Improved Route Discovery Schemes for Reactive routing protocols of MANET

Sanjay singh kaurav[1] Umesh barahdia[2] Manoj jakheniya[3] S S Dhakad[4]
[1,2,3]Assistant Professor [4]Research Scholer
[1,2,3,4]Nagaji Institute of Technology & Management, *Gwalior* (M. P.)

Abstract— Ad-hoc wireless networks due to their rapid and economically less demanding deployment, find applications in many areas. Ad-hoc networks can be very beneficial in establishing communication between various groups running numerous applications in an area where setting up of a stable infrastructure may not be possible. An ad-hoc wireless network contains of a set of mobile nodes linked by wireless links. The topology of these network changes randomly. A range of routing protocols for ad-hoc wireless networks has been proposed in the previous reactive, proactive and hybrid. In this work we have clarified different -2 techniques to improve reactive routing protocols like AODV and DSR.

Key words: Application Cluster, AODV, DSR, OLSR, OPNET.

I. INTRODUCTION

MANETs are communication networks made up by a collection of mobile devices which can communicate over wireless connections. Routing is an important one in ad hoc networks, which defines directing data packets from a starting node to destinations. Due to the dynamic topology and absence of central administration, routing reflects as a complicated process in ad hoc networks. Hence, routing algorithms should be strong and adaptive in a self-organizing and decentralized way. Due to the nature of mobile ad hoc networks it is non-trivial problem to discover path from source to the destination and makes communication between nodes for a extended period of time.

A number of routing protocols using a range of routing techniques have been proposed for use in MANETs .Ad hoc On demand Distance Vector Routing, Dynamic Source Routing, Temporally Ordered Routing Algorithm [3], Location Aided Routing [4] (in which nodes maintain or search for a route only when route is desired), and periodic (proactive) protocols such as Destination Sequence Distance Vector[5], Distributed Bellman Ford [6] (in which nodes periodically share routing information and then can always identify a current route to each destination). Also, many protocols using both reactive and proactive mechanism such as Zone Resolution Protocol [7], Cluster Based Routing Protocol[8]. The basic impression of on-demand routing protocols, is that a source node sends a route request and creates routing decision based on received route reply, which may be directed by destination or enter mediate node. On-demand routing have many advantage, such as simplicity, flexibility and correctness.

In conventional on-demand routing protocols [2], a node determines routes to a particular destination, by broadcasting a Route Request packet. Upon getting the RREQ, the node checks whether or not the packet has been formerly received. In case of packet has been received formerly the node will drop the packet, otherwise the node will checks whether it has a route to the destination, if yes, the node will send back Route Reply to the source node; else the node will rebroadcast the RREQ to its immediate neighbors until the destination is found. This technique of route discovery is denoted as blind flooding. Every mobile node rebroadcasts one duplicate copy of received RREQ, so the maximum number of rebroadcasts is identical to N – 2, where N is the number of nodes in the network. This can potentially lead to extreme redundant retransmissions thus high channel contention and causing extreme packet collisions in thick networks. Such a\ phenomenon is refried to as broadcast storm problem [10], which significantly raises network communication overhead and end-to-end delay [10, 11]. To decrease the effect of blind flooding, a number of broadcasting techniques have been advised in [10-13].

Many approaches are offered to improve flooding performances which are based on decreasing the number of redundant messages. In Candidate Neighbors to Rebroadcast the RREQ for efficient flooding in Mobile Ad hoc Network nominated neighbors are permitted to re broad cast RREQ packets from different zones .

II. REACTIVE ROUTING PROTOCOLS

An ad hoc routing protocol is a standard or convention, that controls how nodes choose which way to route packets between computing devices in a mobile ad-hoc network. Routing protocols on which this study has been done are clarified in this section.

