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Minimizing End-To-End Delay to Enhance QOS in Next Generation MANET Based On E-RAT

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Abstract

In the era of fast communication, being connected has become a necessity for all of us due to various reasons. Everyone needs high-speed spontaneous connectivity. This led to exponential growth in the field of information technology. A mobile ad hoc network plays a key role in establishing communication on the fly without any fixed infrastructure. The flexibility and dynamism offered by the mobile ad hoc network made this unique.QoS is one of the key issues whenever the performance of the network is measured. Next-Generation Network ensures better QoS with minimum delay or latency. QoS and QoE are the two faces of the same coin. Like the major two issues of the Next-generation Network can be speed and reliability, which needs to be addressed in a next-generation network. The purpose of this paper is to explore the significance of End-to-End Delay or Latency to provide a fast network and improve reliability also, in the context of Next Generation Ad hoc Network on which other parameters are directly or indirectly dependents. It proposed to measure the values of one of the key parameters such as End-to-End Delay in existing RAT and for E-RAT under different scenarios. To carry out critical analysis NS-3 is used. Apart from the other parameters, the emphasis is on the delay.Thus the results obtained would play a significant role to understand the importance of delay and also help to provide better QoE.

Keywords: QoS, QoE, RAT, E-RAT, End-to-End Delay

1.1. Introduction

Currently, the availability of the Internet has become a fundamental prerequisite to exchange information around the globe. In the previous twenty years, we have seen colossal development on the Internet. This gigantic progress in the field of the internet has turned the whole world into a global village. More gadgets and applications will be associated with the network. Accidentally fast networks will turn into the need of the day as new applications are Internet hungry later on. Exceptional development is seen in both the measure of mobile broadband traffic and the client's interest in quicker information gets to. Rapid networks are harnessed for dissimilar information, for example, voice data generated through video conferencing, video calls, and the latest applications in which anyone can upload videos or download videos. Images from social networking sites can also be transmitted without any delay, and so forth.

The delay depends upon propagation delay, routing & switching, and queueing & buffering. Applications response to delay is critical in accomplishing the task. All Next Generation Applications like AI-Driven fast responsive applications, IoT 4.0, V.R. / A.R Applications, VoIP, Robotics, transportation. (Self-Driving Cars), Healthcare with AI-based nanobots. Internationally in the present situation correspondence availability to the Internet has become a fundamental prerequisite. The web has not just upset customary mailing, banking, trade, and the after setups, yet also gadget better approaches for data sharing internet-based life and something else. In the previous twenty years, we have seen colossal development on the Internet. Later on, additionally, the size of the Internet will be expanding. More gadgets and applications will be associated with the network. Accidentally fast networks will turn into the need of the day as new applications are Internet hungry later on. Exceptional development is seen in both the measure of mobile broadband traffic and the client's interest for quicker information gets to. As announced by a lot of mammoth network administration associating gear fabricating file Forecast and Methodology in general worldwide network traffic will develop at a compound annual growth rate (CAGR)of 23 percent from 2014 to 2020 and satisfy this prerequisite it is the

need fast networks.

Rapid networks are equipped for conveying numerous sorts of information, for example, voice, information, pictures, and video. These administrations have various necessitiesregarding transfer speed, information misfortune, delay, and so forth. The objective is to improve the nature of administration offered and give secure correspondence during times of worry, as saw by both the network supplier and the client. Such networks fill two needs, giving spine associations that are utilized at the same time by numerous sets of imparting machines and giving high-throughput associations with an individual pair of machines.

Mobile ad hoc networks (MANETs) [1] which are non-framework based expected to turn into a significant piece of the next-generation architecture. A specially appointed mobile network is a transient network framed progressively by an assortment of discretionarily found remote portable hubs without the utilization of existing network foundations or brought together organization. Portable impromptu networks are picking up consideration since they help acknowledge arrange administrations for mobile clients in zones with no previous correspondence framework. Impromptu Networking empowers free remote hubs, each constrained in transmission and preparing power, to be "fastened" together to give more extensive network administration inclusion and handling capacities. The hubs can likewise be associated with a fixed spine arrange through a devoted passage gadget, empowering IP organizing administrations in zones where Internet administrations are not accessible because of an absence of a pre-installed foundation. Every one of these focal points makes impromptu network administration an alluring alternative later on remote network field. Security in a MANET is a basic segment of fundamental network capacities like parcel sending and directing. Network administrators can be effectively risked if countermeasures are not inserted into essential network capacities at the beginning periods of their plan.

