Neighbor coverage rebroadcast reduced in MANET using Zone based group mobility

[1]Sara Begum, [2]Kanchan Gorde, [3]Raosaheb Waghmare
[1]M.E Student, [2-3]Assistant Professor
Department of Electronics, TEC Mumbai University, India

Abstract - MANET is the one of the type of special wireless network. In MANET there is no static topology due to high mobility of nodes, there exists frequent link breakages which leads to path failure and route discovery. Due to link breakage problem arises in data transmission that raise issue of routing overhead. This will also decrease Throughput and Packet Delivery Ratio. To overcome this problem in this paper propose a solution to reduce routing overhead and communication overhead and improving routing performance by using Zone based Technique. The NCPR protocol used to find Uncovered Nodes in the network. The problem in NCPR is nodes get same RREQ packet again and again. We propose solution, provide Zone Technique which builds a stable Zone in NCPR to reduce routing overhead and improve routing performance. The Zone having Distributed and Reactive nature we can improve efficiency of routing, packet delivery ratio and throughput. This will also reduce End-to-End delay in network. This technique will evaluate using NS2.

Index Terms - Cluster head, Gateway, intra cluster, inter cluster, Clustering.

I.INTRODUCTION

Nodes in MANETs can be dynamically self-organized into arbitrary topology networks without a fixed infrastructure. One of the fundamental challenges of MANETs is the design of dynamic routing protocols with good performance and less overhead. Many routing protocols, such as Ad hoc On-demand Distance Vector Routing (AODV) [1] and Dynamic Source Routing (DSR) [2], have been proposed for MANETs. The above two protocols are on-demand routing protocols, and they could improve the scalability of MANETs by limiting the routing overhead when a new route is requested [3].However, due to node mobility in MANETs, frequent link breakages may lead to frequent path failures and route discoveries, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay [4]. Thus, reducing the routing overhead in route discovery is an essential problem. The conventional on demand routing protocols use flooding to discover a route. They broadcast a Route Request (RREQ) packet to the networks, and the broadcasting induces excessive redundant retransmissions of RREQ packet and causes the broadcast storm problem [5], which leads to a considerable number of packet collisions, especially in dense networks [6].Therefore, it is indispensable to optimize this broadcasting mechanism.
Williams and Camp [7] categorized broadcasting protocols into four classes: “simple flooding, probability based methods, area-based methods, and neighbor knowledge methods.” Xin [8] propose a neighbor coverage-based probabilistic rebroadcast (NCPR) protocol which helps to keep the network connectivity and reduce the redundant retransmissions, it need a metric named connectivity factor to determine how many neighbors should receive the RREQ packet. The disadvantage in NCPR is that, node will receives the same RREQ packet again and again.
Clustering is one of the types of routing and an effective way to transfer data between nodes in a network. In Zone based scheme the network is divided into chunk of nodes known as Clusters where one node in each cluster act as a Cluster head which is used for Routing. Mainly we used creation of cluster and election of cluster head algorithm. The Cluster creation algorithm we check that node is in the communication range or not. If present in range then node will be added otherwise not added. For each node less distance is efficient. The cluster information is maintained by each node. The cluster information is very important. This information keeps track of the all necessary information for clustering algorithm. When updating the information, a node can determine its own status by exchanging cluster information with its neighboring nodes. The cluster information is used for cluster maintenance and routing. Each node maintains.