A. Dynamic Source Routing (DSR):

DSR is an on-demand reactive routing protocol intended to restrict the bandwidth spent by control packets in ad hoc wireless networks by removing the periodic table update messages required in the table-driven method. The major difference among this and the other on-demand routing protocols is that it is beacon-less and hence does not need periodic hello packet (beacon) transmissions, which are used by a node to notify its neighbors of its presence. The basic approach of this protocol (and all other on-demand routing protocols) throughout the route construction phase is to establish a route by flooding Route Request packets in the network. The destination node, on getting a Route Request packet, replies by sending a Route Reply packet back to the source, which brings the route traversed by the Route Request packet received. Source routing prompts the source transmission node to get an ordered list of intermediate nodes which would combine the complete route to the destination node. Each node keeps a route cache. Whenever a source node needs to transmit a packet, it first checks its route cache for a route to the destination node. In case it is found, the node uses that one found. In case the node does not find any effective route to the destination, it starts the route discovery process. In the route discovery process, the source node broadcasts a Route Request packet, which is flooded over intermediate nodes. Nodes without route to the destination attach their addresses to the RREQ packet and rebroadcast it until it reaches the destination node or an intermediate node with a effective route to the destination. Then, it rejects the RREQ packet received. The destination node (or the intermediate node with a effective route), upon received the RREQ packet, directs a Route Reply (RREP) packet to the source. It holds the complete route from the source node to the destination one.

B. Ad-hoc on demand distance vector (AODV):

Ad-hoc On-demand distance vector is alternative variant of classical distance vector routing algorithm, a mixture of both DSDV and DSR. It shares DSR's on-demand characteristics hence determines routes whenever it is desirable through a similar route discovery process. However, AODV adopts traditional routing tables; one entry per destination which is in contrast to DSR that keeps multiple route cache entries for each destination. The primary design of AODV is undertaken after the experience with DSDV routing algorithm. Like DSDV, AODV offers loop free routes while fixing link breakages but unlike DSDV, it doesn't need global periodic routing advertisements. AODV also has additional significant features. Whenever a route is open from source to destination, it does not increase any overhead to the packets. However, route discovery process is only started when routes are expired and/or not used and consequently discarded. This approach reduces the effects of stale routes as well as the requirement for route maintenance for unused routes. Another individual feature of AODV is the ability to offer unicast, multicast and broadcast communication. AODV uses a broadcast route discovery algorithm and then the unicast route reply massage.

III. SCHEMES TO IMPROVE REACTIVE ROUTING

Several schemes have been suggested to reduce the effect of the broadcast storm caused by simple flooding [12, 13]. Those schemes can be categorized into four categories: probability-based methods, neighbor knowledge methods and area based methods, Counter-based scheme.

(1)Probability-based methods: Reference [10] offered two methods to decrease the number of rebroadcasts: the counter-based scheme and the probabilistic scheme. The probabilistic scheme is likely to the simple flooding, not including that the nodes rebroadcast the RREQ with a predetermined probability p.

(2)Counter-based scheme: In the counter-based scheme, upon getting a previously unseen broadcast message, the mobile node initializes a counter with a value of one and set a random defer time. Due to this deferring time; the counter is increases by one for each redundant message received. If the counter is less than a predetermined threshold, when the deferring time pass away, the message will be relayed. Otherwise, it is simply discarded.

The probability-based and the counter-based methods are simple, but their performance depends on the variation of network thickness. This is due to the values of the probability and the counter threshold that are distinct regardless of the variation on the network environment.

(3)Area-based methods: The area-based methods consist of the location-based scheme and the distance-based scheme. It highlight on how much more supplementary area (than the area enclosed by the previous broadcast) can a node propose if it rebroadcasts the message.) Within the node transmission range, the longer distance from the earlier broadcasting node, the additional coverage can be acquired causing in more opportunity to reach more nodes. The relative distance between neighboring nodes is estimated either by received signal strength in distance-based scheme or pre acquired location information of neighbor by location tracking devices such as the Global Position System in location based scheme.

EFPA [15], the author offered an efficient flooding algorithm, which creates a small number of packet transmissions in a short time. EFPA [15] allocates a precedence of packet transmission or a waiting time to every node considering the distance from a sender node and the direction of packet transmission, so every node in a network can get packets rapidly.

Our proposed scheme is based on the area based methods where the exact position of node is determined using GPS.

A. N hop knowledge methods:

The N hop knowledge methods generally utilize the one-hop or two-hop neighborhood information to decrease redundant transmissions. The neighborhood information is gained by periodically exchanging "HELLO" messages between neighbor nodes. In [16], T.D. Le and H. Choo suggested the concept of 2- hop backward information to be used for reducing the number of forwarding nodes and minimizing the collisions in the network.

