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OPTIMAL ROUTE SELECTION STRATEGY FOR QOS IMPROVEMENT

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Abstract- An ad-hoc mobile network is a collection of mobile nodes that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis.Adhoc nodes operating in a single path, single channel model might experience packet loss and high latency due to the congestion caused. Nodes along the heavy traffic path could reach the maximum bandwidth limit and experience undesirable amounts of packet drop. In Adhoc networks the nodes are mobile and contain no infrastructure. Certain emergency messages have to be delivered with very low latency and high reliability. An efficient routing protocol should ensure reliable packet delivery in a timely manner. Our Proposed solution is to setup multiple optimal paths based on bandwidth and delay. It allows storing multiple optimal paths based on Bandwidth and delay. At time of link failure, it will switch to next available path. To set up multiple paths, we have used the information that we get in the RREQ packet and also send RREP packet to more than one path It reduces overhead of local route discovery at the time of link failure. We investigated the performance metrics namely Retransmission Attempt, Media Access Delay, Network Load by through OPNET simulation.

Keywords- *Ad hoc Network, AODV Protocol, Media Access Delay, Network Load, Retransmission Attempt (Packet)*

I. INTRODUCTION

Mobile Ad-Hoc networks (MANETS) are self-configured and infrastructure less network with more number of mobile devices connected via a wireless links. Energy conservation in ad-hoc networks is very important due to the limited energy availability in each wireless node [12]. Ad hoc networks are typically considered to be composed of mobile wireless devices, with the result that the interconnection pathways between the devices can change rapidly. This characteristic often causes ad hoc networks to be viewed more quite different than traditional networks; however, our experience shows that instead there is a strong commonality which, as we learn to understand it better, will illuminate not only the nature of ad hoc networks but also some fundamental aspects of networking [1]. The MANET is the combination of mobile nodes (MN) and wireless communication links. They are connected to each other without the help of access point (AP) and it is shown in figure1. For efficient communication in MANET, the frequent link establishment is mandatory and it has application in disaster area, battle field etc. It requires the routing protocols to establish the connection and route data packets [13].

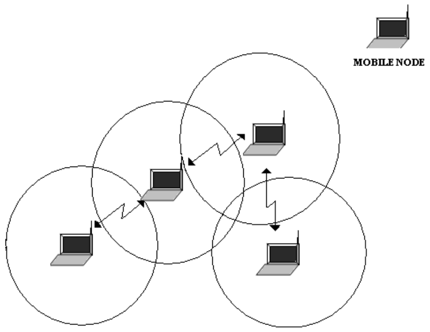

Figure 1: Ad Hoc Network System Architecture

The need for exchange of digital information outside the typical wired office or unarranged environment is growing such as a class of students may need to interact during a lecture; business associates serendipitously meeting in an airport may wish to share files; or disaster recovery personnel may need to coordinate relief information after a hurricane or flood. Each of the devices used by these information producers and consumers can be considered a node in a MANET [2]. For this, two types of signals are used: control signal and data signal and they are categorized according to their properties: Proactive and Reactive routing protocol [13].

The proactive routing protocol is table driven routing protocol. In this, routing table is updated if any change occurred in the network topology. It is well known, the mobile nodes are dynamic by nature so, proactive routing protocols are not useful over dynamic topology [13]. In a network utilizing a proactive routing protocol, every node maintains one or more tables representing the entire topology of the network. These tables are updated regularly in order to maintain up-to-date routing information from each node to every other node. To maintain the up-to-date routing information, topology information needs to be exchanged between the nodes on a regular basis, leading to relatively high overhead on the network [14].

Reactive routing protocols are on-demand protocols. These proto-cols do not attempt to maintain correct routing information on all nodes at all times. Routing information is collected only when it is needed, and route determination depends on sending route queries throughout the network. The primary advantage of reactive routing is that the wireless channel is not subject to the routing overhead data for routes that may never be used [14]. Reactive routing protocols in MANETs such as DSR and AODV are often supported by an Expanding Ring Search [15].