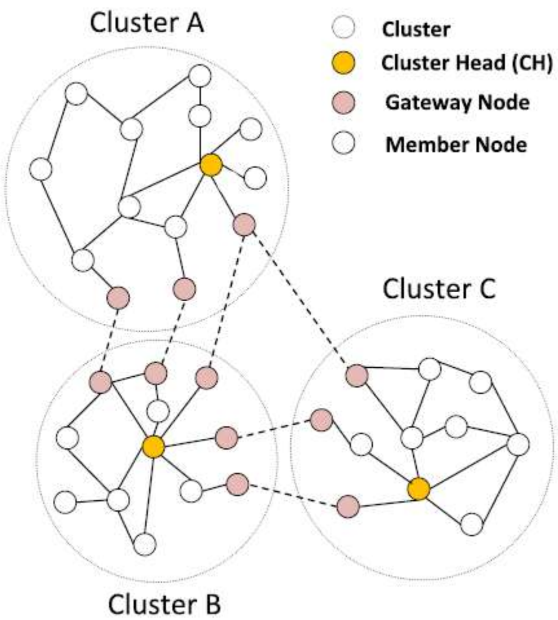


Fig 1: Clustering in MANET

The communication between the nodes of the same cluster is called intra cluster communication while inter cluster communication takes place when a node of one cluster communicates with the node of other cluster through gateway nodes. Gateway nodes of each cluster are responsible to manage communication among clusters.

Our major contributions are:

1) Nodes are deployed in MANETs using zone based approach to achieve group mobility.
2) Selection of CH in MANET.
3) A dynamic mechanism for cluster size management is taken into account to control the network congestion hence improve the performance of cluster based MANETs in the presence of group mobility.
4) Both Intra and inter cluster communications are considered for MANETs.

II.Related Work

Neighbor Coverage Based Probabilistic Rebroadcast (NCPR)

Neighbor Coverage Based Probabilistic Rebroadcast (NCPR) protocol that reduces the routing overhead is presented. To obtain the neighbor coverage information the protocol employs rebroadcast delay and rebroadcast probability approaches. The rebroadcast delay is used to obtain the forwarding order. The rebroadcast probability is determined to minimize the number of transmissions, thereby improving the routing performance

i. Uncovered Neighbor Set and Rebroadcast Delay

The rebroadcast delay is utilized to determine the forwarding order and the node that contains more common neighbors have the lower delay. The uncovered neighbor set U (Xi) of a node is determined as follows:

$$U(Xi)=N(Xi)-N(Xi)\cap N(S)-S$$

Where, Xi and S are the node and upstream node respectively. And N(S) and N(Xi) are the neighbors of node S and Xi respectively.

ii. Additional coverage ratio

The additional coverage ratio is defined as ACR

$$Xi=\frac{U(Xi)}{N(Xi)}$$

This shows the ratio of the additional neighbors that are covered by this rebroadcast. The nodes that are covered additionally must receive and process the RREQ packet. As ACR becomes larger, more nodes would be covered by this rebroadcast and hence the rebroadcast probability must be set to high.

iii. Connectivity factor

The connectivity factor may defined as

$$\text{CF} = \frac{Nc}{N(Xi)}$$

Where Nc is the connectivity metric. When N Xi is greater than Nc, then CF is less than 1. This means the node Xi is in the dense network area; only portion of the neighbors of Xi that forwarded the RREQ packet maintains the network connectivity.

When N Xi is less than Nc, then CF is greater than 1, meaning that the node Xi is in the sparse network area and should rebroadcast RREQ to approach network connectivity.

iv. Rebroadcast Probability

The rebroadcast probability (pr) is obtained by combining Additional Coverage Ratio (ACF) and Connectivity Factor (CF).

$$pr\ Xi = CF\ Xi\ .\ ACR\ Xi$$

The node Xi rebroadcasts the RREQ packets with the probability pr. Xin et al. [8], proposed NCPR protocol used to keep network connectivity and reduce retransmission, but disadvantage is that, node receive same RREQ packet again and again.

III.Problem statement

Mobility brings fundamental challenges to the design of protocol stacks for mobile ad hoc networks (MANET). Because of nodes movements, routing protocols of MANETs have to cope with frequent topology evolutions and ensure quick response and adaptation to topology changes. By continuously monitoring topology changes and disseminating such information over the whole network, routing protocols provide fast response to topology change but at the price of increased overhead of control traffic. Increasing control traffic could further lead into less packet delivery ratio and increase in delay. Under the worst case, it could result in "broadcast-storm" problem and the whole network will be congested. It is thus essential to understand the intricate relations between routing overhead and topology evolutions, for the design of routing protocols in MANETs.

