Fuzzy Based Routing Information Protocol (Rip) To Enhance the Performance in Mobile Ad Hoc Networks

P. Srinivasa Rao, S. Pallam Shetty

***Abstract:** MANET has wide application in communication of data. MANET is defined as self-configuring ad hoc network model mobile nodes. Routing in network layer protocol it is discovers the best available path from source to destination. The performance of MANET routing protocol is evaluated different QOS parameters such as throughput, end-to-end delay, load etc. an attempt has been made to compare the performance of Fuzzy logic based RIP with traditional RIP using OPNET simulator. The simulation are carried out by varying update timer counter interval time dynamically calculating the timer values by using Fuzzy logic. In the Fuzzy base RIP outperforms for small network when compare with traditional RIP. The FLBUDTCRIP has the better performance than RIP in small network sizes. The throughput was enhanced by 2.25%, Traffic sent was enhanced by 5.39% , Traffic received was enhanced by 5.18%. The performance comparision of RIP and FLBUDTCRIP for medium size networks in terms of performance metrics throughput, Average end-to-end delay, Load, Traffic sent, Traffic received . The end-to-end delay was reduced by 0.25% , load was reduced by 0.6%.The performance comparison of RIP and FLBUDTCRIP for Large size networks in terms of performance metrics throughput, Average end-to-end delay , Load, Traffic sent, Traffic received. The end-to-end delay was reduced by 0.76% , load was reduced by 1.278%,Traffic sent was enhanced by 1.68%.The FLBUDTCRIP not suitable for large network sizes.*

***Keywords:** RIP, FLBUDTC, Fuzzy system, Update timer counter interval time, throughput, delay, load .*

I. INTRODUCTION

MANET is a self-configured, self-organised, and without aid of any pre-existing infrastructure consists of mobile nodes .The RIP routing protocol is one of the purest proactive routing protocol. The proactive routing protocol analysed in various network sizes namely small, medium, large network sizes. The network size expressed in terms of number of nodes from simulation results, it was observed that the network size , mobility of nodes and static configuration parameter has a large impact on the performance of RIP routing protocol . The IETF draft of RIP suggested that the configuration parameter values should be adjusted with the network conditions. The real world problems can be solved by fuzzy logic than the crisp logic.

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Fuzzy logic concept is incorporated in RIP to fine tune the static configuration parameter of RIP Update Timer Counter interval value with various network sizes, which is named as FLBUDTCRIP. Mobile ad-hoc Network (MANETS) is a compilation of independent wireless mobile nodes which animatedly forms a temporary network without use of any fixed infrastructure or centralized administration. MANET has dynamic topology due to node mobility; hence routing with robustness performance to support the Quality of Service(QOS) is one of the key challenges in deploying MANET. The purest proactive routing protocol in MANET is RIP. The review of literature survey and IETF Draft of RIP, suggest the RIP exhibits different behavior with network conditions. Therefore there is a necessity to verify the behavior of RIP protocol with the network conditions by conducting various experiments on it.
In FLBUDTCRIP the author has taken two inputs network size and node mobility and the output is update timer counter interval. The network size varies from 10 nodes to 110 nodes, node mobility varies from 4 m/s to 28 m/s. And update timer counter interval varies from 0.01 sec. to 0.5 sec. are given as inputs for fuzzification process. Fuzzification is the process of mapping the real world inputs to the fuzzy input range(0,1). The author used the sugeno model for developing the concept of fuzzy in RIP protocol. Triangular membership functions are used for fuzzification. The author has generated fuzzy association rules in fuzzy rule editor. Fuzzy rules are based on IF-THEN statements. The fuzzy inference system generates the output based on fuzzy inputs and fuzzy rules. After the fuzzy inference step the overall result is a fuzzy value. Membership functions are used in the fuzzification and defuzzification to map the non fuzzy values to the fuzzy linguistic terms and vice versa.

II. NECESSITY OF FUZZY LOGIC IN RIP

From the previous experimental results, it is observed that the network size, mobility of the nodes and the static parameter value of the protocol has a large impact on the performance of the mobile ad hoc network. The IETF draft of RIP has also emphasized that parameters of RIP should be configured by considering the network conditions. Thus there is a necessity to adjust the parameters of the protocol with respect to the network conditions. The real world problems are expressed intelligently through the fuzzy logic than the crisp logic. Human knowledge and their experiences can be implemented through the fuzzy logic membership functions and fuzzy rules. Fuzzy logic may be employed to adjust the RIP protocol parameters to the network behaviour.