Contrasted with wire networks MANETs are increasingly powerless as far as security assaults because of the absence of a believed incorporated cut-off and restricted assets. Assaults on specially appointed networks can be named detached and dynamic assaults or inner assaults and outer assaults. The securityadministrations, for example, secrecy, validness, and information trustworthiness are likewise vital for both wired and remote networks to ensure essential applications. Enormous scale registering applications using numerous computational hubs associated through networks have become executable due to fast network and processing innovations. Numerous such processing applications rehash estimations and synchronous information trade among computational hubs then again, so much information is moved between hubs at nearly a similar time. Such applications incorporate GPS, GIS, and area mindful administrations like CAB Services.

The idea of Smart City and fast trains are reliant upon rapid networks and that innovation is that makes it conceivable. The primary test of brilliant applications is versatility. These constant applications need to move the mentioned information and data on time with practically the least postponement. QoS and Security are significant issues for these ongoing SMART applications [2].

1.2. Literature Survey

Next-Generation Network will support many latency-critical services in different domains. Few of them are as mentioned here. Fintech applications, IoT applications, Industrial IoT 4.0, Video & VOIP applications, Healthcare applications, AR-VR applications, Satellite.Communication, Bluetooth-based application, and several others. But one common, which is common is that all are data-hungry applications that require high-speed seamless connectivity with minimum delay and maximum throughput, without which it is too difficult to offer good QoS to the customer. It has been observed that delay between any two endpoints of the network, at various levels, creates a significant impact on QoS. Propagation delay depends upon the transmission medium used for transmission. The delay which is occurred to switch from one packet to another while forwarding a packet to the destination is a measurement of time. Each packet has to wait for some time depends upon the size of the Queue, available at the switch or router. The delay which is occurred at a switch or router in a queue is called Queuing delay. Server Delay determines the elapsed time on the server when the request arrived and the response was generated. All the applications required minimum latency or delay, in order to provide optimum performance .Next-Generation Network is the foundation to all the applications which required high- speed spontaneous connectivity, in which the end-to-end delay is one of the major parameters which affects other parameters also.

Authors [1], demonstrates the use of NFV to reduce the End to End Delay in heterogeneous networks by considering all types of delays such as queuing delays, transmission delays, etc. Authors [2], explores the importance of bandwidth, delay, and user density in the context of 5G networks and how to get the optimize performance of the network to improve QoS. They also suggested the splitting of the network based on different properties. Authors [3], provides fronthaul solutions to improve the delay and overall performance of the network using multiplexing and also suggested advanced optical access technologies.Authors [4], explore the problem of multipath routing and proposed a Zone-based leader election protocol (ZBLE) to reduce the battery consumption of a node. The entire network is divided into different zones and based on the energy level, distance, and power of a node. The authors also emphasized on different parameters which helps us to enhance the Quality of Service (QoS).In this paper, the authors[5] proposes a handover scheme for next-generation self-organized networks (SON) they also compared the conventional handover scheme and the proposed scheme in terms of delay that occurred during handover to enhance the quality of experience(QoE).Authors [6], analyzedthe impact of delay on various applications and proposed a model which can be

used to increase Bandwidth and decrease Latency. Authors [7], analyzed the importance of delay and jitter concerning the 5G applications. The proposed new scheduling schemes to improve the performance of the network.Authors [8], suggested that the lifetime of the entire network depends upon the energy level of nodes in the case of crises if some nodes are out of battery then the communication may stop. To overcome this problem an improved routing algorithm is proposed which selects the high- energy nodes to void any disruption in communication.Authors [9], carried out a Comprehensive Survey on identified low latency approaches used in various applications based on SDN, NFV.Authors [10], explored QoS in the Internet of Things Networks in terms of various parameters used to enhance based on various techniques used in the cloud Authors [11], provides useful insights on End to end Delay and Handover in terms of reducing it by applying SDN approached to fulfill the Next Generation applications & its demands.Authors [12], suggested that the most important task is to select the appropriate node out of the available nodes based on various parameters to achieve maximum performance of the network. This new improved version of the Rider Optimization Algorithm (ROA)is used to select the winner node. There are set of nodes called bypass riders which helped us to find the alternative route if any problem occurs in the existing route. Followers, overtakers, and attackers nodes played the important role in finding the best path.Authors [13], demonstratean energy-efficient clustering algorithm used in wireless sensor networks to communicate with the nodes. This proposed the method of clustering based on the common properties of the nodes such as transmission power, receiving power, energy level, etc.Authors [14], proposed a new algorithm based on hierarchical clustering. Also, examine the decentralized behavior of all nodes in an ad hoc network.In this paper, authors [15], a new approach is devised to save the overall energy of the network.A new protocol based on clustering is introduced which selects the cluster head to mitigate the problem.Authors [16], proposed a trust-based routing protocol in combination with energy awareness in order to find the reliable route and also shortest route. The reliability of the network depends upon more number of packets transmitted known as the Packet Delivery Ratio (PDR).Authors [17], addressed various issues of Wireless Mesh Networks and introduced load balancing techniques in the routing of packets from source to destination.Authors [18], proposed a new routing protocol that is used to maximize the throughput and minimize the end-to- to end delay of the network when real-time data is transferred.Authors [19], investigated various important parameters like delay, transmission power in the context of DTN and devised a routing scheme to ensure timely delivery of the message.Authors [20], proposed neighbor hold timer and hello timer which is different from the conventional timer. Routing is based on the active link but the activeness of the link is determined by link duration.