II. ROUTING IN MANET

“Routing is the process of information exchange from one host to the other host in a network.” Routing is the mechanism of forwarding packet towards its destination using most efficient path. Efficiency of the path is measured in various metrics like, Number of hops, traffic, security, etc. In Ad-hoc network each host node acts as specialized router itself [4]. The primary goal of routing protocols in ad-hoc network is to establish optimal path (min hops) between source and destination with minimum overhead and minimum bandwidth consumption so that packets are delivered in a timely manner [16].

2.1 Different Strategies

Routing protocol for ad-hoc network can be categorized in three strategies.

a) Flat Vs Hierarchical architecture.
b) Pro- active Vs Re- active routing protocol.
c) Hybrid protocols.

2.2 Flat Vs. Hierarchical architecture

Hierarchical Network architecture topology consists of multiple layers where top layers are more seen as master of their lower layer nodes. There are cluster of nodes and one gateway node among all clusters has a duty to communicate with the gateway node in other cluster. In this schema there is a clear distribution of task. Burden of storage of network topology is on gateway nodes, where communicating different control message is dependent on cluster nodes.

But this architecture breaks down when there is single node failure (Gateway node). Gateway nodes become very critical for successful operation of network. Examples include Zone-based Hierarchical Link State (ZHLS) routing protocol. Where in flat architecture there is no layering of responsibility.

2.3 Proactive vs. Reactive routing protocol in MANET

2.3.1 Proactive Routing Protocol

In this, each node maintains the network topology information in the form of routing tables by periodically exchanging routing information. Routing information is generally flooded in the whole network. Whenever a node needs a route to the destination it runs an appropriate path finding algorithm on the topology information it maintains [4]. Current routing protocol like Link State Routing (LSR) protocol (open shortest path first) and the Distance Vector Routing Protocol (Bellman-Ford algorithm) are not suitable to be used in mobile environment. Destination Sequenced Distance Vector Routing protocol (DSDV) and Wireless routing protocols were proposed to eliminate counting to infinity and looping problems of the distributed Bellman-Ford Algorithm[5].

Examples of Proactive Routing Protocols are:

a) Global State Routing (GSR).
b) Hierarchical State Routing (HSR).
c) Destination Sequenced Distance Vector Routing (DSDV).

2.3.2 Reactive Routing Protocol

In this type of routing protocol, each node in a network discovers or maintains a route based on-demand. It floods a control message by global broadcast during discovering a route and when route is discovered then bandwidth is used for data transmission. The main advantage is that this protocol needs less touting information but the disadvantages are that it produces huge control packets due to route discovery during topology changes which occurs frequently in MANETs and it incurs higher latency. [4]

Examples of reactive protocols are:

a) Ad hoc On-demand Distance Vector Routing (AODV)
b) Dynamic Source Routing (DSR)
c) Location Aided Routing (LAR)
d) Temporally Ordered Routing Algorithm (TORA) [5]

2.4 Hybrid routing protocols in MANET

These protocols combine the best features of the above two categories. Nodes with a certain distance from the source node concerned or within a particular geographical region are said to be within the routing zone of the given node. For routing within this zone, a table-driven approach is used. For nodes located beyond this zone, an on-demand approach is used [4].

2. 5 Cost benefits trade-off between proactive and reactive protocols

Advantage: Proactive vs. Reactive

Proactive protocols: Routes are readily available when there is any requirement to send packet to any other mobile node in the network. Quick response to application program.

III. PROPOSED SYSTEM

In the proposed algorithm, multipath is discovered and maintained in advance at the time of route discovery, but instead of considering each and every RREQ at each node it will consider only specified number of request. At destination or intermediate node, RREP is sent to every received RREQ from unique node. Thus more than one path is maintained all with same but least hop count will be stored in routing table and one of them will be used for data transfer. Other non used paths will be used at time of link breakage.