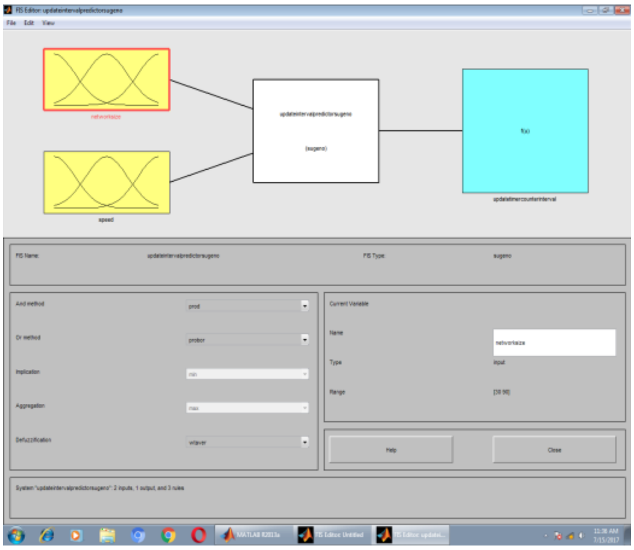

Figure 1: Sugeno Architecture of FLBUDTCTRIP

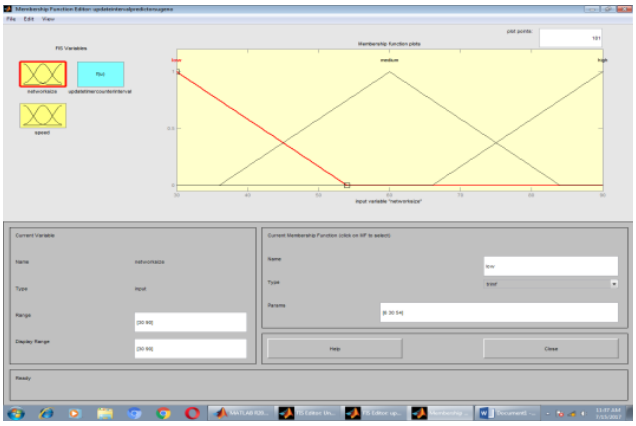

Figure2: membership functions of the input variable "network size"

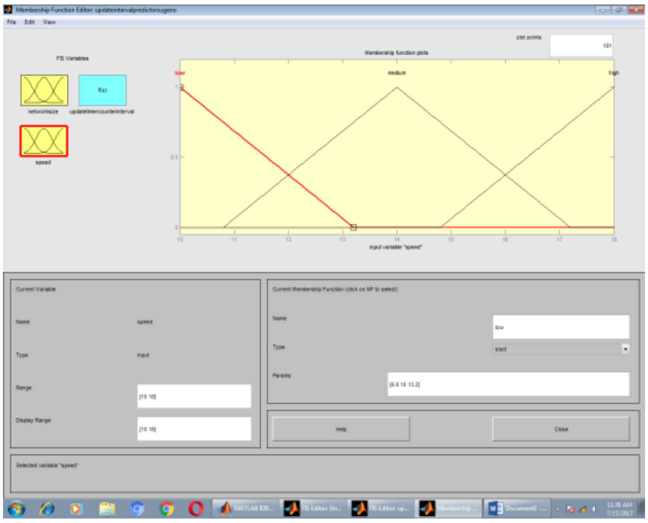

Figure 3: membership functions of the input variable "mobility"

III. 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 fuzziffier, knowledge base defuzziffier and an inference engine as shown in figure 1.

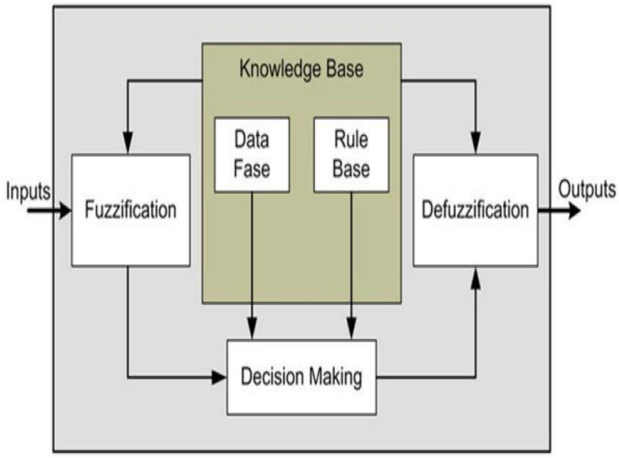

Figure 4: general model of fuzzy system

A. Fuzzification

Fuzzification is a procedure where crisp input values are represented in terms of the membership function, of the fuzzy sets. The fuzzy logic controller triangular membership functions are defined over the range of the fuzzy input values and linguistically describe the variable's universe of discourse. Following the fuzzification process the inference engine determines the fuzzy output using fuzzy rules that are in the form of " if then rules".

B. Defuzzification

Defuzzifier produces a real-world output from the fuzzy outputs which are in the range [0,1] by using defuzzification technique. There are many types of defuzzifiers used for defuzzification. Since the main objective of proposed approach is to choose an optimal path with the best fuzzy cost, it doesn't require the fuzzy outputs to be defuzzified. Results can be derived by comparing the fuzzy costs itself.

C. Fuzzy Engine

A fuzzy engine , is typified by the inference system that includes the system rule base, input membership functions that fuzzify the input variables and the output variable. Fuzzification is a procedure where crisp input values are represented in terms of the membership function, of the fuzzy sets. The fuzzy logic controller triangular membership functions are defined over the range of the fuzzy input values and linguistically describe the variables universe of disclosure as shown in figure2. Following the fuzzification process the inference engine determines the fuzzy output using fuzzy rules that are in the form of if then rules. Defuzzification is then used to translate the fuzzy output to a crisp value.

D. Fuzzy Rule Base

The rule base for the fuzzy inference system is shown in the table 3.4 with three variables classified into three membership functions low, medium and high. The membership functions used are triangular membership function.

