FUZZY LOGIC BASED TORA TO ENHANCE THE QOS IN MANETS

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Abstract
A mobile Ad hoc network (MANET) is a set of wireless mobile autonomous nodes that can communicate with each other without using any fixed infrastructure. It is also necessary for MANET devices to communicate in a seamless manner. Due to the dynamic nature of MANET, topology changes frequently. So the static values are not suitable for the dynamic environment. TORA routing protocol supports this dynamic environment. TORA is the only protocol which has two modes of operation. Those are the Proactive or Reactive mode of operations. In this paper, we designed and implemented fuzzy logic based TORA (FBTORA) to enhance the QoS in MANET. The results show that Fuzzy based TORA (FBTORA) performs well for the small, medium and large network in Proactive mode. But in Reactive, Fuzzy based TORA support medium and large networks only.

Index Terms: MANET, TORA, Fuzzy, Small, Medium, Large.

I. INTRODUCTION

The emergence of wireless networks has gone a long way in solving the growing service demands. The focus of research and development endeavor has almost shifted from wired networks to wireless networks. The limitations of wireless network techniques such as power restrictions high error rate, bandwidth limitations and other constraints have not lead to the growth of wireless networks. Mobile Ad-hoc network (MANET) is one of the most demanding fields in the area of the wireless network. MANET consists of mobile devices or users which are generally known as nodes, and each one of nodes which are equipped with a radio transceiver. MANET is a temporary network of wireless mobile nodes which have no fixed infrastructure. There are no dedicated routers, servers, access points, base stations, and cables. The mobile nodes which are within each other's transmission range can communicate with each other directly; or else, other nodes in between can forward the packets if the source and the destination node are ―out of each other's range. Every node acts as a router to forward the packets to other nodes whenever required. Mobile ad-hoc network is ―infrastructure-less networks having nodes which can act as a transmitter, router or receiver. MANETs have a dynamic topology where nodes are mobile. To monitor the workings of these nodes and the nature in which they behave while sending, receiving or forwarding data is classified by a set of rules known as routing protocols.

II. TEMPORALLY ORDERED ROUTING ALGORITHM

TORA is an adaptive routing protocol for multi-hop networks that include the following attribute:
* Distributed execution,
* Loop-free routing,
* Multipath routing,

* Reactive or proactive route establishment and maintenance, and
* Minimization of communication overhead via localization of algorithmic reaction to topological changes.

TORA is distributed, in that routers need only maintain information about adjacent routers (i.e., one-hop knowledge). TORA maintains state on a per-destination basis like a distance vector routing approach. However, TORA does not continuously execute a shortest-path computation and thus the metric used to establish the routing structure does not represent a distance. The destination-oriented nature of the routing structure in TORA supports either reactive or proactive routing on a per-destination basis. During reactive operation, sources initiate the establishment of routes to a given destination on-demand. This mode of operation may be advantageous in a dynamic environment with relatively sparse traffic patterns, since it may not be necessary to maintain routes between every source/destination pair at all times. Concurrently selected destinations can initiate proactive operation, resembling traditional table-driven routing approaches. This allows routes to be proactively maintained to destinations for which routing is frequently required.

III. METHODOLOGY

A. Fuzzy Logic:

Fuzzy Logic Toolbox provides MATLAB functions, apps, and a Simulink block for analyzing, designing, and simulating systems based on fuzzy logic. The product guides you through the steps of designing fuzzy inference systems. We can create a fuzzy system to match any set of input-output data. This process is made particularly easy by adaptive techniques like Adaptive Neuro-Fuzzy Inference Systems (ANFIS), which are available in Fuzzy Logic Toolbox software. A fuzzy inference system (FIS) is a system that uses fuzzy set theory to map inputs to outputs. The mapping then provides a basis from which decisions can be made, or patterns discerned. Fuzzy inference process comprises of five parts:

- o Fuzzification of the input variables
- o Application of the fuzzy operator (AND or OR) in the antecedent Fuzzy Inference Process
- o Implication from the antecedent to the consequent
- o Aggregation of the consequents across the rules
- o Defuzzification

B. Fuzzy Based TORA:

TORA considers the defaults constants in the dynamic environment. The proposed method concentrates on the Beacon Period value which plays an important role in calculating dynamic environment, the attribute which specifies how often the Beacon Packet will be sent out to the neighbor. The TORA suggests that the BP value should be constant but does not mention how this value should be adjusted with network size. The proposed method" Fuzzy Based TORA (FBTORA)" suggests that the Beacon Period should be a suitable value with the Network size. The dynamic value of beacon period is calculated by using fuzzy logic by taking network size and mobility as inputs. We implemented FBTORA protocol to enhance the scalability of TORA routing protocol by using OPNET simulator.