IV. SOME VERY IMPORTANT METHODS BASED ON THESE FOUR METHODS

A. Cluster based scheme :

The AODV is one of the reactive routing protocols most usually used in MANETs. Although the AODV protocol executes well with mobile nodes, it incurs high overhead with a growth in the network's size, the nodal degree or the amount of communicating source-destination pairs. By using AODV maintenance mechanisms and route construction, clustering architecture can be created on demand.

Clusters are preserved when data are to be sent. Such an integrated routing and clustering scheme can increase throughput and decrease routing overhead. The two main contributions of this paper are: (a) we propose a clustering architecture based on an extended AODV routing protocol for cluster creation, purging and maintenance operations; and (b) we propose an adaptive Cluster-AODV routing protocol that uses AODV and clustering information for rapid route discovery, packet delivery and maintenance.

B. Cluster Management :

A clustering architecture provides fault tolerance and network scalability, and results in more effective use of network resources. It can be used for resource administration, location and routing management to decrease computational and communication overhead. In this section, we discuss cluster formation and maintenance mechanisms.

Clustering Algorithm Design Goal We intend to integrate clustering with routing functionalities. The key design goals of our clustering scheme are:

(1) The algorithm should use a routing protocol's control messages for cluster formation with minimal overhead.
(2) The algorithm must operate in localized and distributed manners and interoperate with nodes running only AODV.
(3) The algorithm must incur minimal cluster formation and maintenance overhead and support on-demand cluster formation.
(4) The algorithm should minimize network-wide flooding and be scalable.

Our proposed scheme constructs or updates clustering architecture only when clusters' service is needed. The on-demand nature emanates from the demand driven nature of the AODV the scheme is based on. Nodes that take part in clustering are known from topological information maintained in the CHs and individual nodes.

C. Cluster Formation:

The main purpose of clustering is to use the network resources more efficiently, enhance availability, reduce overheads and provide scalable architecture [23, 24, 30].
The choice of a clustering algorithm affects the clusters' stability. Our proposal divides the network into several two-hop clusters. In each cluster, a node can play one of five roles: cluster head, ordinary node, secondary cluster head, gateway or undecided node. A gateway is a node that can directly communicate with two or more clusters.

In each cluster, a cluster head (CH) is elected and responsible for cluster maintenance and inter-cluster and intra-cluster communication. A Secondary Cluster Head (SCH) is also elected to avoid the CH from becoming a bottleneck [21]. The SCH stores backup routing and cluster information. This role is rotated between other ordinary nodes. Its election does not require extra overhead because any node that wishes to serve as a SCH notifies only the CH and the CH informs other members of the cluster. In addition to a routing table, every CH maintains two tables, an intra-cluster node table and a k-hop cluster table. The intra-cluster node table contains the IDs of all nodes within a cluster. The k-hop table stores the IDs of the CHs of all other clusters located in a 2-hop neighborhood. The CHs are coordinators in each cluster and they store shared information. Every node periodically broadcasts a hello message to maintain information about its neighbors. To reduce periodic broadcasting overhead, new nodes or undecided nodes can learn their nearest CH on demand by sending a cluster head request packet. These nodes then act as either an ordinary node or a gateway based on its current location.

D. Cluster Head Election:

Several distributed algorithms were proposed for CH election in MANETs [18, 19, 23, 25, 27, 30]. Chiang et al [2] have shown that the Lowest ID (LID) algorithm performs better than the cluster head election algorithms based on Highest Connectivity (HC).

The proposals in [27, 30] use multiple criteria for CH election. Because a cluster head is responsible for cluster maintenance and intra-cluster and inter-cluster communication, it is expected to function for a long period of time once elected.

Nodal mobility and link failure are the main causes of cluster head re-election and cluster membership changes.

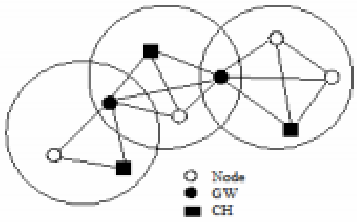

Fig. 1: CH election

In [25], a mobility-based clustering algorithm for clustering was proposed. In this algorithm, a node is elected as a cluster head only when its mobility index is below a certain threshold. The mobility index is computed based on cluster membership changes and the number of cluster head changes. In situation of a tie, the node with the lowest ID is chosen. In our cluster election algorithm, the lowest ID clustering is initially used for cluster formation. Thus, a node is elected as a CH if it has the lowest ID. This forms initial node configuration. Later on, a node with a lower mobility index than its neighbors [25] is used as a criterion. For example, in Fig. 1, each node broadcasts its mobility information to its neighbors during the cluster head election phase. After collecting information from neighbors, each node checks whether it has the lowest mobility index. Once it confirms this, it sets itself as a cluster head and notifies its neighbors.