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To compute the output of this FIS for the given inputs, must go through six steps Determining a set of fuzzy rules

1. Fuzzifying the inputs using the input membership functions,
2. Combining the fuzzified inputs according to the fuzzy rules to establish a rule strength,
3. Finding the consequence of the rule by combining the rule strength and the output membership function,
4. Combining the consequences to get an output distribution, and
5. Defuzzifying the output distribution for computing the crisp output.

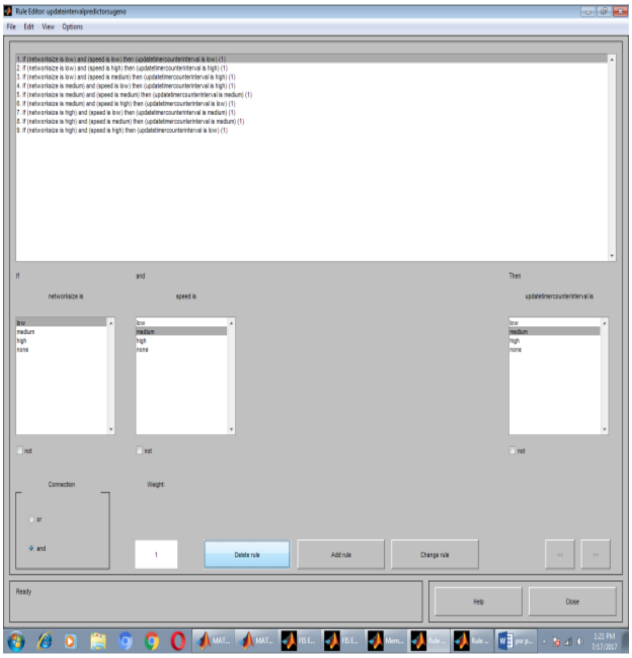


Figure 5: rule viewer for FLBUDTCRIP

IV. FUZZY LOGIC BASED UPDATE TIMER COUNTER INTERVAL TIME RIP (FLBUDTCRIP)

There is a necessity to adjust the parameters of RIP routing protocol with respect to the network conditions. The fuzzy logic is used to configure the parameters in RIP according to the network behaviour to enhance the performance of network. The RIP utilizing the fuzzy logic approach to determine its update timer counter interval time parameter with respect to the network size is termed as fuzzy logic based update timer counter interval time RIP(FLBUDTCRIP). The design of FLBUDTCRIP is shown in the figure.

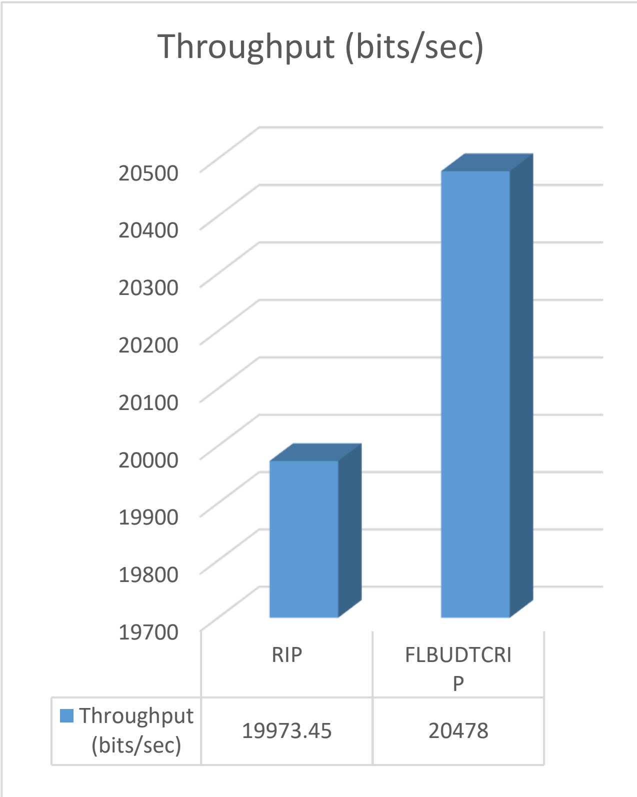
Performance analysis of RIP and FLBUDTCRIP protocols in various network sizes: To evaluate the newly designed protocol in this paper, an effort is made to choose the most suitable evaluation methodology. Three evaluation methodologies are identified. 1. Mathematical 2. Experimental 3. Simulation. The dynamic nature of mobile nodes is not advisable to use mathematical methods and experimental method is highly cost expensive. Simulation is an economical and an easy method to carry out experiments in MANETs. So the evaluation method chosen in this thesis is simulation. To evaluate the performance analysis of RIP and FLBUDTCRIP, OPNET 14.5 simulator is used. The simulation parameters are shown in the table below.