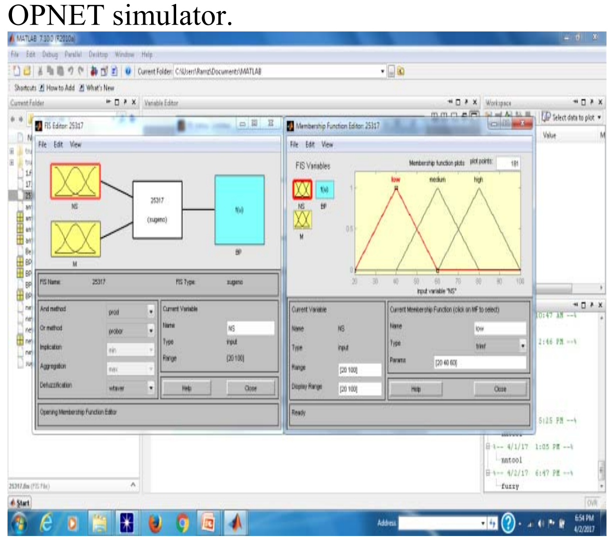

Figure 1: Fuzzy Inference System of FBTORA and Membership function for the input variables Network Size

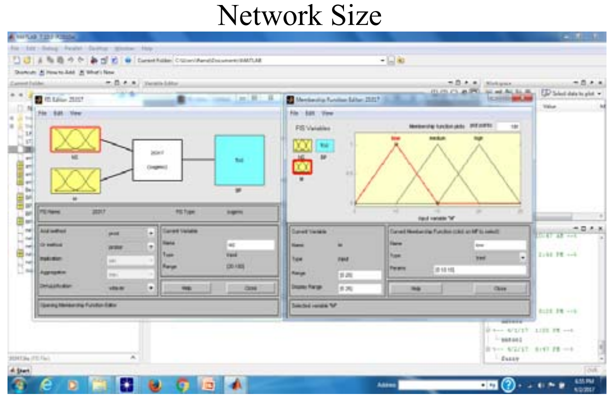

Figure 2: Membership function for the input variables Mobility

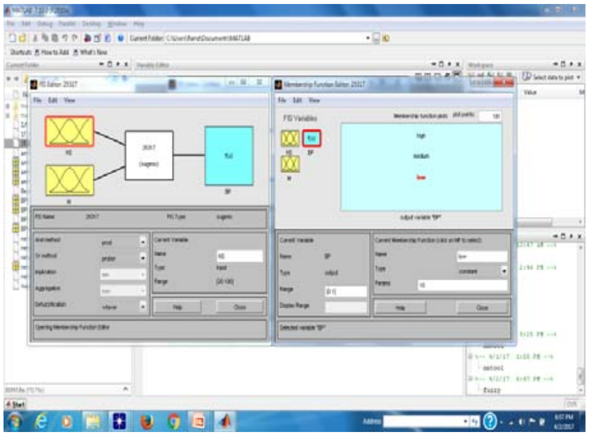

Figure 3: Membership function for the output variables Beacon Period

INPUT 1	INPUT 2	OUTPUT
Number of nodes (n nodes)	Speed	Beacon Period
L	L	L
L	M	L
L	H	M
M	L	L
M	M	M
M	H	M
H	L	M
H	M	H
H	H	H

Table 1 shows different rules given by taking input variables as Network Size and Speed, output variable as Beacon Period