After exploring different papers on the associated domains of Next Generation Ad hoc networks. There is a need to address the issue of delay which plays a key role in the performance of the network. I found that all applications need better QoS and QoE. To ensure QoS we need to incorporate different techniques concerning for domain at the architecture level and the application level also.

1.3. Proposed Flow Diagram of E-RAT

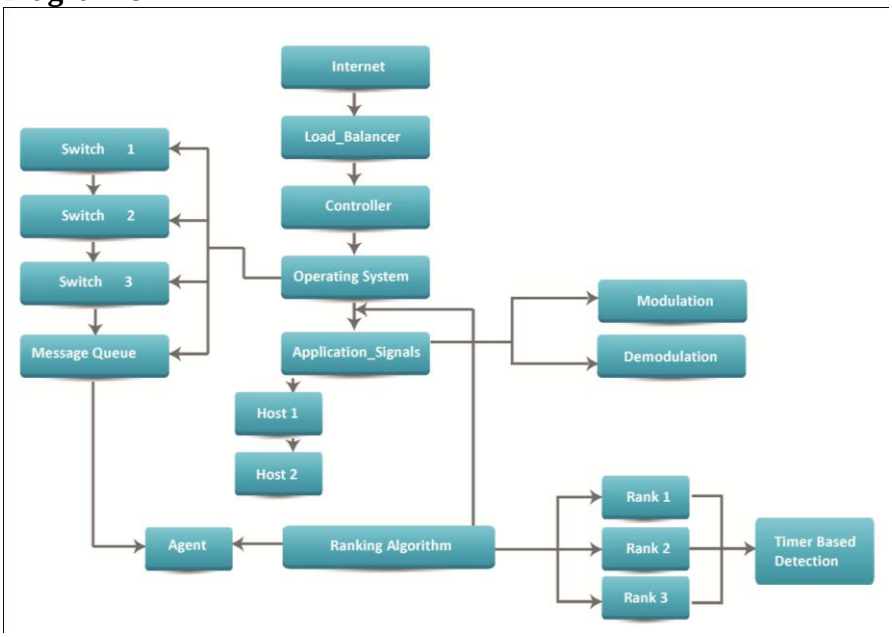


Fig 1.1 Proposed Flow Diagram of E-RAT

The flow diagram of E-RAT is described in the following manner.

1.3.1. Switches and Controller: Various switches are present whose function is to establish a connection to the operating system with the help of the controller. The establishment of the connection is done between switches and controllers. The message code should be modulated and demodulated.

1.3.2. Load Balancer: It is an important element of the above diagram. The removal of redundant packets during the transmission is done by the load balancer so that there is no delay between the transmissions of packets.

1.3.3.Timer-based detection: The controller monitors the routing flow of the packets. During congestion,the controller reroutes the routing flow.

1.3.4. Ranking Algorithm: In the ns3 simulator, switches are present in the form of nodes. Here nodes can only route the packets to the receiver by routing path. Neighboring nodes should be selected by using this ranking algorithm. Rank should be distributed based upon the node performance factors such as transmission power, reception power, energy level, etc.

