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Gateway Based Inter Cluster Flooding Scheme (GICFS) for Effective Data Transmission in Mobile Ad Hoc Networks

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Abstract:

In Mobile Ad Hoc Network (MANET), mobile nodes could interact with one another without any kind of architecture. Dynamic topology is the fundamental feature of MANET. Because of this behaviour in MANET, topology of network modifies periodically which results in the failure of efficient routes. Hence, process of identifying proper routes leads a evident failure in the entire network. In order to find a novel authentic path for the marked mobile node, proactive routing protocols utilizes ordinary telecast model known to be simple flooding. This model broadcasts route request (RREQ) packets from source to remaining nodes present in mobile network. Therefore, the demerit available is unequal recurring retransmission of RREQ packet that leads to greater contention on accessible channel as well as packet collision since higher traffic in the network. This paper introduces a Gateway based inter cluster flooding scheme (GICFS) for effective data transmission in MANET. GICFS techniques has the benefit of obtaining routing data only if routes are required. Besides, gateways only rebroadcast a packets from one gateway node (GN) to others to reduce useless re-communication, and providing the GN joins several CH. This method undergo extensive experimentation under diverse scenarios. The resultant values from simulation indicated the effective performance of the presented GICFS technique.

Index Terms—Broadcasting, Flooding, MANET, Routing

1 INTRODUCTION

Developing an effective router is a demanding operation in mobile adhoc network (MANET) [1, 2]. It consist of a path which is comprised with multi hops created by middle nodes available for transmitting the packets from the initial source to destination mobile nodes. Some of the exclusive features such as dynamic topology, resource sharing and mobility, would make the routing operation a challenging task. Due to regular transformation of nodes, there is a maximum dynamic topological networks where the path failure occurs continuously. Since there is a distributed wireless channel, mobile nodes are associated with less and varied number of bandwidth. It assist communication process among the mobile nodes; finally, this would influence data packet transmission and might cause a reasonable loss in throughput. Thus, routing protocol should be developed in such a way of adapting the dynamic topology of network with a ability to decrease request packet transmission across data packet transmission. It could improve the size of bandwidth

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in order to perform the transmission operation in an efficient manner. Consequently, MANET includes variable ID of optimal and efficient routers [3, 4] over a many years. Based on the process of route identification as well as routing table update, routing protocols of MANET is divided into 3 types: proactive, reactive and hybrid driven protocols (integration of proactive and reactive techniques).

As mentioned in [3, 4], proactive techniques usually manages the revised and exact data regarding the valid routes form every competing mobile nodes to alternate nodes of present network [5]. The process if improving topology of routing patterns is telecasted for whole mobile network on each periodical time to maintain the reliability of MANET. Supervising the modern data from mobile nodes to residual nodes of network would be a merit for these kind of protocols [6]. Using this advantage, table driven protocol could remove the basic delay that occurs during the selection of routers for transmitting data. An efficient route would be finalized rapidly by acquiring information from modernized routing table. Hence, it has some disadvantages like originating more quantity of control packets to carry out regular updates in table compared to communicating data packets [7-10].

As discussed in [11, 12], on demand routing techniques create a valuable path form initial mobile nodes to final nodes by functioning of easy flooding of RREQ packets obtained from the source to other residual nodes of the network whenever it is essential. If there is no requirement for a router to activate the communication the reactive protocols would not perform the process of discovering new routes. Thus, the identified route is supervised with the help of few rules and patterns once the acknowledgement (RREP) is received from routing establishment. Based on the comparative results of proactive routing techniques, utilities employed by these protocols are very less for updating the routing table. Protocols belonging to these types consume more amount of time to identify a valid path, that results in longer latency for initiating the data packet transmission. Ad Hoc On-Demand Distance Vector(AODV) [11] and Dynamic Source Routing(DSR) [12] both are familiar and regularly utilized protocols present in reactive routing protocols. [13] described that routing protocols integrates the characteristics of proactive as well as reactive principles. Subsequently, these types of routing techniques divides the entire network to a set of clusters, which is said to be regions. Proactive routing is computed within the zone also is carried out within a region is liable to the procedure of finding novel paths and handle the actual routes in intra region. Simultaneously, reactive routing is operated among the clusters. Each cluster would be handled by a single mobile node of specific zone called as cluster head (CH).