V. SIMULATION ENVIRONMENT

Table 1: simulation parameters for RIP and FLBUDTCRIP with various network sizes

Routing Protocol	RIP
Simulation Time	300 Sec
Simulation Area	1000m x 1000m
Traffic	Exponential
Node Type	MANET
Packet size	1024 bytes
Nodes	30,63,95
Transmission Range	250m
Min & Max speed	0 m/s & 12m/s
Pause Time	0 m/s
Address Mode	IPv4
Mobility model	Random way point
Node Placement Model	Random

Performance Analysis of RIP and FLBUDTCRIP for small network sizes



FIURE 6. The Variation of Throughput for RIP and FLBUDTCRIP for small network size

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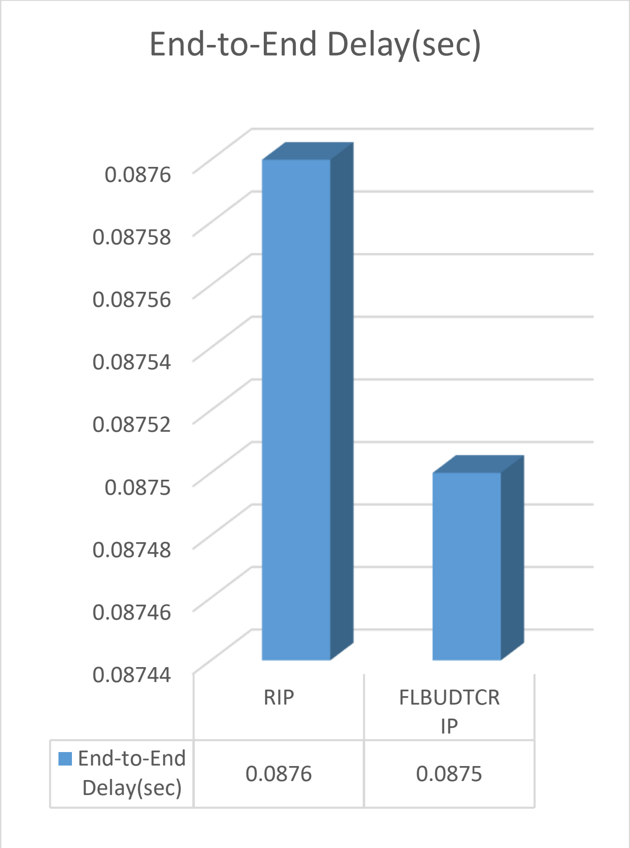
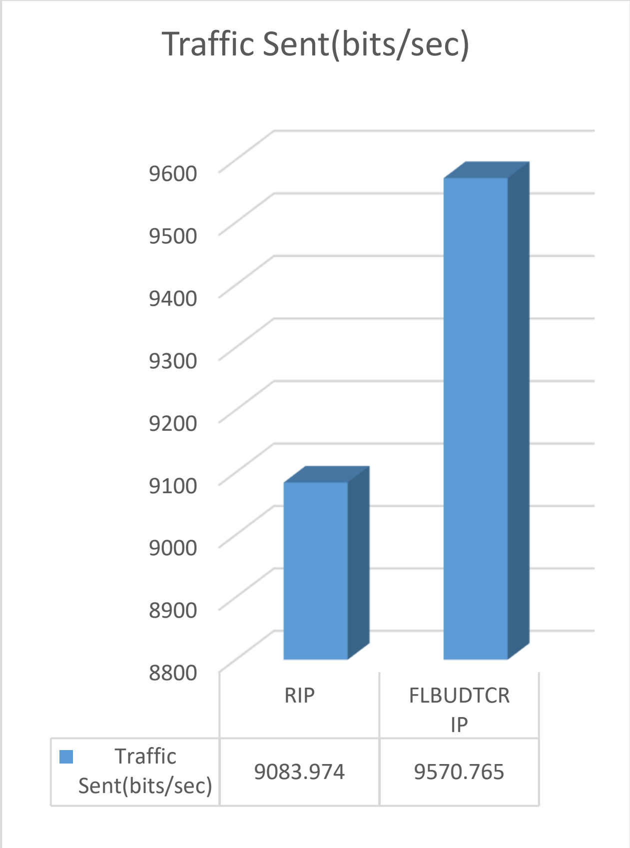
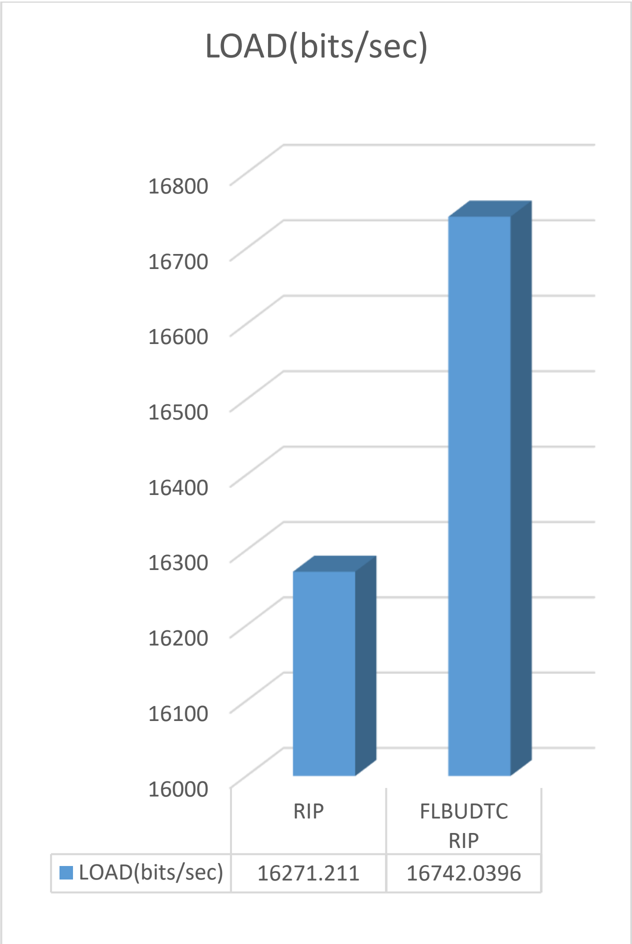