1.4. Methodology

To optimize the performance of the network and its capacity. Here, a hybrid decision model is incorporated that combines an energy-efficient model and load balancing model. The hybrid model includes two inter-dependent decision-making processes.The first method adapts an effective energy model that derives apposite network information for guiding user decisions in order to meet operator objectives. The second method utilizesa hybrid optimization technique to provide effective load balancing that helps to balance the load in the network. Figure 1 describes the block diagram of the proposed ERAT model. In order to implement, we initialize switches and controllers.Switches send a flow request and establish a connection. The receiver node establishes the node connection In order to find the best path between the nodes, a routing mechanism is performed to discover the route for the flow of packets. Due to the rapid change of the position of the nodes and also in the capability of the nodes in terms of energy level and transmission power, it is difficult to choose the appropriate node. To do this we use to rank .Rank is given based on energy level and transmission power of the node.To stabilize the nodes with mobility prediction, load balancing is applied in the proposed approach.
The proposed method is different from the existing approaches. In this, we have designed a new protocol using RAT into E-RAT based on AODV by modifying certain parameters including End to End Delay. It is tried to minimize the delay which will eventually increase the speed of the network and benchmark it with 5G and beyond. So the new protocol tested against available standard protocol for the performance. The proposed algorithm is as follows.

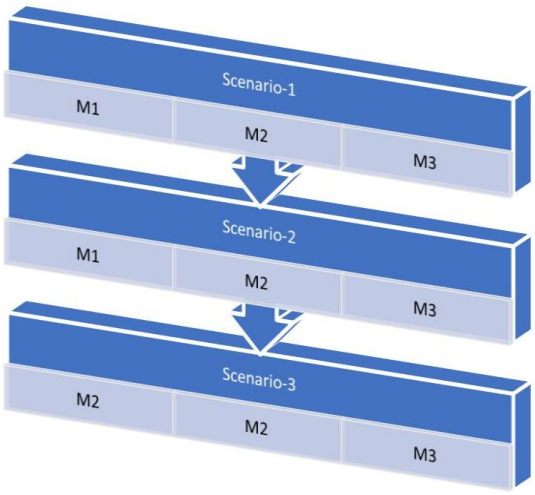


Fig-1.2 Different Scenarios

1.4.1 Algorithm Steps

Step-1 Initialization: Initialize the switches and controllers
Initialization si, ci

Step-2 Sending flow request: Switches send a flow request and establishes a connection.
If e0 →(Si Sj), then =si->cid(k (i, j); If, then e1 →(Si Sj) Cid.

Step-3 Receiver node establishes the host connection.

Total_pkt=TCP_pkt+SYNC_pkt+ACK_pkt

Step-4 Routing Mechanism: After it enters the route discovery mechanism for flow selection.
Hi (t) =Lmin (t)/h (t)

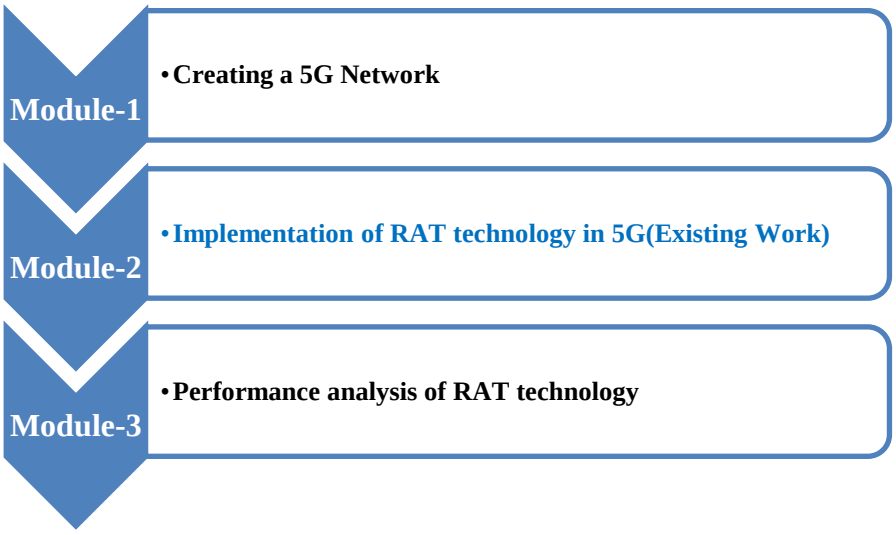
Step-5 Then it connects the switches
C (si, sj) = [si*t (1)/sj+sj*t (2)/sj]
C (si, sj) -> Connection of switches

Step-6 Rank Based Entry: Ranking based on neighborhood id formation and ranking the nodes within a cluster to select heads.
Ri=ei (1)/di (1) +ei (2)/di (2) +ei (n)/di (n)
Ri=ranking value of nodes
ei=energy value
di=transmission-power