Broadcasting is a simple and primary operation performed in MANET where similar data is transmitted from source node to residual nodes in the network [16]. Since it contains only restricted amount of radio ranges, MANET has the multi hop behaviour [17]. Therefore, packet which is transferred from efficient source nodes could not attain the goal in one-hop [18]. Hence, few nodes are in need of forwarding the transmitted packets to the receiver and is called as intermittent nodes. The procedure of selecting intermediary node is a crucial factor since the node employ a beneficial resource of network such as energy and bandwidth. By this selection, it would minimize the redundant nature in packet forwarding operation [19-21]. Two models that is applied in broadcasting in terms of physical layer, like one-to-many (source transmitted packet would forwarded to alternate neighbour nodes of primary node) adjacent nodes are that is below the communication region of source node and 1-to-1 method, where source transmitted packet would be provided to particular neighbour. In [14], broadcasting process consist of merits in terms of network layer. Therefore, broadcasting technique in MANET is treated as an optimal determination for many other protocols in network layer. It facilitates many other services, namely pagination of a node, forwarding packets for the entire mobile network, managing network, controlling overhead, route

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identification and maintaining process.

A considerable number of broadcasting is supported by few principle like probability, counter, position and neighbour based routing. Probabilistic based routing technique consist of intermediary nodes which is transmitted to corresponding neighbour on the basis of permanent possible value. A probabilistic based routing technique is introduced which is termed as dynamic probabilistic route discovery. Hence, mobile nodes could estimate the relaying data packet in aggressive manner also it is performed with the help of probability function that is depending upon the number of local neighbours as well as increasing number of its neighbours.

This paper introduces a Gateway based inter cluster flooding scheme (GICFS) for effective data transmission in MANET. GICFS techniques has the benefit of obtaining routing data only if routes are required. only GNs rebroadcast packets among clusters (hierarchical group). Besides, gateways only rebroadcast a packet from single gateway node (GN) to other to reduce useless re-communications, and providing the GN joins a several CH. This method undergo extensive experimentation under diverse scenarios. The resultant values from simulation indicated the effective performance of the presented GICFS technique.

2 GATEWAY BASED INTER CLUSTER FLOODING SCHEME (GICFS)

A new gateway technique is presented in MANET called Gateway based inter cluster flooding scheme (GICFS). The GICFS techniques has the benefit of obtaining routing data only if routes are required. GICFS has the subsequent characteristics: Initially, it enhances the conventional routing techniques, dependent on non-position based techniques by utilizing the location data given with GPS. Then, it reduces flooding of Location Request (LREQ) packets. Flooding commands to manage traffic due to the application of chosen nodes, referred as gateways, for disseminating LREQ communications. The functions of GN is to reduce the flooding of transmit communications through decreasing copy re-communications in the same area. Member node is exchanged into gateways while they obtain communications from in excess of one CH. All the CM read and development the packet, although do not rebroadcast the broadcasted communication. It automatically decreases the number of re-communications in a flooding or transmits process in heavy network. Then, GNs rebroadcast packets among clusters. Besides, gateways rebroadcast a packet from one GN to other to reduce useless re-communications, and providing the gateway joins a several CH.

Excepting general Hello communications, the technique cannot create further manage traffic in reply to connection inclusion and losses [15]. Accordingly, it is fitting to networks through maximum measures of geographic alteration. Since the protocol maintains only the position of the data of the [source, target] pair in the MANET, the protocols are specially fitting to huge and heavy networks through very high mobility. The protocols are also planned for work in an entirely shared approach and do not based on some central entity. The protocols do not need dependable broadcast to it's manage communications, as every node sends it's manage communications regularly and thus, continue some packet failure. It is essential in radio networks, where deep fade is probable. This technique we present in this study do not functions in a source routing approach [11]. Instead, it acts hop-by-hop routing as every node utilizes its mainly current location data of its nearby nodes for route a packet. So, if a nodes are moving, its positions are recorded in a routing table in order that the progresses could be expected that are essential for accurately direct the packets for the subsequent hop for the target.

2.1 Protocol functions of GICFS

Gateway based inters cluster flooding scheme (GICFS) performs several purposes which is required for act the task of routing. This section would propose some of the purposes of the

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technique.

2.2 Neighbour sensing

Every node has to identify the nearby nodes through that it holds straightforward connection. To achieve this, every node regularly transmits a Hello communication, including its location data, address and status. These manage communication is addressed in transmit mode and obtained with every one-hop nearby, however they are not transmitted for some extra nodes. A Hello communication includes the subsequent data:

- Node Addresses,
- Node type (Undecided, CM, GN or CH) and
- Location.