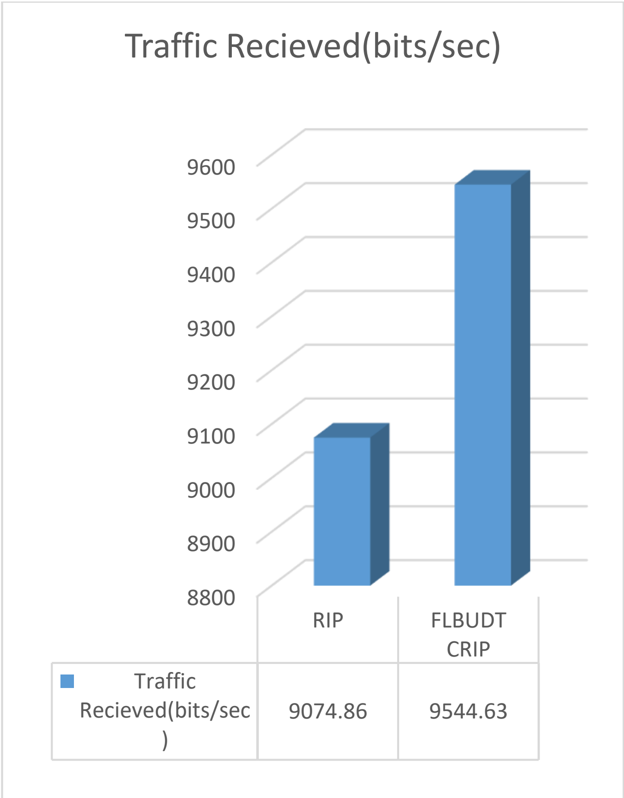
FIURE7 The Variation of End-to-End Delay for RIP and FLBUDTCRIP for small network size



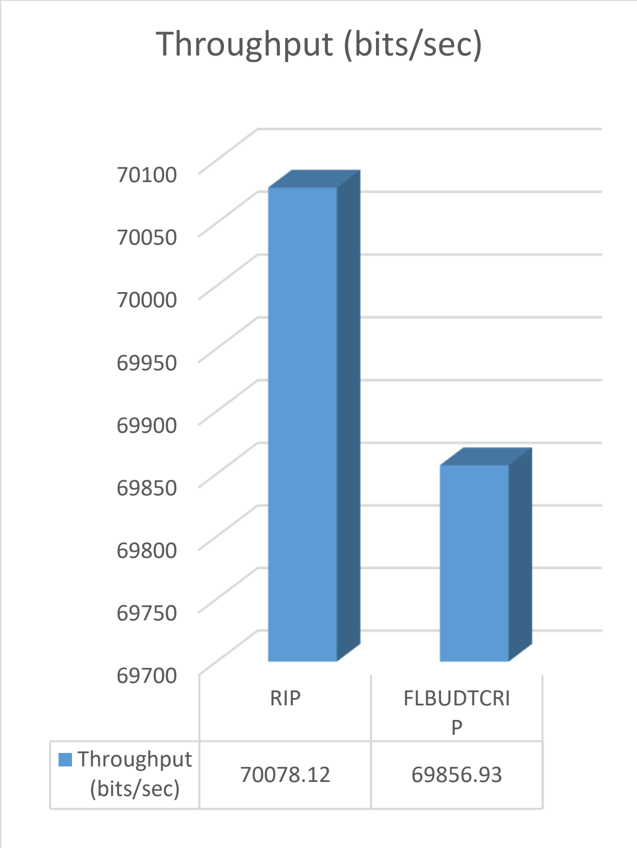
FIURE9 The Variation of Traffic sent for RIP and FLBUDTCRIP for small network size



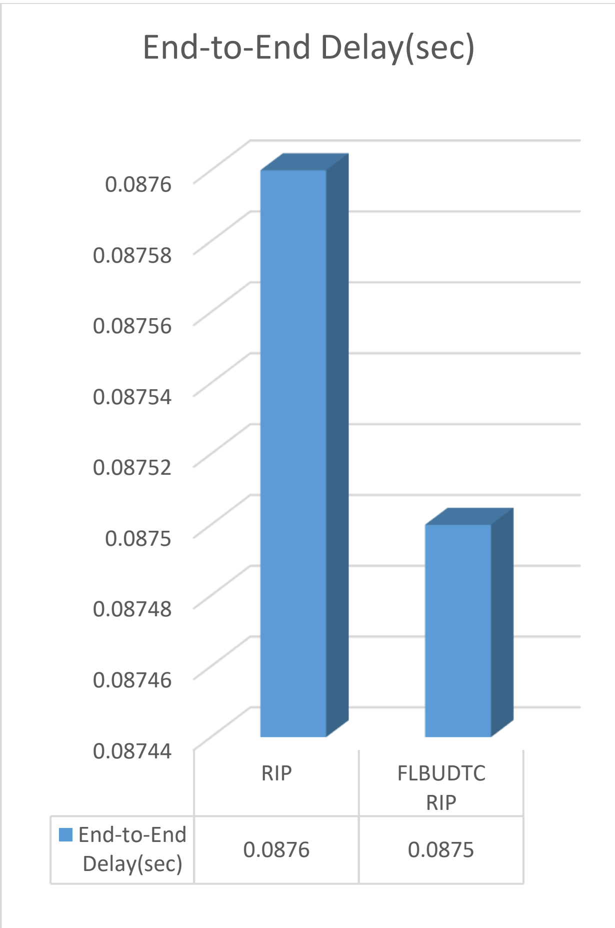
FIURE8 The Variation of Load for RIP and FLBUDTCRIP for small network size