Step 7 Load Balancing: Load balancer technique should stabilize the nodes with mobility prediction
Lxn/xnij=Lxi/xij+Lxj/xij;
Lj=omega1*(lbestp1) +omega2 (glbestp2**)**
lbestp1->local best position
glbestp2->global best position

1.4.2 Modules Framework

In order to implement the proposed algorithm, the complete tasks are divided into 6 modules. The details of the modules are as follows:



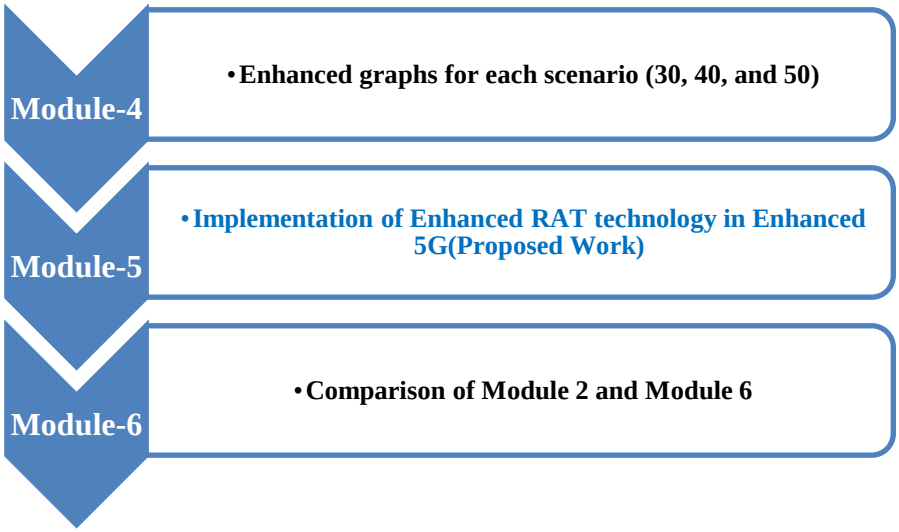


Fig 1.3 Module Framework

In Module-1, wecreate a simulation environment of AODV (ad hoc on-demand distance vector routing protocol) in the 5G network and populate the scenario with numerous nodes and rigorous testing. Then the transmission of packets will be done from source to destination in the network and communication will be established in the network.
In Module-2, Implementation of Radio access technology in 5G and with a sufficient number of nodes and transmission of the packets from source to destination based on the scenarios mentioned below with 3 different mobility conditions in a simulation time of 300 seconds. It offers a high quality of service. Three scenarios (based onthe variation of nodes i.e. 30.40 and 50 respectively) are being tested for three different mobility'sviz M1, M2, and M3 respectively.
In Module-3, performance analysis was performed in RAT technology on different parameters such as PDR, latency, routing overhead, and throughput. These analyses were plotted on a graph and in tabular format.
In Module-4, Enhanced graphs for each scenario have been made for 30, 40, and 50 nodes. The simulation graph is plotted between Mobility M1 and different parameters such as End-to-end Delay and Routing Overhead.
In Module-5,Enhanced RAT with improved quality of service is implemented. The various analysis was performed in ERAT technology such as PDR, latency, routing overhead and throughput. These analyses will be plotted on a graph and in tabular format. Analyses have been made and will be presented in graphical form. Implementation of design from source to destination based on below scenarios with 3 different mobility in a simulation time of 300 seconds. It overcomes the delay problem in the existing system with high reliability by using mobility prediction and load balancing.
In Module-6, we have compared the values of different parameters under three scenarios of Module-1 and Module-4 for existing RAT and Enhanced RAT (proposed) on different mobility's.

1.5 Experimental Tool or Simulation Tool –NS-3

NS-3 is an open-source simulator software that is used to simulate networks and facilitated to establish communication between Nodes. To test the protocol using discrete event-based simulator ns-3. Installation of ns-3 was done on the Windows platform which is open source and needs typical configuration. For testing the ERAT virtual network has to design as per the requirement with a variety of scenarios so that testing can be done thoroughly and on different parameters. The various table has to be generated based on the observation and data collection after that some calculation and data manipulation is needed so that inferences and graphs can be developed to arrive at some conclusions. In the end, comparisons can be done between standard protocols and newly developed or enhanced protocols can be done. The summarization can be done on qualitative as well as qualitative aspects and give recommendations along with future directions.
There are two kinds of parameters used for simulation.