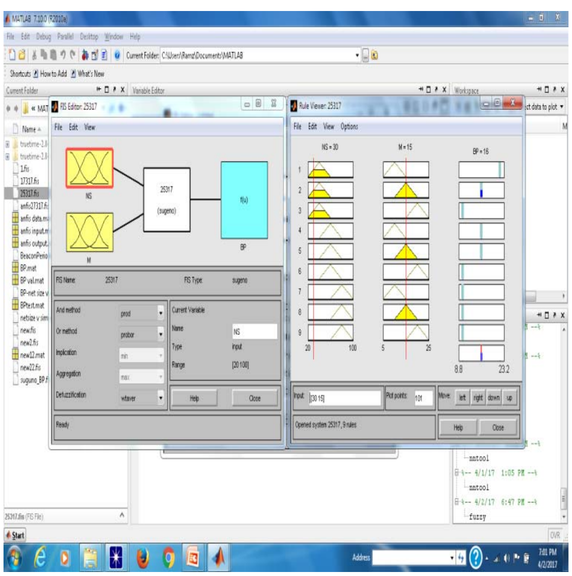

Figure 4: Rule viewer

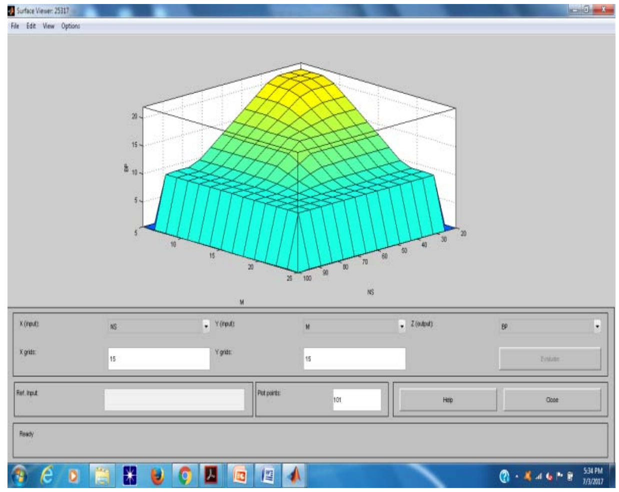

Figure 5: Surface viewer of FBTORA

IV. SIMULTION ENVIRONMENT

Simulators like NS2, Glomosim, Opnet, and Qualnet etc., were developed to evaluate the performance of routing protocols. The experiments for evaluating the FBTORA model were implemented within the OPNET. OPNET is a network simulator that provides virtual network communication environment. It is prominent for the research studies, network modeling and engineering, R & D Operation and performance analysis. It is extensive and powerful simulation software with a wide variety of possibilities and Enables the possibility to simulate entire heterogeneous networks with various protocols. The simulation parameters used in the method was given in table below.

ROUTING PROTOCOL	TORA
Area	1000m x 1000m
Nodes	30,60,90
Nodes Placement	Random
Mobility Model	Random Way Point
Node Transmission Power	0.005mw
Operational mode	802.11b
Data rate	11Mbps
Simulation time	300 sec
Routing mode of operation	Proactive, Reactive