E. Cluster Maintenance:

There are two parts to cluster maintenance: intra-cluster maintenance and inter cluster maintenance.

1) Intra-cluster maintenance:

In order to keep the neighbor table and CH Information consistent, nodes broadcast and exchange hello messages periodically. A hello message contains information about a node's ID and roles. If no hello message is received from a neighbor during the ALLOW_HELLO_LOST interval, the neighbor is considered lost and is removed from the neighbor table. An ordinary node checks its neighbor table to verify whether a CH still exists. If a node finds that no CH exists, a new CH will be elected in the neighborhood. If a CH fails, local maintenance is carried out.

2) Inter-cluster maintenance:

Each cluster head maintains a K-hop cluster table, which contains all k-hop CHs alive in a network. Each CH notifies other neighbor CHs that it is still alive by sending a Head Alive message. A CH, say, CH1, receives a Head Alive message from another CH, say, CH2. If CH1 finds out that CH2 already exists in its CH table, CH2's expiration time will be updated.

Otherwise, a new CH entry of CH2 will be inserted and its expiration time will be set by adding the CH update time to the recent time. If no Head Alive message is received from a cluster head during a HEAD_UPDATE_INTERVAL interval, that cluster is considered inaccessible. If no Head Alive message is received during an ALLOW_HEADALIVE_LOST interval, the CH is considered unavailable and removed from CH table.

F. CNRR Approach /Base Approach:

An Efficient Flooding Algorithm has been proposed in CNRR that makes use of the nodes' position to rebroadcast the packets and efficiently spread the control traffic in the network. The offered algorithm is applied on the route discovery process of Ad-hoc On Demand Distance Vector (AODV) protocol to reduce the number of propagating Route Request (RREQ) messages. The RREQ has been reformed by assigning a list to the RREQ contain fourth Candidate Neighbors to Rebroadcast the RREQ (CNRR).

The aim of this work is to design an efficient flooding algorithm for mobile ad hoc network to improve the network performance by eliminating the redundant retransmission, therefore reducing the chances of contention and collision among the neighboring nodes. This can be achieved by involving a specific set of nodes in the dissemination process of the RREQ.

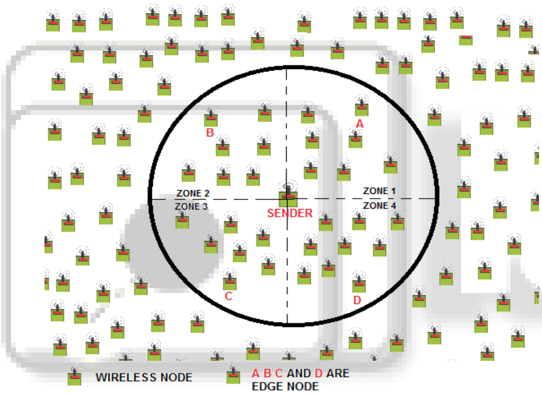

Fig. 2: Divide the transmission range and locate each neighbor in the right Zone.

The key concept of the proposed algorithm is to partition the radio transmission range of the mobile node into four zones. Then, one node per zone is selected to forward the RREQ. The selection process is performed by determining the closest node to the edge of the zone as shown in Figure2 to provide more coverage area. The sender attaches the address of the **C**andidate **N**eighbor to **R**ebroadcast the **R**REQ (CNRR) into the RREQ field. Any neighbors when received the RREQ it will check if the sender select it as forwarder node or not, if so, it will partition its transmission range and select a new set forwarder nodes and attach them into the RREQ and rebroadcast the RREQ, otherwise it will drop the RREQ. We assume in this work that every node is able to obtain its geographical position. Besides that, every node shares its position information with its direct neighbor through the HELLO message mechanism.

if: $S_x \le A_x$ and $S_y \le A_y$ (1)

Then we can locate node A inside Zone 1 of node S.

Else if $S_x > B_x$ and $S_y \le B_y$ (2)

Then we can locate node B inside Zone 2 of node S.

Else if : $S_x \ge C_x$ and $S_y > C_y$ (3)

Then we can say node c inside Zone 3 of node S.