1.5.1 Static Parameters

S. No	Parameters	Values
1.	Simulator	NS-3

2.	Simulator Protocol	AODV
3.	Simulation Time	Min-300 seconds
4.	Simulation Area	1000m X 1000m
5.	No. of Nodes	30/40/50
6.	Transmission Range	0.075 dBm
7.	Bandwidth	2.023 hertz
8.	Mobility Model	Random Waypoint
9.	Minimum Speed	0 ms
10.	Maximum Speed	0-30 m/s
11.	Pause Time	1.0 seconds
12.	Traffic Type	CBR
13.	Data Packet Size	512 byte
14.	Data Rate	200 Kbyte

Table 1.2 Static Parameters

1.5.2 Dynamic Parameters

The number of Nodes and Mobility are two dynamic parameters in this simulation. In a simulation, the number of available nodes in which communication takes place is varied depending upon the scenario. Mobility specifies the speed of the mobility of different nodes.

1.6 Result and Discussion

Table 1.3 displays the values after considering all observations, performing calculations and data analysis for End-to-End delay,

S.No.	Mobility	Standard RAT	Enhanced RAT	% Decrement
1	M1	315.001	202.24	-35.79%
2	M2	353.213	246.55	-30.19%
3	M3	402.111	287.34	-28.54%
4	Average	356.774	245.37	-31.22%

Table 1.3 Comparison Data for End to End Delay for 30 Nodes

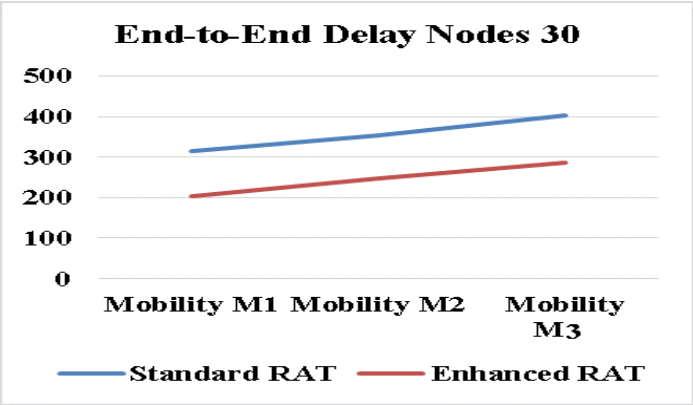


Fig 1.4 Comparative Line Graph for End to End Delay -30

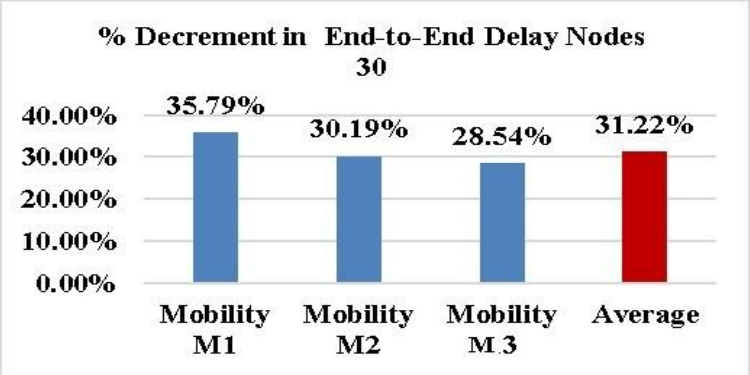


Fig 1.5Comparative Bar Graph for End to End Delay-30 Nodes

Now, Table 1.3 and subsequent Fig. 1.4 and Fig 1.5 demonstrate that the end-to-end delay is declining on various mobility. ERAT is better pertaining to the end-to-end delay in comparison with standard protocol RAT. The average decrease is 31.22% in the end-to-end delay as per Table 1.3. From Fig 1.5 illustrates that ERAT end-to-end delay is on decreasing trend in comparison with the average percentage decrease in end-to-delay which is shown in brown color across all the mobility. So, it can be concluded that ERAT is better performing in comparison to the RAT.

Post analysis of data, the values are shown in Table V as below -

S. No	Mobility	Standard RAT	Enhanced RAT	% Decrement
1.	M1	367.001	213.112	-41.93%
2.	M2	382.12	256.001	-33.00%
3.	M3	423.16	272.88	-35.51%
4.	Average	390.760	247.331	-36.70%