2.3 Operation of Gateway based inter cluster flooding scheme (GICFS)

GICFS have to contain one CH, extra members in each cluster, and more than one gateway, to transmit by alternate CHs. Every CH protects a "Cluster Table," that is described as a table which have to transmit and geographical locations of CM and GNs. They are affected as every node could compute their locations with GPS or several local coordinate scheme. If a transmitting node efforts sending information for the target, it initial looks its routing table for resolving it when it discerns the position of the target. When it occurs, it transmits the packet for the nearby neighbours for the target. Else, the basis accumulates the information packet in the buffer, begins with a timer value and transmits Location Request (LREQ) packets. Only GNs and CHs rebroadcast the LREQ packets. GNs only rebroadcast a packet from one GN to others for reducing useless re-communications, and only when the GN joins several CHs.

Upon receiving a location request, every CH verifies looks on when the target is a CM. If it is yes, it will trigger a Location Reply (LREP) packet which proceeds for the transmitter utilizing geographic routing, as every node knows location as well as nearby neighbours, dependent on the data obtained from the LREQ and the neighbour sensing method. Loss triggers re-communication with the CH for neighbouring CHs, where the target addresses are registered in the packet. CHs and gateway, consequently, remove LREQ packets as they have formerly approached. After the source reach the target, it obtains the information packets from the buffer and transmits it for the nearest neighbour for the target. Actually, the technique consists of four phases:

- Cluster construction
- Discovering Location (LREQ and LREP).
- Data Routing
- Maintaining location details.

2.4 Formation of clusters

The GICFS technique introduces with initial cluster formation. If the transmissions has begun, each node initialized as idle, executes a time unit, and transmits a Hello communication. When an idle node obtains a Hello communication from a CH previous to end the timer, it develops into member. Otherwise, it develops into CH. The CH is responsible to the clusters and has to transmit a Hello communication regularly. If the member obtains a Hello communication, it records the CH and replies through the respond Hello communication. The CH then informs the cluster table by the addresses and positions of each CM. If the CM obtains Hello packet from various CH, it initial records the CH and alters its position for a GN and transmits the recent data for the CHs. Subsequent to obtaining the Hello packet, the CH informs the Cluster Table by the recent data. When the transmitter source needs sending a communication for the target, it begin verifies the routing table for resolving if it holds a "recent" route for the target. When it exist, it starts to search in the cluster table to resolve the nearby neighbour for the target. Otherwise, it begins the location detection method.

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2.5 Discovery Location

If the sources of the information packet needs for broadcast for targets which are not contained in its routing table, or if their routes have ended, it initially put the information packets in its buffer and transmits a LREQ packet. When a CH obtains a LREQ packet, it verifies the recognition fields of the packet for resolve if to see before the LREQ packet. It removes the packet. Otherwise, when the target node is a CM, it will unicast the Location Reply (LREP) packet. When the target nodes does not comes under a member of the CH, it initial registers the address of the LREQ packet in its record and retransmits the LREQ packet to nearest CHs. Every CH node leading the packet only once. The packet is transmitting only for the nearest CH through an omni-directional antenna which route them using the GNs. GNs only rebroadcast a packet from one GN for other GNs to reduce useless re-communications, and providing the GN joins various CHs. If the CH target obtains the LREQ packet, it registers the source address and location. From this, the target's CH could resolve the position of the basis node. The target subsequently transmits a LREP communication reverse for the source using its nearby neighbouring node.

At last, the packet will reach the basis node which created the REQ packet. When the basis node do not obtain some LREP after transmitting out a LREQ to a set duration time, it exits into an aggressive backoff previous to rebroadcasting the LREQ. Thus, a single packet is broadcasted reverse for source nodes. The REP packet do not need preserve a routing paths between source and destination, and the ways are resolved from the location data provided with the basis node. It is essential noting that which the route crossed with the LREQ can be travel with the LREP.

