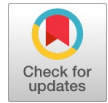# Modifying the MANET Routing algorithm by GBR CNR-Efficient Neighbor Selection Algorithm

Ankur Goyal, Vivek Kumar Sharma

Abstract- In today's worlds, Mobile Ad-Hoc Network (MANET) plays most important role in the field networks technology in the world. The MANET has been rapidly rising and becoming significant from the last decade. A MANET is a kind of wireless network which has been set-up without requirement of fixed infrastructure where mobile nodes are connected over wireless link. Due to moving nature of the devices, the network topology is unstable and will change dynamically. That's why stable routing in MANET cannot work properly. In this research paper, a new routing algorithm is proposed to get better routing performance in the MANET. The proposed algorithm designed based on the number of neighbors in the network. Planned algorithm is the improvement of GBR-CNR-LN (GBR-CNR with less neighbors) by calculating the stay time between the selected neighbor nodes and the transmission nodes. If the stay time of sender node is more than the packet transmission time then the selected node is the efficient neighbor selection. The algorithm is implemented and results are analyzed. The results of this paper show the usefulness of the proposed algorithm. The Evaluation of AODV protocol was carried out using Python and outcome of this evaluation showed that proposed Algorithm gave better results than GBR-CNR with less neighbor in terms of End-to-End delay, Number of control message transferred(Routing Overhead) and Network Load. The proposed Algorithm (GC-ENS) decrease Average End-to-End delay 52.54 %, reduce Average Routing Overhead 60.54% and decline the Average load on Network 61.17%.

Index Terms: MANET,AODV, GBR, GBR-CNR, GBR-CNR-LN, GC-ENS algorithm.

I.INTRODUCTION

The most important advantage of using wireless technology is the huge mobility it offers (portability and freedom of movement) [1].With the development of Wireless LAN (WLAN) technology, the users can achieve connectivity while moving in a network, with a useable amount of bandwidth. Now the user can access the network without using any of the wall socket present in the old wired network [2]. New generations of the movable devices allow the users to access the stored data via fast speed network. A wireless network can be divided into two groups: Infrastructure based WSN and Infrastructure less WSN. [3, 4]. In infrastructure based wireless sensor networks, the base station is fixed and the devices can move in the region of the base station during the communication.

There is more than one base station in the infrastructure based network and each base station has its own range. If a node crosses the range of a base station then it will come under the range of another base station, in such a way that connection will not break down. In an infrastructure-less network or an Ad-Hoc network, the base station is not fixed and it moves anywhere in the network, and a node moves in any direction during message transmission.[3, 5]. Further, Infrastructure less wireless routing protocol i.e. ad hoc routing protocol can be sub- divided in Proactive (table-driven),reactive (on-demand)protocol and hybrid protocol [2, 6, 7]. In Proactive routing protocols, devices will exchange routing packets through route table from time to time and find out the routes between sender and receiver in the network, despite of using the routes or not [2]. So, the Proactive Routing Algorithm can consume huge amount of network resources like energy, power consumption and bandwidth, which is not acceptable in MANETs where the resources are limited [2, 8]. Destination Sequence Distance Vector (DSDV) and Wireless Routing Protocol are the examples of Proactive routing Protocol [9] In Reactive Routing protocols, as a node needs to interconnect to another node then only it will discover routes. Hence such type of protocols will not waste network resources by sending or receiving routing information periodically i.e. Ad Hoc On-demand Distance Vector and Dynamic Source Routing [8, 9]. Each node will not maintain routing table.AODV has given better results than DSR in higher mobility situations.AODV protocol consists of common features of DSR and DSDV.AODV protocol apply Route Request packets (RREQ), Route reply packets (RREP) and Route error packets (RERR) for performing many operations. Limitation of proactive protocols in terms of battery power is it consumes more power as compare to reactive protocols [8]. Other than proactive and reactive there is one more protocol which is known as hybrid routing protocols which consists of the common features of both proactive and reactive routing protocols. There are two steps in the protocol, first step is route discovery process to find out the routes between two nodes which follow the basic features of reactive routing protocol and second step is route maintenance process to maintain the route between nodes which follow the features of proactive protocols. Zone Routing Protocol and Hierarchical Routing Protocols are under the category of hybrid routing protocol. Due to Network topology changes frequently in MANET, nodes are free to move rapidly and randomly, they can organize themselves at random and they can connect and leave the network at any time [11]. Due to autonomous behavior of these nodes or devices in MANET are acting like a host and router both to forward the traffic to another node.