The challenges of mobile ad hoc network are to maintain quality of services and performance. Many routing protocols like AODV discover routes whenever required by the source node and the benefit in doing so is that no prior knowledge of the topology is required. The AODV routing protocol is commonly and effectively used for mobile, ad-hoc nodes. So far, many maintenance strategies have been proposed on AODV to provide better QoS services performances. Some modification has been done on computation of delay parameter. The other modification was on multi route selection during route discovery considering only delay as QoS parameter. This paper aims towards proposing a new route maintenance strategy with multiple options that will lead to better performance during link failure on a route. During route discovery and route reply procedure two different QoS parameters considered here are delay and bandwidth. The routes should be selected during route discovery process. The route maintenance strategy may be applied to both the routes independently and simultaneously by the internal nodes where the link failure has occurred.

MANET nodes have limited bandwidth that means there transmission range is limited. A Source node or host can directly communicate with other node if the other node is in transmission range of the source node. Since these nodes can directly communicate with one another, they are called as Neighbors in the network. Communications between Non-neighboring nodes require multi-hop routing protocol. Because of multi-hop routing requirements, MANET nodes need to act as both host as well as router at a time and perform all the routing and state maintenance operations.

3.1 Phases of Proposed System

We Proposed algorithm has three phases, Route Discovery, Data Sending and Route Maintenance.

3.1.1 Route Discovery

Route discovery is initiated by the source node when it has some data to send and does not have the route table entry for the destination. It broadcasts RREQ packet to its neighbors. When Intermediate node gets RREQ, it will check for the route table entry, for the destination mentioned in the RREQ packet. If it finds route table entry for the destination, it will generate RREP packet and send it to the source. If it doesn't have the route table entry for that destination it will rebroadcast the RREQ, after updating the route entry for the source. When RREQ packets come at the destination, it will generate RREP packet for each RREQ packet, and unicast it to the source. At each intermediate node, route to the destination will be established by recording the next hop to the destination.

3.1.2 Data Sending

Simulation Data will be sent as soon as the first RREP packet comes to the source data packets will be sent and it will traverse hop by hop.

3.1.3 Route Maintenance

If a link break is detected, it will check for the unreachable destination and if any, it will broadcast a Route Error (RERR) packet. The entire node getting RRER packet, will re broadcast it if and only if there is at least one unreachable destination. As we have alternate paths, when a data packet arrives, it will use the next path which is available. i.e. it switch to the next path on route failure and will send the RERR only when it does not have any alternate path for the destination.

3.2 Previous Algorithm

HLSMPRA algorithm mainly aims at dealing with the degradation of performance in whole networks resulting from rare area congestion in wire transmission network. Firstly, the focus of our work is to keep the routing information in the source node, so as to conduct data transmission in method of alternative path or multi-path intercurrently in source node when congestion happens. Secondly, check congestion regularly, meanwhile record the bandwidth of each link, and then judge whether the link in the state of overload by comparing excess bandwidth.

3.3 Proposed Algorithm Procedures

This Algorithm Performs the Following Steps

a) Estimate the Delay, Bandwidth, availability, mobility of each node. We seek optimal routes with minimal end to end delivery time and Bandwidth.
b) Calculate the validity of each route for available packet forwarding/transmitting for selecting optimal path.
c) Remove the routes, which is not satisfied the above condition.
d) Randomly select any one route from the available routes, which provides optimal route.
e) Sends the packet using optimal route.

3.4 Difference between Previous Algorithm & Proposed Algorithm

a) Previous algorithm mainly aims at dealing with the degradation of performance in whole networks resulting from rare area congestion in wire transmission network whereas the proposed algorithm mainly estimate the Delay and Bandwidth, availability and mobility of each node.

b) Previous algorithm keep the routing information in the source node, so as to conduct data transmission in method of alternative path or multi-path intercurrently in source node when congestion happens while in the proposed algorithm the routing information is stored at every node in order to keep the information updated at each node in case of a node failure or in congestion.
c) Previous algorithm chooses the best route to send the packet and proposed algorithm sends the packet using optimal route.
d) The packet drop ratio and end to end delay of proposed algorithm is better than the previous algorithm as shown in the graphs below.
e) In the proposed algorithm the network load, media access delay and route error is minimum as compared to previous algorithm.