2.5 Routing of Data Packets

The real routing of information packets is then dependent on the position of source, target and neighbouring nodes. As the protocols are not dependent on basis routing, a packet will travels in the way from source to target dependent on positions. The packet will discover the ways for the targets separately every time they broadcast among the starting point and target. Packet is broadcasted dependent on the information of their related positions. Furthermore, as the broadcasts are the course of the target nodes, the way determined would be lesser than in another routing techniques. In non-positional dependent Routing approaches, the shorter ways are rated in hops. So, the route found could not be the shortest, although the way found utilizing location data would be automatically shorter. When the source of the information packet does not obtain the acceptance packet previous to end the timer, it will rebroadcast the information packet again. This condition can take place through packet failure because of dropping out or network disconnection.

2.6 Maintenance of location details

The GICFS techniques are fitting to networks through extremely quick mobile node as it protects and informs the positional data of the source and target always the pair transmits or obtain information and acceptance packets. The source informs its location data previous to send every information packet. If the target obtains the information packet, its location data are informed and acceptances are sent for the source.

2.7 Forwarding strategy

GICFS utilizes MFR as its forwarding approach. In MFR, the packets are transmitted for the neighbour through the best development for the target. The advantages of these techniques are: to minimize the possibility of delay and collision among the source and target [16].

3 PERFORMANCE VALIDATION

3.1 Experimental Setup

A verification of the results takes place to ensure the optimal feature of the introduced GICFS technique in MANET corresponding to many other aspects.

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The simulation variables included in this experiment are shown in Table 1.

TABLE 1
UNITS FOR MAGENTIC PROPERTIES

Parameter	Value
No. of nodes	100
Area	1000x1000 m2
Communication range	250m
CBR data rate	24 Mb/s
Time space of hello packets	1s

Subsequently, a set of evaluation variables are employed to investigate the results are packet delivery ratio (PDR), routing overhead (RO), end to end (ETE) delay and routing load (RL). For comparing the performance of the presented model, a set of three models are applied such as AODV, CBF2S, D2FS and LORA_CBF.

3.2. Results and Discussion

Fig. 1 illustrates the examination of various methods corresponding to different HC by means of RO. Based on the relative principles, AODV represents poor simulation outcome under RO as amount of hop gets extended. If there is an absence of transitional node, RO could be attained with the help of 25000 packets. The LORA_CBF model achieves almost equivalent RO as AODV. At the same time, even number of hops, the CBF2S model express manageable solution using less RO of 12K packets. Next, D2FS offers better solution over all the compared techniques except the presented GICFS technique. For example, while the hop count (HC) is similar to 3, then AODV attains extreme poor function by maximum RO of 34 packets. The CBF2S model helps in representing minimized overhead using 12.5K packets for RO. Hence, the D2FS method reaches very low RO of 10.8K packets which is similar when there is absence of intermittent nodes. Interestingly, the presented GICFS technique exhibited effective results with the minimal overhead of 8K packets. When the HC is seven, AODV attains extreme RO of 41K packets. It keeps few degrees to implement the equal RO which leads to small proposed procedure that accomplish LORA_CBF for few degree to exhibit the identical RO, that achieves irrelevant RO of 11.6K packets. Although CBF2S method shows gradual outcome associated with RO of 13.5K packets, but the D2FS method outperforms it. However, the presented GICFS technique exhibited effective solution with the minimal overhead of 8K packets. Depending upon this, number of hops get improved, projected technique bear with identical RO and display extended execution over other models.

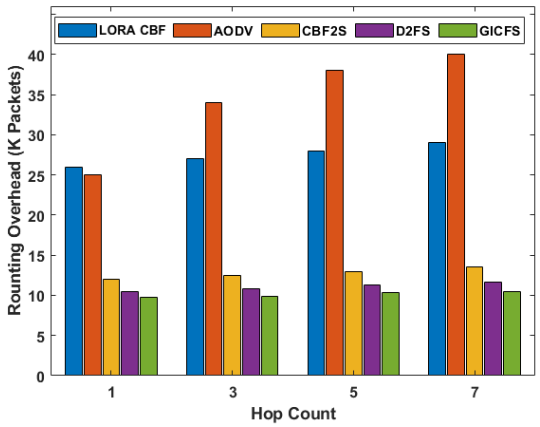

Fig. 1. Comparative analysis in terms of RO under varying HC

Fig. 2 states relevant consequences of different routing techniques in case of modifying HCs with respect to overhead. Based on the examined patterns, AODV and LORA_CBF denotes inefficient solutions in every model of overhead as quantity of intermediate node increments. When HC is 1, overhead required by AODV and LORA_CBF is 98 packets. On the basis of similar HC, the CBF2S and D2FS contributes 99 and 97 packets. Next to that, the presented GICFS technique exhibited effective results with the minimal overhead. If the HC is three, then AODV and LORA_CBF achieves terrible and similar implementation measures by achieving greater overhead of 97 packets. The