Table.2 Simulation parameters for TORA

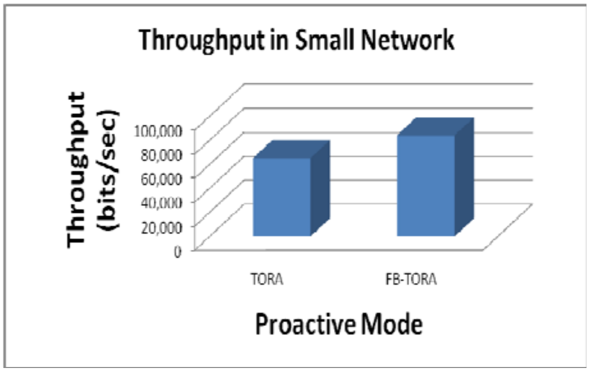

Figure 6: Throughput for Small network in Proactive mode

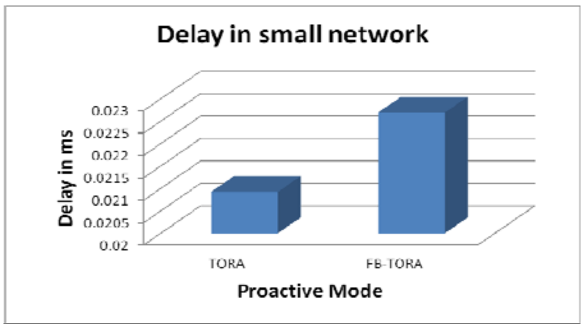

Figure 7: Delay for Small network in Proactive mode

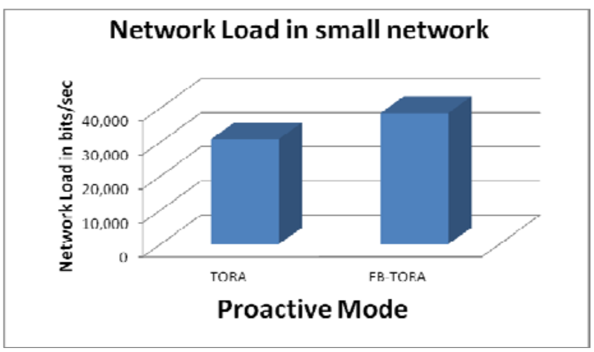

Figure 8: Network Load for Small network in Proactive mode

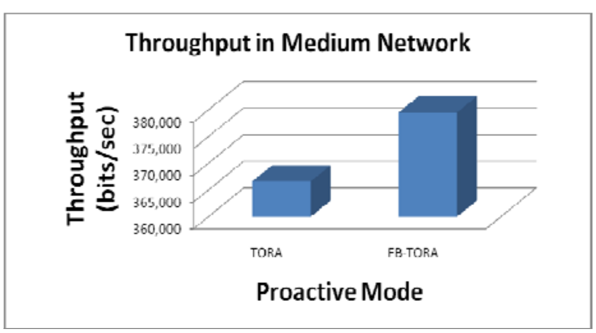

Figure 9: Throughput for Medium network in Proactive mode

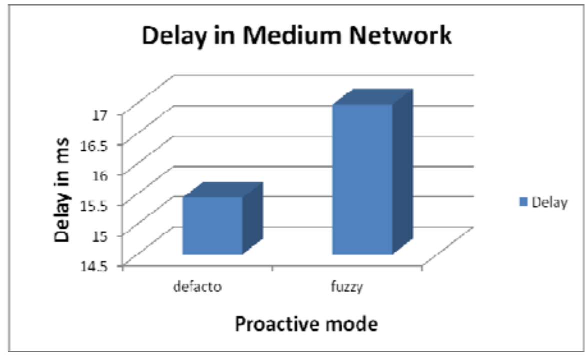

Figure 10: Delay for Medium network in Proactive mode

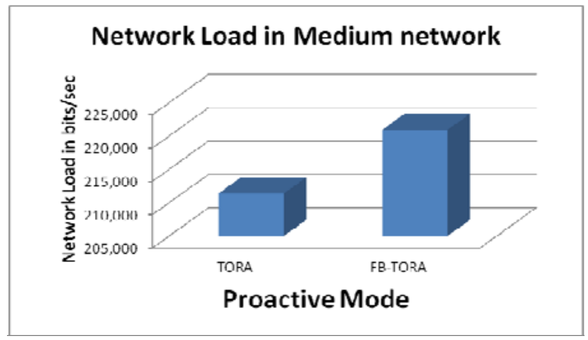

Figure 11: Network Load for Medium network in Proactive mode

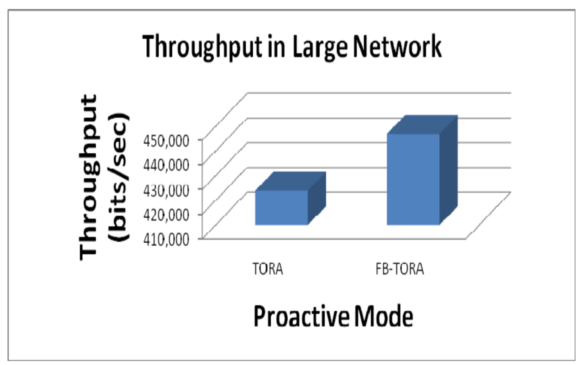

Figure 12: Throughput for large network in Proactive mode

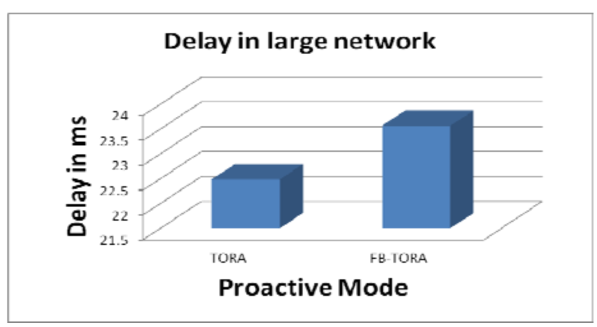

Figure 13: Delay for Large network in Proactive mode