For mobility based MANET, it is more essential to fulfill the basic characteristics and main requirements of clustering in the presence of mobility. Therefore in case of mobility it is a challenging task to manage a stable and efficient clustering environment in MANET and researchers need to focus more on these requirements while designing clustering based schemes. These main requirements are as follows:

1) Optimal Cluster head selection.
2) Neighborhood detection.
3) Node alignment with their neighborhood.
4) Minimum and maximum threshold distance between nodes for node connectivity.
5) Reduce communication & routing overhead.
6) Increase Packet delivery Ratio.

IV.Proposed Scheme

The nodes in the network are first divided into clusters and then the communication process takes place with the help of cluster head (CH). During the communication process the nodes are checked whether they are alive or not, within the range of the CH or not. After that packet transfer will take place according to the conditions. Each node has a particular weight and id which will help in communication process.

The algorithm mainly focuses on two main conditions of route discovery in the case of clustered networks. First is the intra cluster route discovery in which case the sender node and the destination node is present in the same cluster. Second is the case of inter cluster route discovery where the sender and the receiver nodes are in different clusters, under different cluster heads.

The main concept of route discovery is dependent on the cluster head. The cluster head is the node which maintain the information about the nodes present in the network in its various tables. In the intra cluster route discovery only the cluster head of the particular cluster is responsible for the route discovery. If any route to a node is already present then that is also taken into consideration accordingly to the situation whether it is feasible now to transfer data using that route or not.

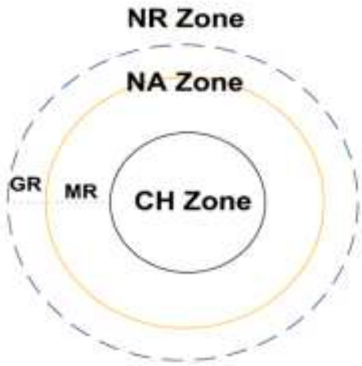


Fig 2: Zone based deployment of node

A CH is elected among the member nodes of a cluster. In clustering based MANET will divide the structure of a cluster into three different types of zones as follows:

Cluster head (CH) Zone, Node attraction (NA) Zone and Node repulsion (NR) Zone. These zones are illustrated in fig 2.

- *CH Zone:* Nodes existing in CH zone are eligible candidates for the selection of CH. A CH will only be selected among the nodes existing in CH Zone.
- *NA Zone:* Node attraction zone is divided into two regions, Gateway Region (GR) and Member Region (MR). A node near to the boundary of a NA zone will exist in GR and those nodes can act as a gateway node to connect cluster A with cluster B. Nodes existing in MR are the member nodes of a cluster. These nodes can communicate with other member nodes of this cluster as well as with the nodes of other clusters by using the nodes of GR.
- *NR Zone:* Nodes existing in NR zone are not members of this cluster because they are not in the range of communication with CH and cluster member nodes. Therefore, they are free to join any cluster. The relationship between these three zones is illustrated in figure 2.

The algorithm is as follows:

Assumptions:
• Nodes are mobile.
• All the nodes are present in one of the clusters formed.
• Each node has a CH selected on the basis of Id
• Each node has two tables associated with it:

a) Routing Table (RT): This table contains information of all nodes within the cluster. The main fields of this table are node, next hope sequence number and hope count.
b) Cluster Member Table (CT): This table contains the information of the CH of the particular cluster under which the node comes.
The main field under this is cluster head.