Table 1.4 Comparison Data for End to End Delay for 40 Nodes

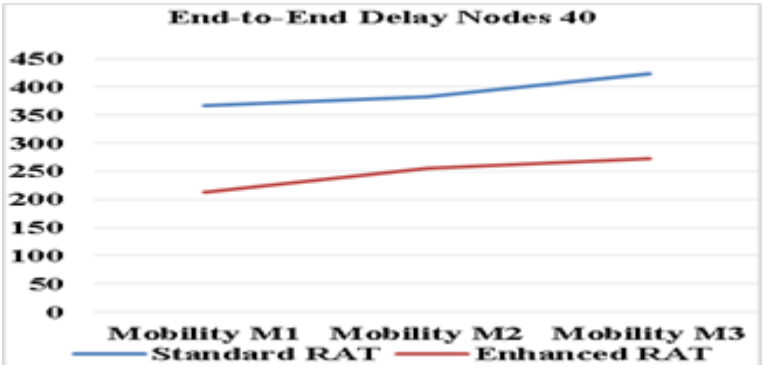


Fig 1.6 Comparative Bar Graph for End to End Delay-40 Nodes

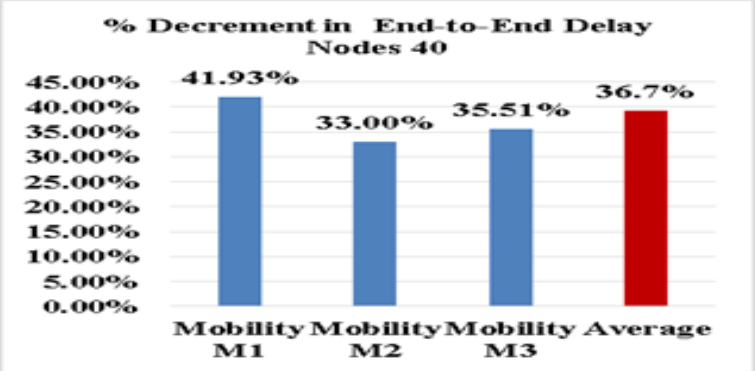


Fig 1.7 Comparative Bar Graph for End to End Delay-40 Nodes

Analysis of graphical representation in Fig. 1.6 and Fig. 1.7 and values in Table 1.4 illustrates that the End-to-End Delay is decreasing on various mobility and the performance of ERAT is improved in comparison with standard protocol RAT. The average decrease in End-to-End delay is 36.7% as per Table 1.4. It is concluded that ERAT end-to-end delay is ramping down in comparison with the average percentage decrease in end-to-delay which is shown in brown color across all the mobility. This leads to the conclusion that ERAT is better in comparison with RAT.

The outcome of observations and analysis is shown in Table 1.5 for the End-to-End Delay.

S. No	Mobility	Standard RAT	Enhanced RAT	% Decrement
1.	M1	412.01	222.01	-46.11%
2.	M2	433.21	272.01	-37.21%
3.	M3	487.15	301.11	-38.18%
4.	Average	444.19	265.04	-40.33%