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As nodes are self-configure, so it does not required human involvement during the implementation [1]. MANET can be implemented easily without the need of any infrastructure. Due to independent, non-centralized wireless techniques of MANET, all nodes, devices, mobiles, and terminals are interconnected by wireless links [11]. All these basic features of MANET make it easy, efficient, scalable, less expansive and very practical to implement and deploy it effectively

AODV is a reactive routing algorithm that creates a route to a destination on demand. Routing method of AODV consists of 2 steps and these steps are path discovery and path maintenance. In the path discovery steps, when the sender wants to send some information to a device and there is no valid active route, then it will start the procedure by broadcasting RREQ message to all devices by flooding method. When a node will receive a RREQ message then it will examine the entry of destination in its routing table. [12, 10]. If the address of the destination is available in the routing table then it will send back the route reply (RREP) message to source and that RREP message is unicast which will send back the path from where RREQ came. If address of the destination is not available in routing table it means route is not found and then the neighbors also broadcast the same RREQ packets to their neighbors. This process will go on until destination or any node which has route towards destination receives the RREQ.The reverse route which was created to send the RREP message to source, will utilized as a route for transmission of the information by sender. [10] In the route maintenance steps, RERR message will be used by the node. When an active node is not receiving HELLO message in regular interval of times then this is defined as a broken link. Initially when a neighbor of node will detect a link break, it will try to repair the route but if it is not possible to repair the route then it will send the RERR message to the source. After receiving a RERR message, source node will broadcast the RREQ message to find out the route by using route discovery process. [9, 10].

The primary challenge for developing a MANET atmosphere is to properly sustain the information that is required to route the traffic effectively. MANETs can connect every node themselves to the network. Nodes are having more than one transceivers. This results in a extremely dynamic and self-directed topology [13, 14]. MANET has an atmosphere that processes the interchange of data from one device to another device. There are many protocols invented for finding out the packet drop rate, the routing overhead initiate by the routing protocol, end-to-end delay, load on Network, network throughput, efficiency transmission time etc.

The routing plays an important role in the MANET. A routing technique affects the quality of the network as well as the power consumption of the device [15]. A properly designed routing improves the quality of the network. The present work is a concern with the development of a new routing algorithm to enhance the network quality. We are dividing this article into five segments. The first segment gives the introduction of the MANETs. The second segment gives the related work in which the work performed by different authors is given. The third segment illustrates the proposed work. The basic description of the proposed algorithm is given. In the fourth segment, the outcomes of the proposed algorithm are discussed. Last and fifth segment describe the conclusion.

II. RELATED WORK

A lot of routing protocols have been planned by different researchers to increase the quality of routing algorithm in MANETs. These Routing protocols can be classified into three categories: topology-based routing, position-based routing & Clustering Algorithms. The work performed by different authors is as following –

A. Interference aware topology-based routing

Interference reduces the efficiency in MANET by mortifying a few packets that are switch over among the different nodes of the network.So.it is important to understand the interference in Manet's atmosphere.

Pyun et al. [16] designed a distributed topology organize system for MANETs. In this work, the transmission power of every moving device was attuned depend on the amount of its neighbor devices and the quantity of interference which was created by the devices for its neighbors. The mobile node can modify its transmission power accordingly to its neighbors to sustain the quantity of objected neighbors. This saves the power at the mobile node.

De Rango et al. [17] designed a procedure that was established the idea of interference to look up the wireless network efficiency. Two different metrics were projected: the first was based upon the Universal interference apparent by devices which were occupied in the communication and the second was based on the interference apparent only on the links fit in to the path from the origin to the end. The Originality of the Suggestion was to accept mentioned two metrics for the process to choose the best possible path from the origin to the end and for the route maintenance process. This designed work was not dependent on the minimum hop count but based on the Universal interference apparent by nodes and on the interference affecting the link which was concerned in the transmission.

C. Gu et al. [18] proposed the Interference Aware Cross-Layer Routing protocol (IA-CLR). This protocol was an interference aware routing protocol which was depended upon sending and receiving ability of a node. IA-CLR constructs the path by using the new routing metric that can widely imitate the network situation.

B. Position-based routing for MANET:

M. Khabbazian et al. [19] proposed an iterative approximation algorithm in which they have given a set of locations for wireless devices. The interference minimization problem is to allot a communication radius of every device such that the resultant communications graph would be connected and reducing the maximum count of overlaps broadcast range of a node.

R. Hekmat et al. [20] projected a model to calculate the capacity and interference in wireless ad-hoc networks and this calculation will depend upon the number of devices, device's density, multi-hop uniqueness of the network, and transmit traffic. The calculation, which was proposed in this paper, was depending on the pathless power law model for radio propagation.