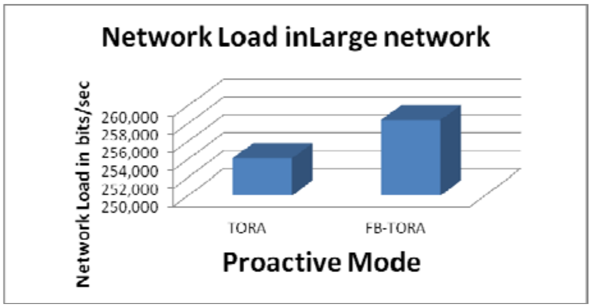

Figure 14: Network Load for Large network in Proactive mode

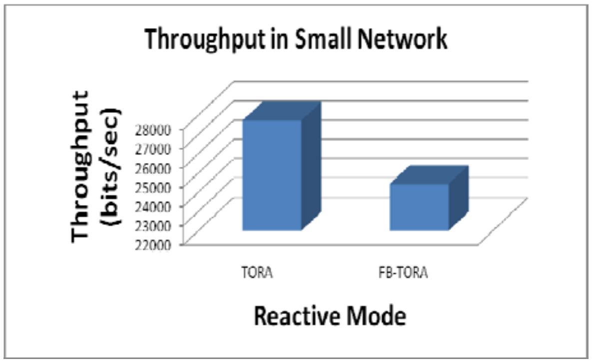

Figure 15: Throughput for small network in Reactive mode

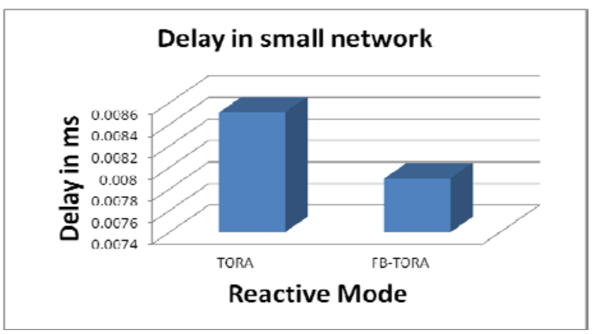

Figure 16: Delay for Large network in Reactive mode

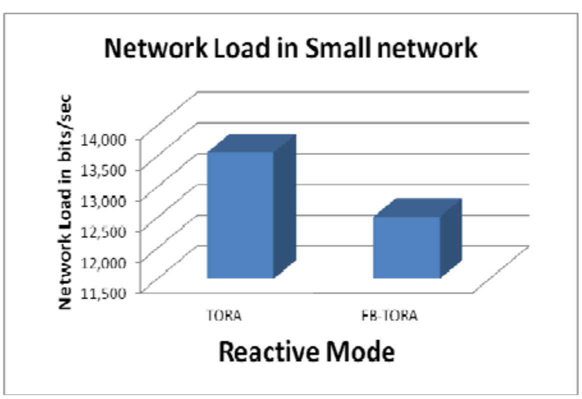

Figure 17: Network Load for Small network in Reactive mode

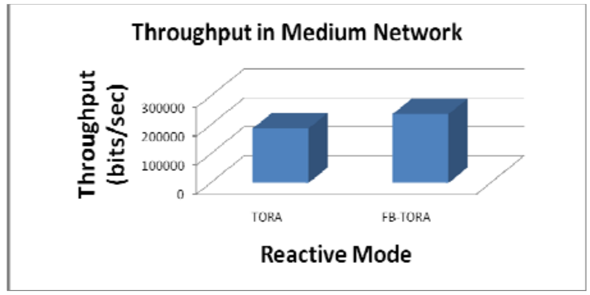

Figure 18: Throughput for small network in Reactive mode

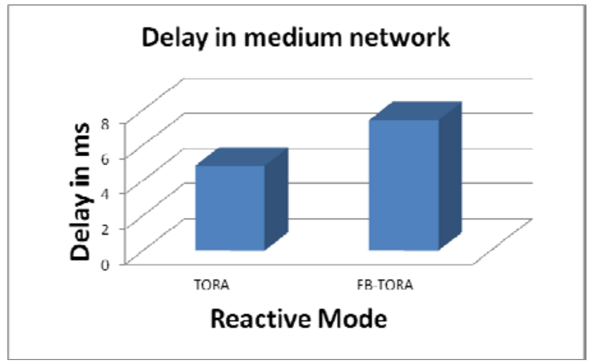

Figure 19: Delay for Large network in Reactive mode

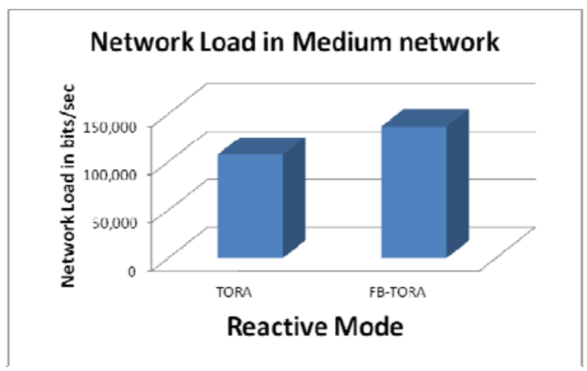

Figure 20: Network Load for Medium network in Reactive mode

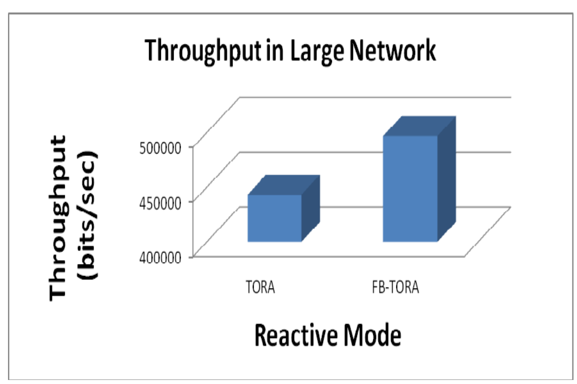

Figure 21: Throughput for large network in Reactive mode

