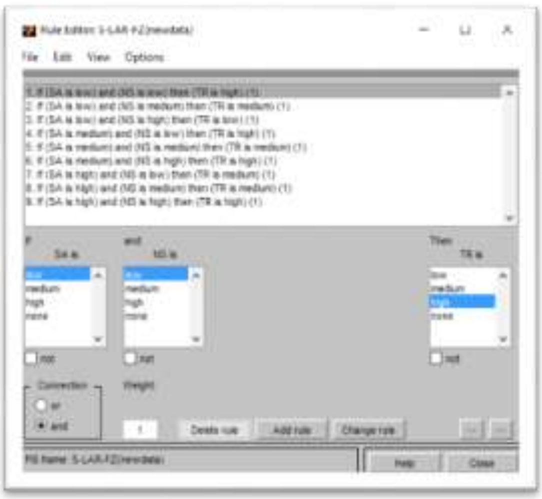

Fig. 5 Fuzzy Rule Editor

The output of fuzzy logic controller is the crisp value evaluated through the membership function as shown in the Fig. 6 and Fig. 7.

Fig. 6 Fuzzy Rule Output

V. RESEARCH METHODOLOGY

To evaluate the designs proposed in this paper, an effort is made to choose the most suitable evaluation methodology. Three evaluation methodologies are identified: simulation, experimental and mathematical. Of these three methods, Simulation method is chosen for the present study, as experimental method is not practicable, while mathematical method is highly restrictive.

VI. SIMULATION RESULTS AND ANALYSIS

NS-2 is an open simulation environment for computer networking research that is preferred in the research community. It is aligned with the simulation needs of modern networking research. It encourages community contribution, peer review, and validation of the software.

Our simulation settings for NS2 are summarized in table below.

TABLE I

Simulation parameters	**Values**
No. of Nodes	20,27,50,57,90,65,87,100
Area Size	200x200,500x500,750x750, 1000x1000
Routing Protocol	S-LAR,FZ-S-LAR
Simulation Time	1000Sec
Propagation Model	Two Ray
Packet Size	512
Mobility Model	Random Way Point
Speed	5m/s
Range	250,500,696,739, 750, and 1000m

VII. PERFORMANCE METRICS

We evaluate mainly the performance according to the following metrics.

1) Average Packet Delivery Ratio: It is the ratio of the number of packets received successfully to the total number of packets transmitted at each node.

2) Average Energy Consumed: Total energy consumed by all the nodes to the number of nodes.

3) Throughput: Total bytes received to the total bytes transmitted.

4) Overhead: Total protocol control bytes to the total data bytes transmitted.

5) Average End to end Delay: Average time take for the packets from send time to received time at the target node.

A. *Results*

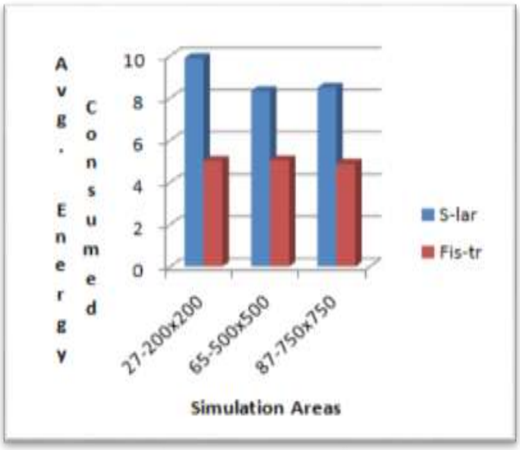

Fig. 7 compares the average energy consumed for S-LAR and FZ-S-LAR. Average 25% saving of energy observed with FZ-S-LAR.

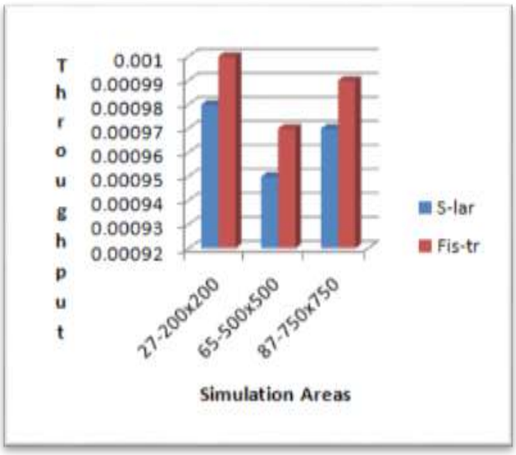

Fig. 8 compares the throughput for S-LAR and FZ-S-LAR. Average 3% throughput improvement is observed with FZ-S-LAR.