Table 1.5 Simulation Data for End-To-End Delay 50 Nodes

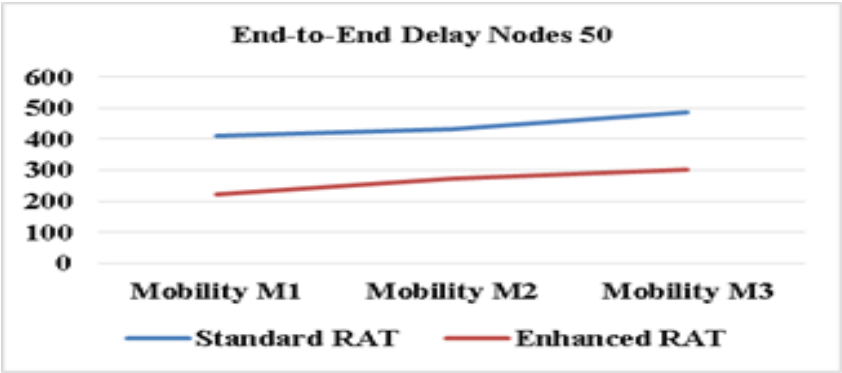


Fig 1.8 Comparative Bar Graph for End to End Delay-50 Nodes

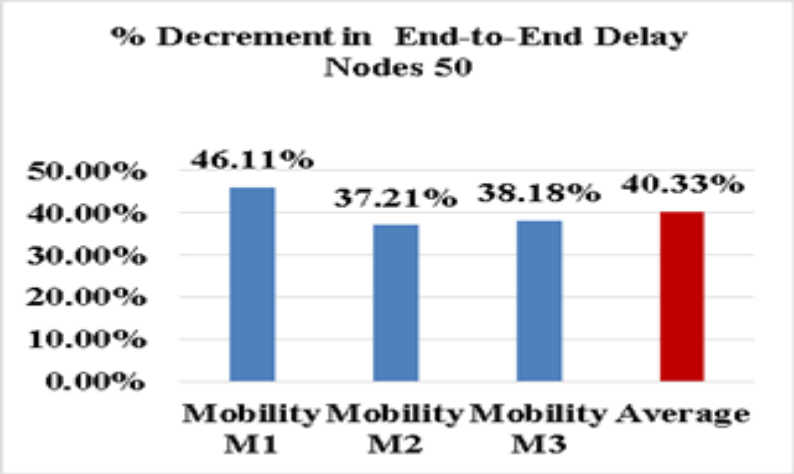


Fig 1.9 Comparative Bar Graph for End to End Delay-50 Nodes

The values in Table VI and subsequent graphs in Fig. 1.8 and 1.9 establish that the End-to-End Delay is decreasing on various mobility. It shows that ERAT is better concerning End-to-End delay in comparison with standard protocol RAT. The average decrease in End-to-End Delay is 40.33% as per Table 1.5. From Fig 1.9 it is visible that in ERAT End-to-End delay is declining in comparison with the average percentage decrease in End-to-End Delay which is shown in brown color across all the mobility. Similarly, this scenario also concludes that ERAT is better in comparison with the RAT.

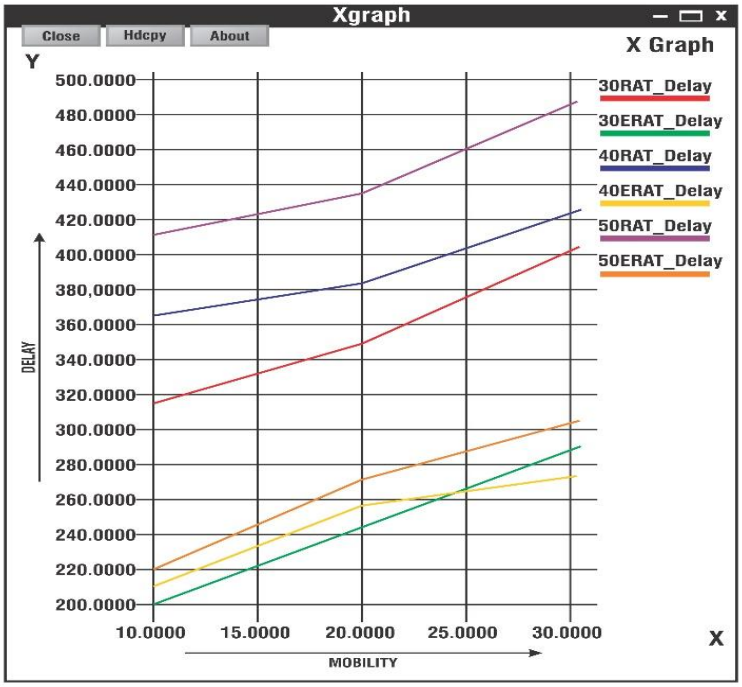


Fig 1.10 Comparison Graph of Delay on RAT and ERAT

An overall comparison graph is plotted between delay and mobility at various nodes to understanding the characteristics or behavior of RAT and ERAT. Analyses of findings as listed in Table IV, V, VI, and subsequent Fig. 1.10, it establishes the fact that the End-to-End Delay is on decreasing trend at various mobility's.Furthermore, it is evident that ERAT is better concerning End-to-End Delay in comparison with standard protocol AODV.

1.7 Conclusion

In this paper, an effort is made to identify the critical role of End to End (E2E) Delay in the context of the Next Generation MANET. The End-to-End Delay is an important parameter influencing the performance. To enhance performance, it is paramount to control End-to-End Delays. This plays a vital role to improve QoS. The values of End-to-end Delay were identified and analyzed on different mobility and the results are compared for existing RAT (Standard AODV) and Enhanced RATs. From Table 1.3, 1.4, and 1.5, the values of End to end Delay under different scenarios on

different mobility's is decreased by 36.08 %.The comparative analysis from Line Graphs shown in Fig 1.4, 1.6 and 1.8 represents that the obtained values of End to End Delay in ERAT are on decreasing trends. The Bar Graphs shown in Fig 1.5, 1.7, and 1.9 represents End to End Delay on different mobilities along with the average. The overall analysis of End to End Delay illustrates that ERAT is better than RAT

In the future, more parameters can be identified and evaluated under different scenarios, which would help us to understand how Enhanced AODV will perform in Next Generation MANET to provide better QoS & QoE.

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