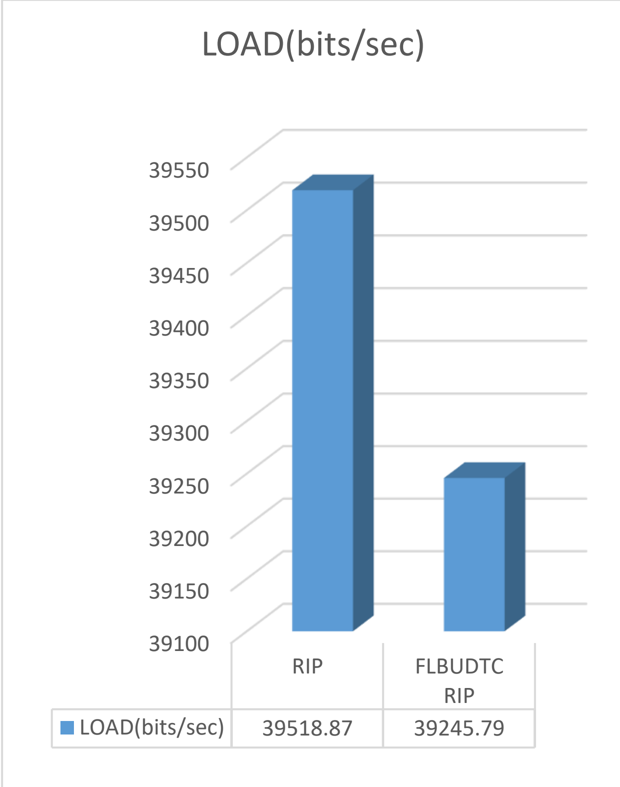
FIURE10 The Variation of Traffic Received for RIP and FLBUDTCRIP for small network size



FIURE11 The Variation of Thoughput for RIP and FLBUDTCRIP for medium network size



FIURE12 The Variation of End-to-End Delay for RIP and FLBUDTCRIP for medium network size



FIURE13 The Variation of LOAD for RIP and FLBUDTCRIP for medium network size

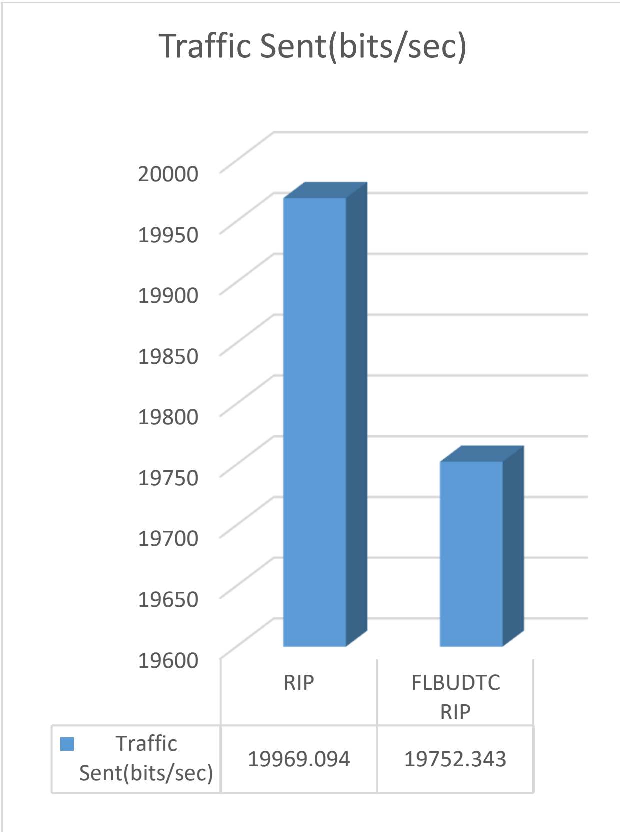


FIGURE14 The Variation of Traffic sent for RIP and FLBUDTCRIP for medium network size