IV. SIMULATION MODEL

4.1 Simulation Model

Simulation is carried out in the OPNET Modeler 14.0. The simulations have been performed using network simulator OPNET. The network simulator OPNET is discrete event simulation software for network simulations which means it simulates events such as sending, receiving, forwarding and dropping packets. The version of OPNET is 14.0, supports simulation for routing protocols for ad hoc wireless networks such as AODV, TORA, DSDV, and DSR. OPNET is written in C++ programming language and Object Tool Common Language (OTCL).

Opnet allows you to model network topologies with nested sub-networking approach. This software allows nodes and protocols to be modeled as classes with all features of object oriented design It facilitates modeling the behavior of individual objects at the “Process Level” and interconnect them to form devices at the "Node Level" So that you can interconnect devices using links to form networks at the "Network Level." You can organize multiple network scenarios into “Projects” to compare designs and Aggregate traffic from LANs or "Cloud" nodes [8]. The package consists of a number of tools, each one focusing on particular aspects of the modeling task. These tools fall into three major categories that correspond to the three phases of modeling and simulation projects: Specification, Data Collection and Simulation, and Analysis [11].

The OPNET usability can be divided into four main steps. The OPNET first step is the modeling, it means to create network model. The sec step is to choose and select statistics. Third step is to simulate the network. Fourth and last step is to view and analyze results. All these steps are shown schematically in the below figure 2.To build a network model the workflow centers on the Project Editor. This is used to create network models, collect statistics directly from each network object or from the network as a hole, execute a simulation and view results.

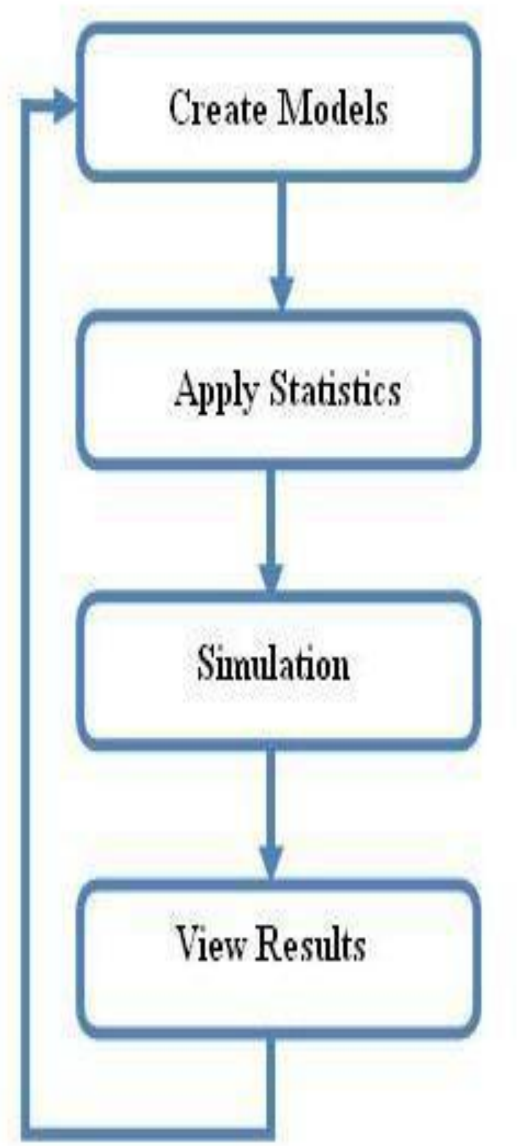

Figure 2: Flow Chart of OPNET

The OPNET model in its very core consists of C++ codes. These codes are complied and executed just like the C++ program.