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previous CBF2S model exhibits gradual results with the lower overhead of 95 packets. Therefore, D2FS model attains least overhead of 102 packets whereas the GICFS model requires a minimum overhead of 101 packets. At the point when HC is seven, the AODV technique reach the most extreme overhead of 99 packets. The LORA_CBF achieves 96 as overhead; it falls across the presented strategy which accompanies negligible overhead of 91 packets. Followed by, the quantity of HC increases, this method signifies major reduction in overhead, subsequently shows the proficient implementation while comparing with alternate techniques.

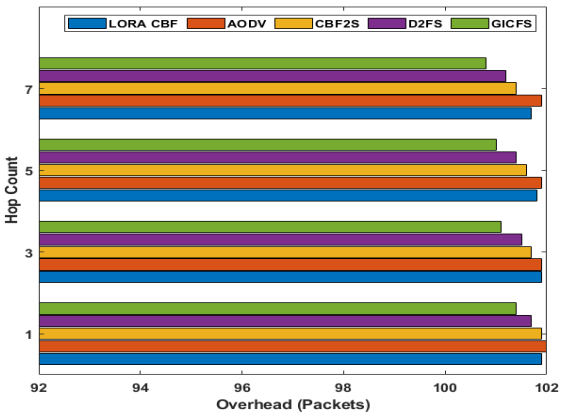

Fig. 2. Comparative analysis in terms of overhead under varying HC

Fig. 3 depicts identical analyzing of diverse routing techniques in terms of altering HCs by ETE delay. By comparing these techniques, the AODV exhibits low results for ETE delay as the amount of HC increases.

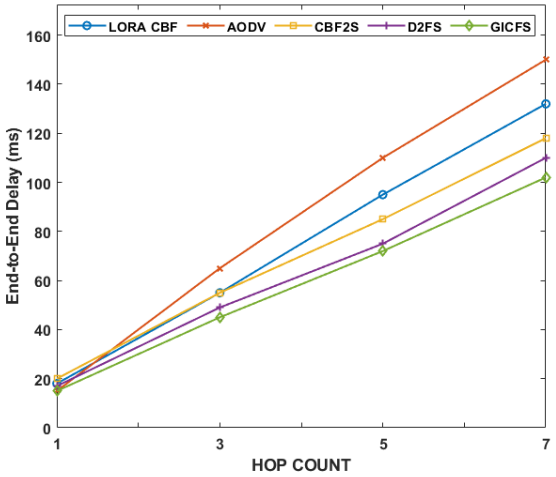

Fig. 3. Comparative analysis in terms of end to end delay under varying HC

If there is no half way nodes present, the ETE delay reached by AODV in 16ms. The LORA_CBF approach attains most equivalent ETE delay rate. Under same HC, the CBF2S attains a lower ETE delay of 20ms, D2FS technique offers slightly higher ETE delay of 17ms. Interestingly, the presented GICFS technique exhibited effective results with the minimal ETE delay of 14ms. When HC is three, the AODV accomplishes very poor results by attaining the increased ETE delay of 66ms. The LORA_CBF and CBF2S achieves the most minimized and identical ETE delay of 54ms, which is displayed when there is absence of middle nodes. In a similar way, the D2FS model achieves small ETE delay around 49ms. Fascinatingly, the presented GICFS technique exhibited effective results with the minimal overhead of 42ms. When HC is equal to seven, the AODV procedure achieves the higher ETE delay of 152ms. The LORA_CBF to some degree records to represent the ETE delay of 133ms, it fails in showing enhanced results considering the proposed method which accomplish negligible ETE delay of 101ms. Similarly, when the quantity of intermittent node improves, the projected model comes with comparative ETE delay.

Fig. 4 states that the relative results of different models using shifting HCs on the basis of RL. Based on the examined strategy, the techniques

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AODV and LORA_CBF implies inefficient results rather than alternate models for RL since the amount of HC gets upgraded. While HC is 1, the routing burden for AODV and LORA_CBF is 250 packets. Based on the identical HC, the proposed technique contributes just 114 packets. When it is three, the AODV gains the rate by achieving higher RL of 500 packets. The LORA_CBF stores for executing the completed range; however, it is rejected to succeed the proposed strategy. Hence, it accomplish the minimum RL of 120 packets across alternate methods.