Y. Zhou et al. [21] proposed a solution of localized link scheduling created by difficult physical interference limitation. By incorporate the dividing and shifting approach into the pick-and-compare scheme, they offered a class of localized scheduling algorithm with verifiable throughput guarantee subject to physical interference limitation.

W. Yang et al. [22] offered a Greedy-based Backup Routing Protocol (GBR).This proposed algorithm was developed to arrive at high route permanence by considering the route length and linkage life time. It was used to build the main pathway such that every device believes the neighboring node to the destination inside its broadcast range as its next hop. To maintain local link stability in the network, GBR locally build backup pathway. As the greedy behavior of GPSR, it may possible that before sending the next HELLO signal, a node can go outside of the broadcast range of the node. Due to this there is no more signal or message transmitted. A. Zadin et al. [23] proposed a Greedy-based Backup Routing Protocol with Conservative Neighborhood Range (GBR-CNR) algorithm by modifying the GBR algorithm. Authors introduced a Conservative Neighborhood Range (CNR) and suggested that sending node will choose the next hop node that will not go outside the range of sender node before receiving the hello message and it is the closest node to the destination Node.[23,24] The CNR is identified by the conservative neighborhood transmission range Rc which depends on the node's velocity, the time interval between the HELLO message transmitted, and the actual transmission range value. Rc is calculated as –

$Rc = R − (Vmax)*t$ where R is the real transmission range, Vmax the maximum velocity of the device, and t is the time gap between two consecutive HELLO message transmitted. There is not as such a requirement to take the back up of the primary path A. Zadin et al. [25] proposed two new routing algorithms based on neighbors and the use of nodes. The basic idea behind the proposed algorithm is that when a node wants to send the data to another node, then node will prefer to select the next hop or receiving node that has less neighbors of surrounding. If we select the node with fewer neighbors then it will decrease the probability of corrupt data due to low traffic, low consumption of network resources and it will increase the throughput of the network. The algorithm is GBR-CNR with less number of neighbors (GBR-CNR-LN). Second variation was based on the approach that sender will select the next hop or receiving node who is involving less communication than other neighbor nodes even though node is far away to the destination. Less used node forwards the packet fast. This algorithm is GBR-CNR with the less used (GBR-CNR-LU).These two mentioned algorithms provide the minimization of interference

C. Cluster based routing for MANET:

In Pathak. S. [26] has proposed a comparative study of various clustering algorithm to find out stable cluster by minimizing cluster head changes. From the study it has been clearly indicated that minimizing cluster head changes will increase more robust cluster for MANETs.
Pathak. S. [27] has proposed priority based weighted clustering algorithm for MAANETs to minimize cluster head changes, clustering overhead and cluster member changes by using the concept of calculating priority of each mobile node.
Pathak. S. [28] has proposed an optimize clustering algorithm to prevent cluster head changes by using the concept

of backup node. In OSCA the node with highest priority will elected as cluster head and node with second largest priority will be elected as backup node.
Pathak. S. [29] has proposed a newel weight based clustering algorithm for MANETs where priority is calculated based on node degree and remaining battery power for each node.

III. PROPOSED WORK

In [25], the authors proposed the GBR-CNR with less neighbors (GBR-CNR-LN). This routing algorithm has different drawbacks, which are as follows –
1. The node with the less neighbor is selected from the neighbors.
2. If the contact time of the transmitting node and receiving node is less than the packet transmission time then the packet cannot be transmitted properly. It causes the loss of the packet.
3. There is no discussion about the stay time of the receiving node in the transmission range of the transmitting device.

These drawbacks pull the present algorithm in doubt. These drawbacks not only create the packet delay but also degrade the network efficiency.

To overcome the drawbacks of the GBR-CNR-LN algorithm, a new algorithm is proposed that is called the GBR-CNR with the Efficient Neighbor Selection Algorithm (GC-ENS Algorithm).

In the GC-ENS Algorithm, Each mobile node in the MANET is moving in the network with V-speed. Due to the variation in the velocities, the maximum velocity is taken Vmax. Each node has its location coordinate (x,y) in the simulation area. Each moving node has transceiver with a range. It is taken TRange in which the node can receive and transmit the messages.

When the transmitting node wants to transmit the packet, then it first checks the entire neighbors which are connected with it. Now from all of the neighbors, neighbors are selected that are in the transmission range TRange of the transmitting node. The packets have the packet transfer time TPktTr. Now the neighbor is selected from the several neighbors that are in transmission range called the minimum neighbor's node (MinNbsNode) which has the minimum neighbors. Now the stay time (TStay) is calculated between the selected neighbor node (MinNbsNode) and the transmitting node.