Else: $S_x < D_x$ and $S_y < D_y$ (4)

Then we can say node D inside Zone 4 of node S.

After locate each neighbor in the right zone, then we calculate the distance from the sender node to each neighbor according to bellow equation:

$$\text{Distance }(S, N) = \sqrt{(S_x - N_x)^2 + (S_y - N_y)^2} \quad (5)$$

According to equation 5, node S will be able to know the distance from each neighbor.

Type	**J**	**R**	**G**	**D**	**U**	**Reserved**	**Hop Count**
RREQ ID							
Destination IP Address							
Destination Sequence Number							
Originator IP Address							
Originator Sequence Number							
CNRR IP Address							

Table 1:Modified frame format for CNRR RREQ packet

G. CNRR Algorithm:

1) Process at sender node:

(1) Node(S) want to send data to node (D) then Node sends a RREQ packet.
(2) S Locates each neighbour in the right zone Using equations 1 to 5.
(3) Select the Candidate neighbours in each Zone . A source (S) node selects candidate node (CN) among the neighbors if (D<80%)of the source transmission range (Source_R).
(4) Insert all the Candidate neighbours in CNRR Field (In RREQ packet).
(5) Rebroadcast the RREQ packet.

2) Process at Receiver Node:

```
(1) Node X Receives RREQ
(2)  checks RREQ packet
(3)          if(x_nodeiP == CNRR_IP)
             {
(4)              If (Node X has valid route to D)
                   {
                    Send Reply to S
                    }
                     else
                      {
                       Apply the algorithm and re-
                       broadcast the RRE
                       }
(5)   else
                       {
                         Discard RREQ
                       }
```

V. PROBLEM FOUND IN BASE

(1) If we know the approximate position of destination no then why to use normal antennas instead of directional antennas.
(2) If we know then we can restrict the flooding of RREQ packets to requested zone only.

(3) Full strength of transmission is used always.

VI. PROPOSED SOLUTION

Process at sender node

(1) Node(S) want to send data to node (D) then Node sends a RREQ packet.
(2) S Locates each neighbour in the right zone Using equations 1 to 5.
(3) Find out co-ordinate of Request zone .

– 1.if (sender s is communicating first time to designation d).
– {it will use default AODV protocol for route discovery.}
– else { get the previous location co – ordinates(xd,yd) ,avg_speed .
– Calcutate time _diffT1-T0.

Where T1 is current time and T0 is time of previous communication .

– Calculate R for expected Zone using
  ▪ R=avg_speed X (time_diff).
– Get the End co-ordinates of Expected zone .
– On the bases of Expected zone calculate the co-ordinates of Requested zone .

I(xs,ys) , II (xs,yd+R),III(xs+R,ys+R) ,IV(xs+r,ys)

(4) Select the Nominated neighbours in each Zone .

(5)A source (S) node selects Selected node (SN) among the neighbors if (D<(Source_Rx.80)). Insert all the Candidate neighbours in CNRR Field (In RREQ packet).

(6) Insert Requested Zone co-ordinates in Request zone co-ordinates field.

(7) Rebroadcast the RREQ packet.

A. *Process at Receiver Node :*

(1) Node X Receives RREQ
(2) checks RREQ packet
(3) if(x_nodeiP == CNRR_IP && my co-ordinates' comes in Request zone)

```
{
(4) 4   If (Node X has valid route to D)
{
Send Reply to S
}
else
{
Apply the algorithm and re-broadcast the RREQ
}
(5) else
{
Discard RREQ
}
```

Notes: In our approach we have used directional antennas and the transmission rang is changed vary according to destination to avoid unwanted bifurcation.

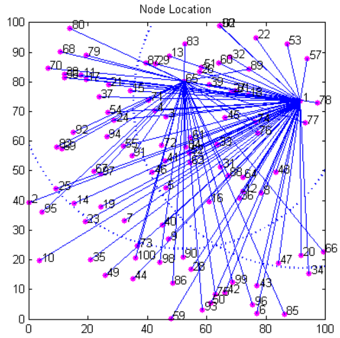

Fig. 3: Process at receive nodes

The low-power transfer method, suggested in this study, is applied to the CNRR approach ad-hoc MAC protocol, and a comparative analysis is made of its performance.

VII. RESULTS

Comparison of results b/w AODV, Base (CNRR) and proposed.