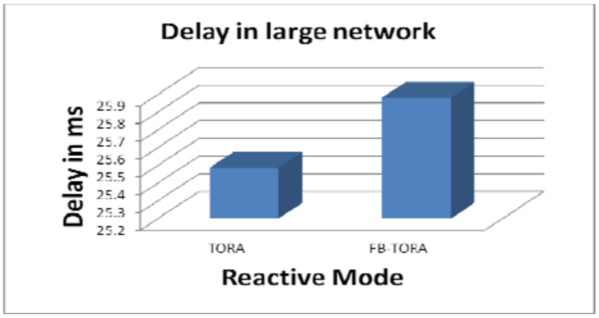

Figure 22: Delay for Large network in Reactive mode

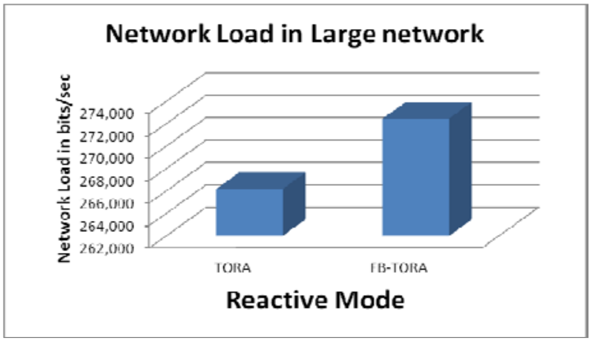

Figure 23: Network Load for Large network in Reactive mode

V. RESULTS AND CONCLUSION

Fuzzy based TORA outperforms for Small size, Medium size and large networks, when compared to De-facto TORA in Proactive Mode Fuzzy based TORA, outperforms for Medium size and large networks except for small network when compared to De-facto TORA in Reactive Mode. Throughput was increased by 29.28% in smaller, 3.52% in Medium and 5.42% in the Large network when compared with de-facto TORA in Proactive Mode. Throughput was increased by 26.44% in medium, 12.09% in Large Network but degraded in Small Network when compared with de-facto TORA in Reactive Mode.

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