Here, while HC is seven, the AODV method attains maximum RL of 1060 packets. The LORA_CBF accomplishes maximum RL of 275 packets whereas the CBF2S reaches nearly lower RL of 180 packets. Simultaneously, the proposed technique achieves trivial RL of 155 packets. Thus, the size of HC improves, the proposed strategy denotes lower RL, exhibiting efficient projection when compared with the other techniques.

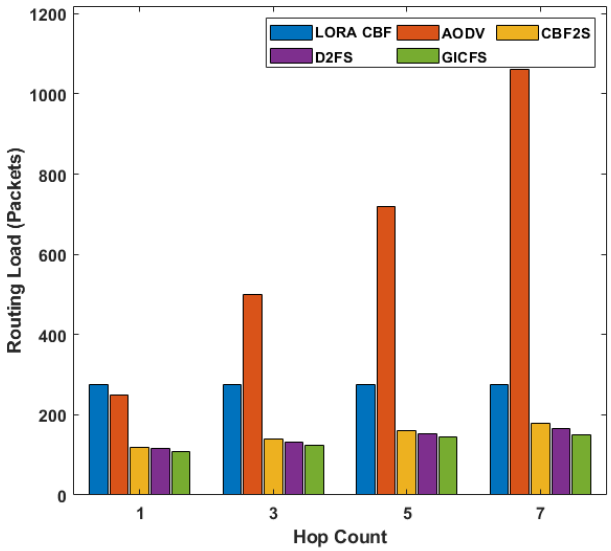

Fig. 4. Comparative analysis in terms of RL under varying HC

Fig. 5 illustrates the comparative examination diverse models in terms of altering HCs under PDR. Generally, proposed strategy attains the higher PDR when the intermittent rate is maximum. While HC of 1, the AODV technique very low that profits diminished PDR of 98, while the LORA_CBF, D2FS and proposed strategy achieves most comparable PDR of 100. For the HC of 3, AODV reaches the minimum PDR rate of 68 and the LORA_CBF gains PDR of 84. The proposed model obtains the equivalent PDR rate of 100. For the HC of 7, better PDR rate is acquired by AODV gaining PDR rate of 38 while the LORA_CBF achieves 75 as PDR rate. Even through the HC is increased, maximum PDR rate of 100 is defined by the proposed model. In every case, the proposed technique is effective when compared to other models by means of several dimensions.

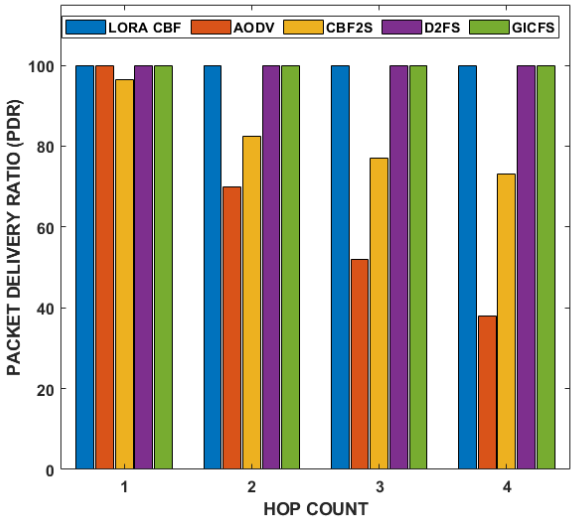

Fig. 5. Comparative analysis in terms of RL under varying HC

On looking into the above experimental outcomes, it is evident that the presented GICFS technique offers maximum performance with the minimum RO, minimum ETE delay and maximum PDR. These values indicated that the presented model can be employed as an effective flooding scheme for data transmission in MANET.

4 Conclusion

This paper has introduced a new GICFS technique for effective data transmission in MANET. GICFS techniques has the benefit of obtaining routing data only if routes are required. This method undergo

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extensive experimentation under diverse scenarios. On looking into the above experimental outcomes, it is evident that the presented GICFS technique offers maximum performance with the minimum routing overhead, minimum ETE delay and maximum PDR. These values indicated that the presented model can be employed as an effective flooding scheme for data transmission in MANET. The resultant values from simulation indicated the effective performance of the presented GICFS technique.

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