4.2 Simulation Parameters

We consider a network of nodes placing within a 1000m X 1000m area. Table 1 shows the simulation parameters used in this evaluation.

Table 1: Simulation Parameters Used.

Simulation Parameters	
Simulator	Opnet-14.0
Protocol	AODV
Simulation duration	30 min
Number of Nodes	13
Pause Time	100 sec
Average Speed	102,714 events/sec
Node Traversal Time(sec)	0.04
Route error rate limit	10 pkts/sec
Addressing Mode	IPv4
Packet size(bits)	1024
Data rate(bps)	11mbps
Buffer size(bits)	256000

4.3 Simulation environment

The master thesis simulation is carried out in the OPNET Modeler 14.0. Below figure shows the simulation environment of one scenario having 13 mobile nodes. The key parameters are provided here i.e. Network load, Retransmission Attempts (packets), and Media Access Delay (sec).

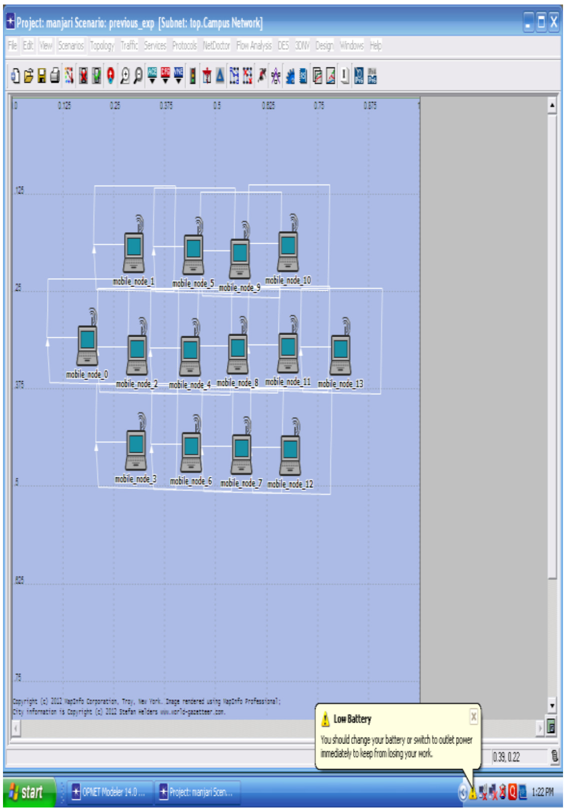

Figure 3: Simulation setup

4.4 Simulation results and Statistics

In OPNET there are two kinds of statistics, one is Object statistics and the other is Global statistics. Object statistics can be defined as the statistics that can be collected from the individual nodes. On the other hand Global statistics can be collected from the entire network. When someone choose the desired statistics then run the simulation to record the statistics. These collected results are viewed and analyzed. To view the results right click in the project editor workspace and choose view results or click on DES, results then view results. Then a browser pops up as shown in this figure 4.