In order to evaluate the performance of our proposed protocol, we compare Candidate Neighbors to Rebroadcast the RREQ for Efficient flooding in Mobile Ad hoc Network (CNRR)[1],Ad hoc On-Demand Distance Vector (AODV) Routing[2] and proposed protocol. we simulate the proposed mechanisms using NS2 Simulator [14]. The simulation environment, performance metrics and results are discussed in the subsequent sections.

A. *Simulation Environment:*

In our simulations, the MAC layer runs on the IEEE 802.11 DCF. The bandwidth set to 2 Mbps and the transmission range is set to 250 m. The evaluations are conducted with a total of 70 nodes that are randomly distributed in an area of 750m x 750m. We use Random Waypoint to model node mobility. The speed was constant to 10 m/s in all the simulation time. In each test, the simulation lasts for 800 seconds. The size of each Constant Bit Rate (CBR) packet is 1000 bytes and packets are generated at the fixed interval rate of 5 packets per second. 25 flows (5, 10, 15, 20, and 25) were configured to choose a random source and destination during the simulation.

B. *Performance Metrics:*

Four metrics were used to evaluate our proposed , AODV protocol:

1) *Packet Delivery Ratio:*

It is the number of succeed to deliver at the destinations and of by the CBR sources.

2) *Data Drop:*

This includes all deleted packets in the network.

3) *Total Overhead:*

The number of control packets transmitted in the network.4) *Total Throughout*: The total number of application layer data bits successfully transmitted in the network per second.

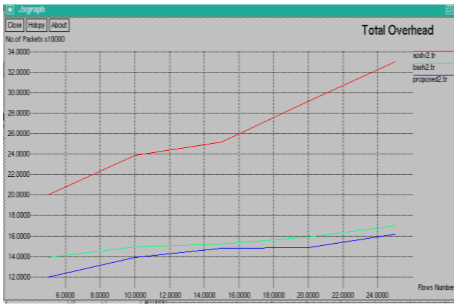

Fig. 4: Total Overhead vs Flows Number

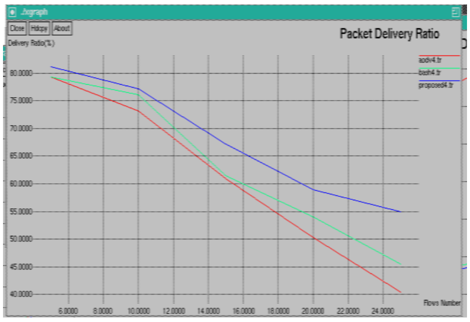

Fig. 5: Packet Delivery Ratio vs Flows Number

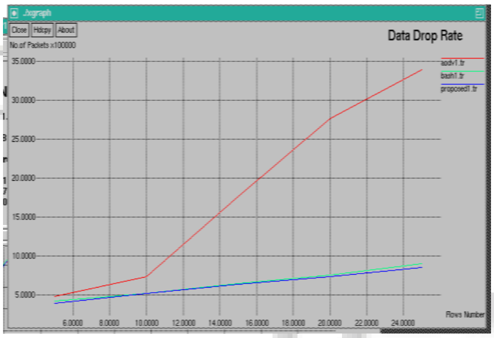

Fig. 6: Data Drop vs Flows Number

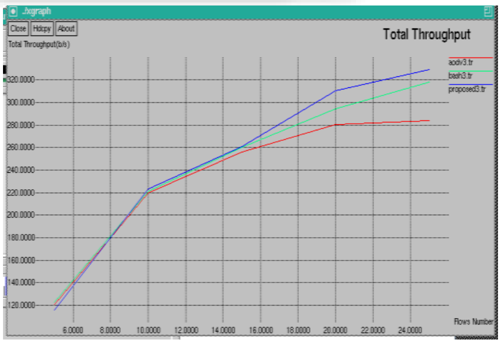

Fig. 7: Throughput (b/s) vs Flows Number

VIII. CONCLUSION

In this paper we have presented several techniques to improve reactive routing protocol and found that among all the algorithms proposed is performing best for a highly movable network and somewhat scalable to but if we take only scalability then cluster approach is also better .In future researchers can create a hybrid algorithm from our approach and cluster based approach to improve routing mechanism of reactive as we as hybrid routing protocol. We hop these algorithm will be implemented to work on real MANETs and will perform well even in real situations.

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