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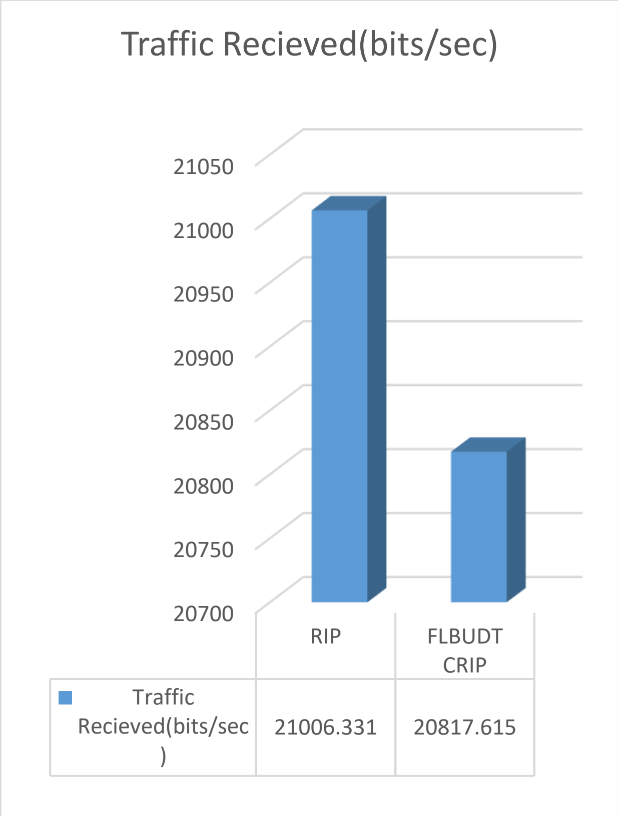
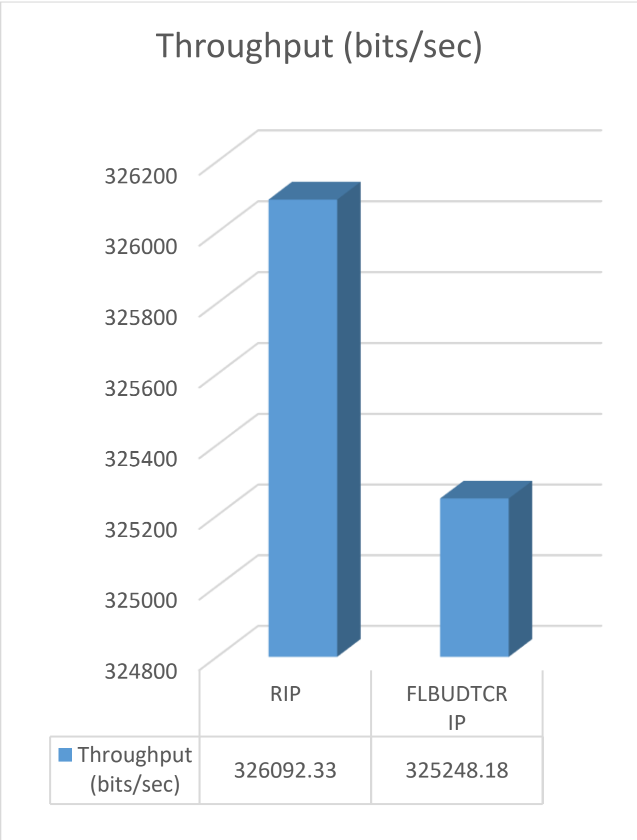
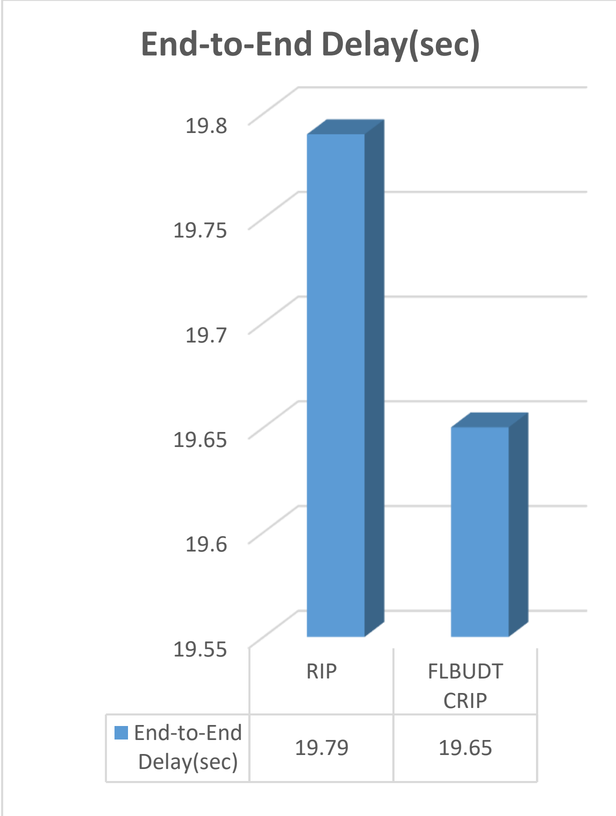


FIURE15 The Variation of Traffic Received for RIP and FLBUDTCRIP for medium network size

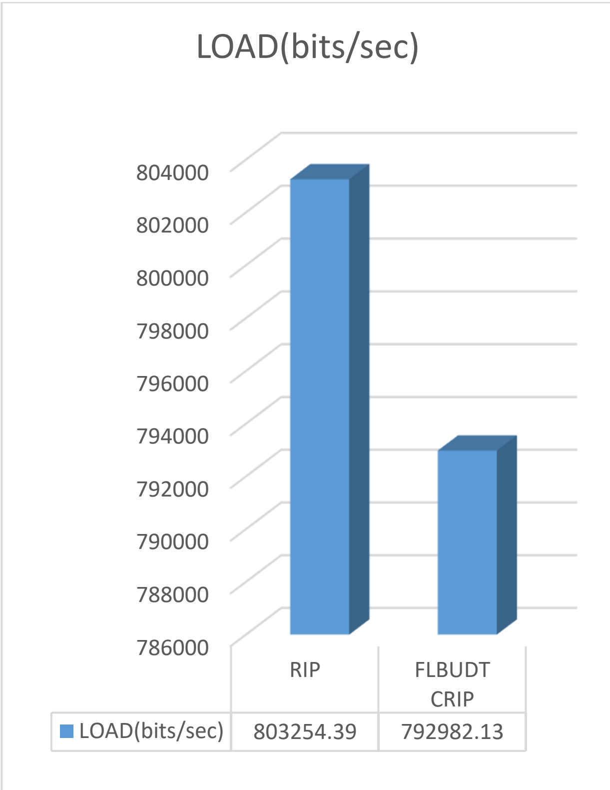
Performance Analysis of RIP and FLBUDTCRIP for Large Network size:



FIURE16 The Variation of Throughput for RIP and FLBUDTCRIP for large network size



FIURE17 The Variation of End-to-End Delay for RIP and FLBUDTCRIP for large network size



FIURE18 The Variation of Load for RIP and FLBUDTCRIP for large network size

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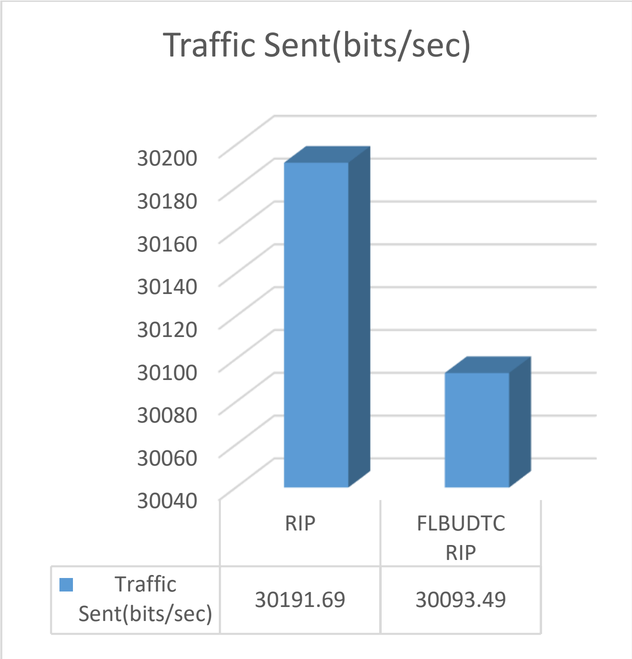
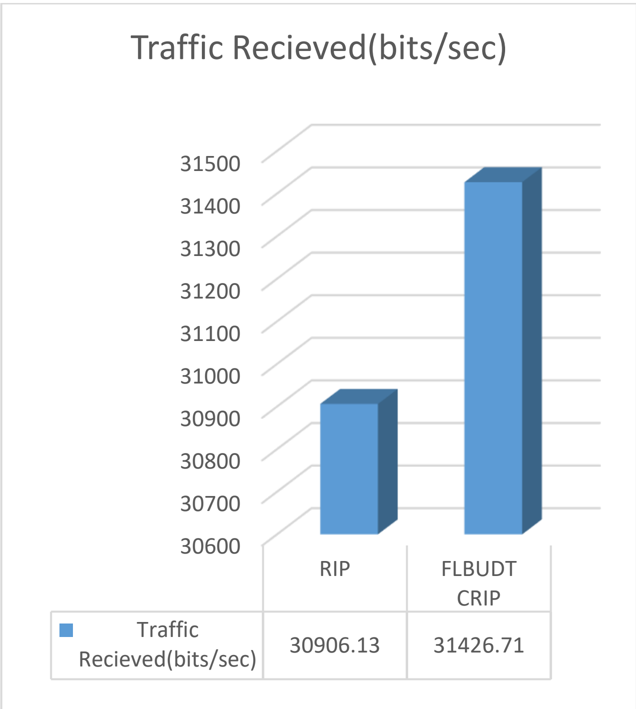


FIURE15 The Variation of Traffic Sent for RIP and FLBUDTCRIP for large network size



FIURE19 The Variation of Traffic Received for RIP and FLBUDTCRIP for large network size

VI. CONCLUSION

The RIP and FLBUDTCRIP protocols have been evaluated using OPNET 14.5 simulator .The performance comparison of RIP and FLBUDTCRIP for small size networks in terms of performance metrics throughput, Average end-to-end delay , Load, Traffic sent ,Traffic received. The FLBUDTCRIP has the better performance than RIP in small network sizes. The throughput was enhanced by 2.25%, Traffic sent was enhanced by 5.39% , Traffic received was enhanced by 5.18%. The performance comparision of RIP and FLBUDTCRIP for medium size networks in terms of performance metrics throughput, Average end-to-end delay, Load, Traffic sent, Traffic received . The end-to-end delay was reduced by 0.25% , load was reduced by 0.6%.The performance comparison of RIP and FLBUDTCRIP for Large size networks in terms of performance metrics throughput, Average end-to-end delay , Load, Traffic sent, Traffic received. The end-to-end delay was reduced by 0.76% , load was reduced by 1.278%,Traffic sent was enhanced by 1.68%.The FLBUDTCRIP not suitable for large network sizes. The performance of the RIP routing protocol in MANETS in enhanced by using Fuzzy logic Based concept in RIP protocol. The newly designed fuzzy based RIP(FLBUDTCRIP) outperforms the RIP routing protocol in small network sizes in terms of throughput, traffic sent and traffic received etc and also FLBUDTCRIP outperforms RIP protocol moderately in medium network sizes in terms of end to end delay , load etc. FLBUDTCRIP is not suitable for large size networks.

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