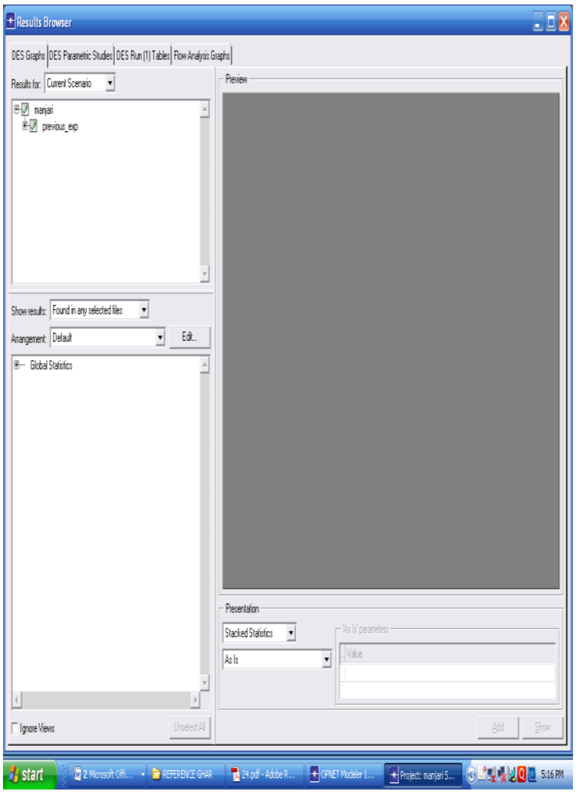

Figure 4: OPNET Results Browser

4.5 Performance Metrics

While analyzed the proposed system with HSLMPRA, we focused on two Performance metrics which are Media Acess Delay, Retransmission Attempt and Network Load.

The graphs Figures 5 to 7 shows that the overall performance- Media Access Delay, Retransmission Attempt and Network Load are improved by using our local route repair method when multiple sources are transmitting data to single source to make available more alternate routes.

Retransmission Attempts (packets): It is the total number of retransmission attempts by all WLAN in the network until either packet is successfully transmitted or it is discarded as a result of reaching short or long retry limit.

Media Access Delay (sec): It represents the global statistic for the total of queuing and contention delays of the data, management, delayed Block-ACK and Block-ACK Request frames transmitted by all WLAN MACs in the network.

Network Load: When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load.

V. SIMULATION RESULTS & OBESRVATION

In this paper, local retransmission is used to improve the Media Acess Delay. Improved efficiency, reliability and effectiveness of proposed routing protocol. Retransmission made from neighboring nodes of source node to destination instead of original source node. Thus, the total route error is reduced to some extent. From Figure 5, the Media Access Delay (sec) shows improved reliability, effectiveness and efficiency and figure 6 shows Network Load. Figure 7 shows Retransmission attempt. Media Access Delay delay than previous algorithm. Due to the fact if a link break occurs in the current topology, proposed algorithm would try to find an alternate path from among the backup routes between the source and the destination node pairs resulting in additional delay to the packet delivery time. Proposed algorithm is based on the optimal path selection criteria as shown in figure 5.It is the total number of retransmission attempts by all WLAN in the network until either packet is successfully transmitted or it is discarded as a result of reaching short or long retry limit. Retransmission of packets in proposed algorithm is minimum as compared to the previous one because each node contains its own Routing table as shown in Fig 7.