If the TStay is more than the TPktTr time then the selected node is an efficient node and the packet can be transmitted, otherwise, the next minimum neighbor's node is selected from the neighbors in the transmission range. The Efficient Neighbor Node is selected.

The GC-ENS algorithm provides a better way to select the efficient neighbor so that the packets can be properly transmitted. The proposed algorithm not only reduces the packet loss but also improve the MANET. The packets are not blindly forwarded to any minimum neighbor node. The node is checked on the time parameters.

Proposed Algorithm:	
Step 1:	Start
	[Input Section]
	Input values for:
Step 2:	Node Speed,
	location coordinate (x,y)
	&Transmission Range (T$_{Range}$).

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[Assignment Section]

Step 3:	Assigned Values For: Simulation area and V_{max}.
Step 4:	Packets transmission time T_{PktTr}.
Step 5:	Select minimum neighbor node (MinNbsNode) from the neighboring nodes with the transmission range.
Step 6:	Calculate stay time (T_{Stay}) between the selected neighbor node (MinNbsNode) and the transmitting node.

Step 7:	**If [T_{Stay}>T_{PktTr}]**
	Efficient Neighbor Node selected.
	Else
	Again select the minimum neighbor node (Min-NbsNode).
	End if

Step 8:	Transfer the packets.
Step 9:	**End**

IV. SIMULATION PARAMETERS

We are using a bounded region of 1000m*1000 m, in which we are placing nodes with a uniform distribution. The results are obtained for the various nodes such as 75,100,125,150,175,200. We are using signal speed as vacuum speed and node speed is 1-2 meter/sec. We evaluate our results through Python. The following table summarizes the simulation parameter used.

Table 1: Performance Parameters

| Name	Value
Simulation Area	1000 m X 1000 m
Transmission Range	250 m
Speed	11 Mbps
Signal Speed	3×10^8 m/sec
Node speed	1-2 m/sec
Number of Packet at each node	10
Packet Size	512 KB
Routing Protocol used	AODV
No. of Nodes	75,100,125,150,175,200

V. Results

The GBR-CNR with the Efficient Neighbor Selection Algorithm (GC-ENS Algorithm) is implemented. We have obtained three major results like End-to-End delay, Routing Overhead (the number of control messages transferred) and load on Network in MB.

The results are given in Table 2. End-to-End Delay refers the maximum time (in seconds or milliseconds) taken from the source device to the destination device for the successful transmission of a packet. As End-to-End Delay in GBR-CNR with an efficient neighbor selection algorithm (GC-ENS Algorithm) is less than End-to-End Delay in GBR-CNR with fewer nodes. So the proposed Algorithm is more efficient because it will take less time to send packets from source to destination. Table 2 explains that the Average End-to-End delay has reduced by 52.54%.

Table 2: End-to-End Delay in GC-LN and GC-ENS Algorithm

Nodes	Delay (GC-LN) in ms	Delay (GC-ENS) in ms
75	217.392	23.678
100	39.782	38.04
125	92.976	28.559
150	21.9175	11.219
175	176.02	112.183
200	32.1985	10.487
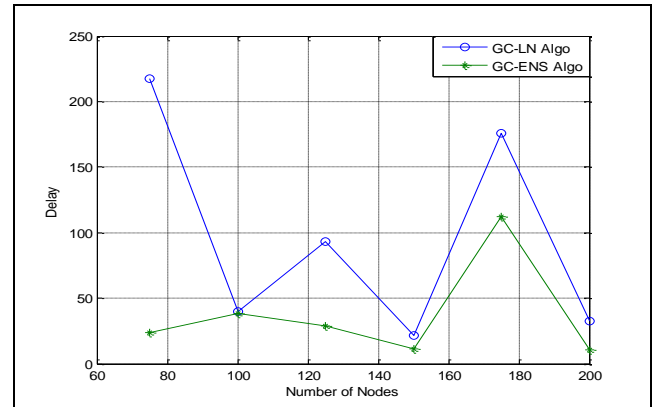
Fig 1: Comparative End-to-End Delay graph

The second parameter for compare proposed Algorithm with GBR-CNR less nodes algorithm is the Routing Overhead (total number of control messages transferred) to find a route and send data from source to destination. Thus, the higher the number of overhead messages transmitted, the higher the amount of energy consumed. It shows that due to fewer control messages transferred in the proposed algorithm, congestion and packet loss will reduce and the proposed algorithm will work more efficiently. So, the proposed algorithm (GBR-CNR Efficient Neighbor selection algorithm) consumes less power and energy than the GBR-CNR less nodes algorithm. Average Routing Overhead of the proposed algorithm has reduced 60.545% as a comparison to GBR-CNR with a less node algorithm. Table 3 and fig 2 shows that GC-ENS algorithm is much more Energy Efficient algorithm.