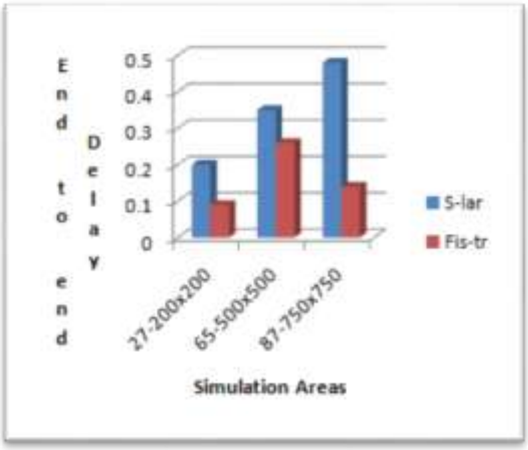

Fig. 9 compares Average end to end delay for S-LAR and FZ-S-LAR.

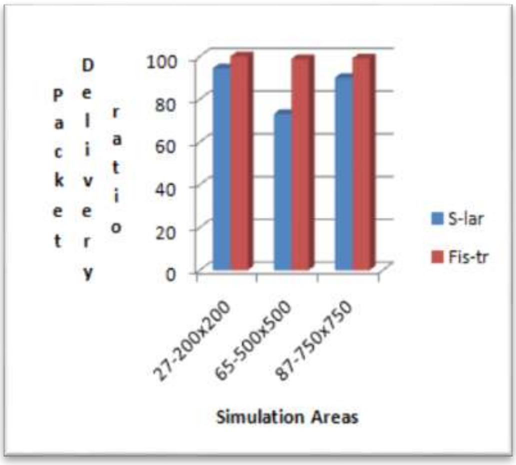

Fig.10 shows the comparison of Packet Delivery Ratio for S-LAR and FZ-S-LAR. FZ-S-LAR performs better than S-LAR.

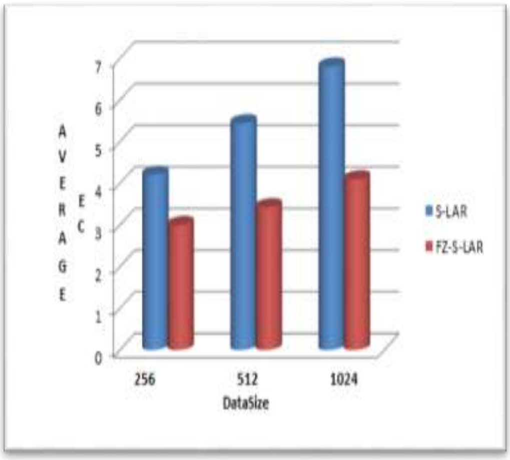

Fig.11 compares energy consumed for S-LAR and FZ-S-LAR with configuration of 200X200 simulation area and 27 nodes for different data sizes. It is observed that as data overload increases the FZ-S-LAR performs better than S-LAR.

VIII. CONCLUSIONS

From the Simulation results it is concluded that FZ-S-LAR total energy consumption decreases by 25% compared to S-LAR. Throughput of FZ-S-LAR increases by 3% compared to S-LAR. Further work can be done on optimizing the throughput by adding it in the FZ-S-LAR rules.

REFERENCES

[1] Aarti, Dr.S.S.Tyagi,"*Study of MANET: Characteristics, Challenges, Application and Security Attacks*", ijarcsse ,vol.3,issue 5,May 2013.

[2] Y.V.S.Sai Pragathi and S.P. Setty,"*Hybrid anonymous location-aided routing protocol for privacy preserving and authentication in manet*",Journal of Theoretical and Applied Information Technology,Vol.55,No.2,Sep.2013.

[3] Y.Ko and N.H.Vaidya, "*Location-aided routing (LAR) in mobile ad hoc networks*," in Proceedings of the ACM/ IEEE International Conference on Mobile Computing and Networking (Mobicom), 1998, pp. 66–75.

[4] Hideyuki Takagi, in the paper entitled, "*Introduction to fuzzy systems, neural networks and genetic algorithms*", appeared in Intelligent Systems: fuzzy logic, neural networks and genetic algorithms, Ch.1, pp 1-33, edited by D.Ruan, Kluwer Academic publishers(Norwell, Massachusetts, USA), September 1997.

[5] K Narasimha raju and Dr.S.P.Setty ," *Implementation of Fuzzy Logic Based Node Traversal Time Performance Enhanced AODV in Mobile Ad hoc Networks*", International Journal of Advances in Computer Science and Technology, Volume 3, No.3, ISSN 2320-2602, March 2014.

[6] Hamid R. Berenji, "*An Introduction to Fuzzy Logic Applications in Intelligent Systems*" Volume 165 of the series The Springer International Series in Engineering and Computer Science pp 69-96.

[7] N. Jansma and B. Arrendondo, "*Performance Comparison of Elliptic Curve and RSA Digital Signatures*", 2004.

[8] Book: "*Cryptography and Network Security Principles and Practice*", 5th Edition by William Stallings.

[9] Wikipedia.org- http://en.wikipedia.org/wiki/Cryptography

[10] Wikipedia.org-http://en.wikipedia.org/wiki/Elliptic_curve

[11] http://in.mathworks.com/products/fuzzy-logic/

[12] Book: "*Neuro Fuzzy and Soft computing*", Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Prentice Hall Upper Saddle river ,NJ 07458.