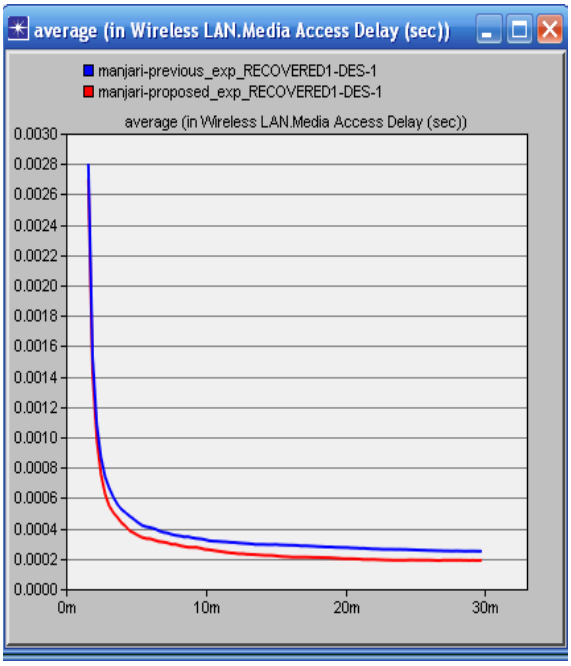

Figure 5: Media Access Delay

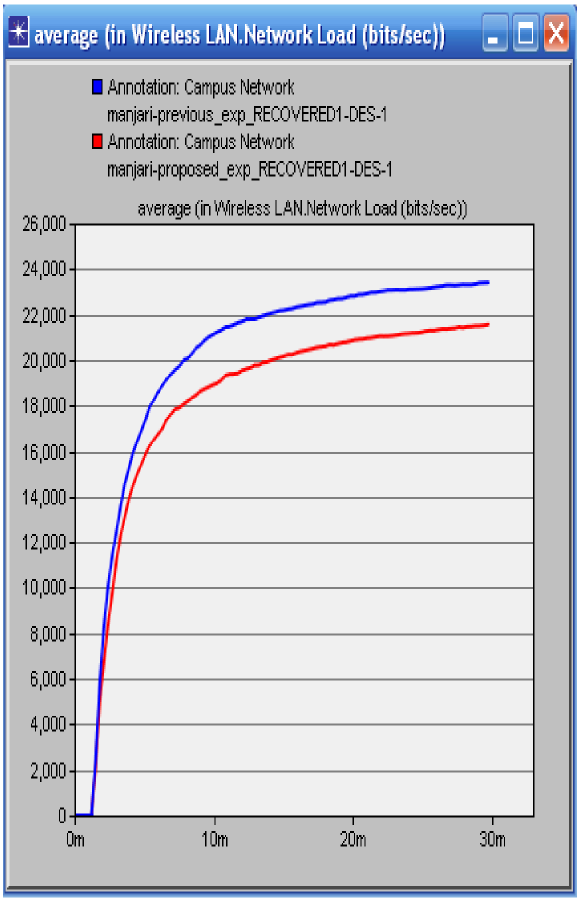

Figure 6: Network Load

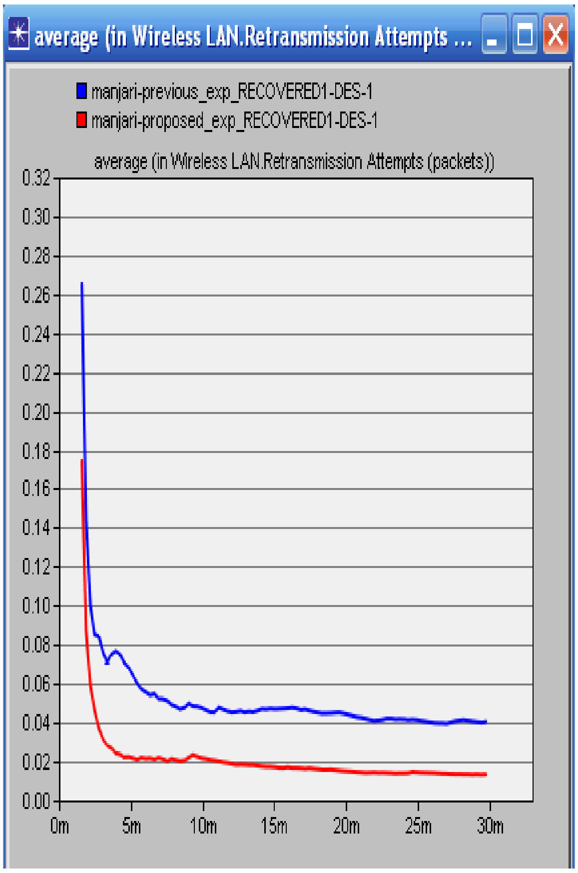

Figure 7: Retransmission Attempt

VI. CONCLUSION

The proposed algorithm will generate slightly higher overhead than that of Previous Algorithm for first time at the time of route discovery. But once route discovery is over, it will be beneficial for route maintenance. And this overhead overcomes the route overhead generated at the time of link failure. The proposed Algorithm reduces the total Delay, Routing Load, Packet Drop, Total route error sent. This algorithm is based on Optimization. The proposed algorithm improves the efficiency, robustness and reliability. The efficiency of proposed Algorithm shown to better than Previous Algorithm.

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