Table 3 Number of Control Messages Transferred (Routing Overhead) in GC-LN and GC-ENS Algorithm

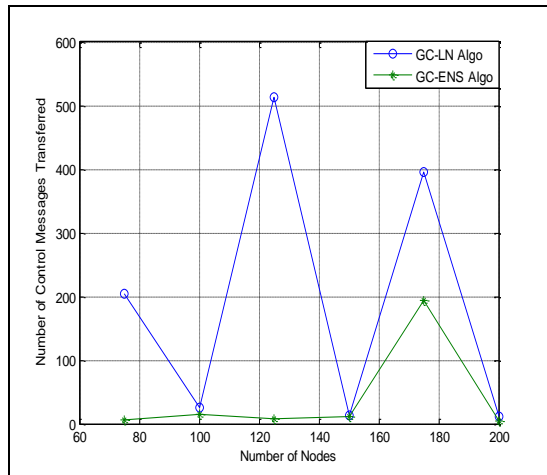| Nodes	No. of Control Messages transferred(GC-LN)	No. of Control Messages transferred (GC-ENS)
75	204	6
100	26	15
125	514	8
150	13	12
175	395	193
200	12	4

915

Fig.2 Comparative Number of Control Messages Transferred (Routing Overhead) Graph.

The third parameter to compare both algorithms is load on the network. It is the total size of packets (in MB) transferred uselessly in the network from source to destination. Table 4 shows that the GC-ENS algorithm will send and receive less packets so traffic on the network will reduce and simultaneously load on the network will reduce. It also decreases the congestion in the Network. The average load on Network had decreased 61.17% of the proposed algorithm (GC-ENS).

Table 4 Load on Network in GC-LN and GC-ENS Algorithm

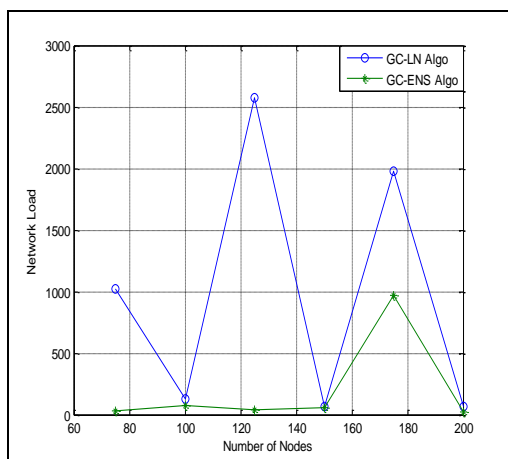| Nodes	Load on Network (GC-LN) in MB	Load on Network (GC-ENS) in MB
75	1024	30
100	130	75
125	2573	40
150	67	60
175	1976	967
200	62	20

Fig.3 Comparative Load on Network Graph

VI. CONCLUSION

A routing protocol plays an important role in networks. The properly designed algorithm not only improves the quality of services but also becomes more popular among the network providers. This work considers the problem of the selection of neighbors in the AODV routing protocol. The new technique for the selection of neighbors is proposed. The new proposed algorithm is GBR-CNR with the Efficient Neighbor Selection Algorithm (GC-ENS Algorithm). The proposed algorithm for neighbor selection is executed and the outcomes are achieved. In MANET, sender will send the data to its neighbor nodes. By this proposed algorithm, we will not send the data to all its neighbor nodes but we will send the data to only those neighbor nodes which are in the transmission range of the sender, which has minimum number of neighbor nodes and stay time of sender node should be more than the packet transfer time. The results compared with the previous algorithm. We have examined the GBR-CNR efficient nodes selection algorithm using Python with three parameters i.e. End-to-End delay, Routing overhead and Load on Network. A comparative analysis is performed which investigates that the proposed algorithm is giving better results in all three parameters. The main contribution of this paper is to select better neighbors than the previous algorithms during the finalize the route from source to destination. The proposed Algorithm (GC-ENS) decrease Average End-to-End delay 52.54%, reduce Average Routing Overhead 60.54% and decline the Average load on Network 61.17%. In the future, the new method based on the node information can be developed that will further enhance the MANET performance.

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