• Each CH has three tables associated with it:
a) Mobile Node Table (MT): This table contains the information of all the nodes under the particular cluster head. Nodes is the main field of this table.
b) Neighbor CH Table (NT): This table contains information of the neighboring CHs. Neighbor cluster head is the main field under this table.
c) History Table (HT): This table contains the information of few previous packet transfers. Destination and path are the main fields under this table.

ALGORITHM:-
1. When a source node(s) wants to send a packet to destination node (d), it checks its RT:
1.1. If it is empty, as in the beginning, it will send RREQ to CH, the CH will send a message back informing the node about all the nodes present within the cluster.
1.2. The node (d) can be within the cluster or outside the cluster.
1.3. If the node (d) is within the cluster of the node (s), it will find out the shortest path to the node, all the communication will take place through this path and it will be saved in the RT of node.
1.4. Else
1.5. If node (d) is outside the cluster, as can be found by CH, it is the responsibility of the CH to carry out all the communication.
1.6. Within the cluster (intra-cluster) the communication is handled by the node itself and outside the cluster (inter-cluster) it is handled by CH [9].
2. The nodes will always have updated routing tables.
3. Whenever a new node enters or leaves a node CH informs all the nodes and CHs about the change.
4. In the case of inter-cluster communication,
4. 1. In the beginning CH broadcasts the RREQs to all the CHs, when the HT is empty.
4.2. If there is some information related to the particular destination node (d), the CH will send the RREQ only to that particular CH which has send RREP in that case.
4.3. If the route still exists, the communication will take place through that route, else an error message is sent back by the CH.
5. In the case, the HT is empty each CH checks their MT to find out the (d) node and sends the RREQs to the node and the RREP packet to the source CH.
6. To avoid broadcasting of RREQs every time a new inter-cluster communication is to take place, HT tables are maintained by CHs which avoids the broadcast of RREQs.
7. HT tables, contains the information of few previous communications (for a specific time period can be set by the use of timers) so that the broadcast of RREQs can be limited

Given below is the flowchart for the algorithm we have discussed above. The flowchart for the algorithm is divided into a main flowchart and a sub part shown with the help of a connector HT. Main flowchart describes the working of the algorithm and the HT flowchart describes one particular condition faced in the algorithm.

Fig 3: Flowchart for proposed algorithm

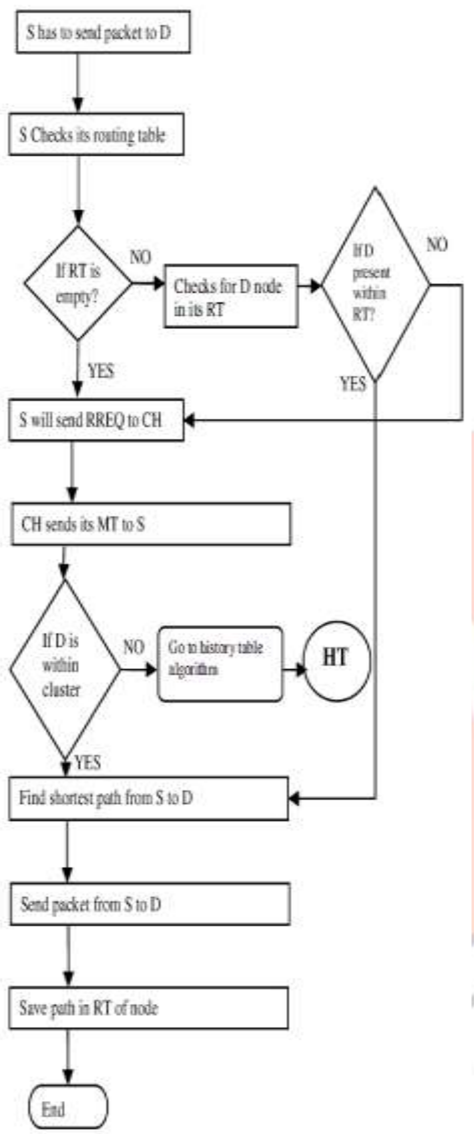
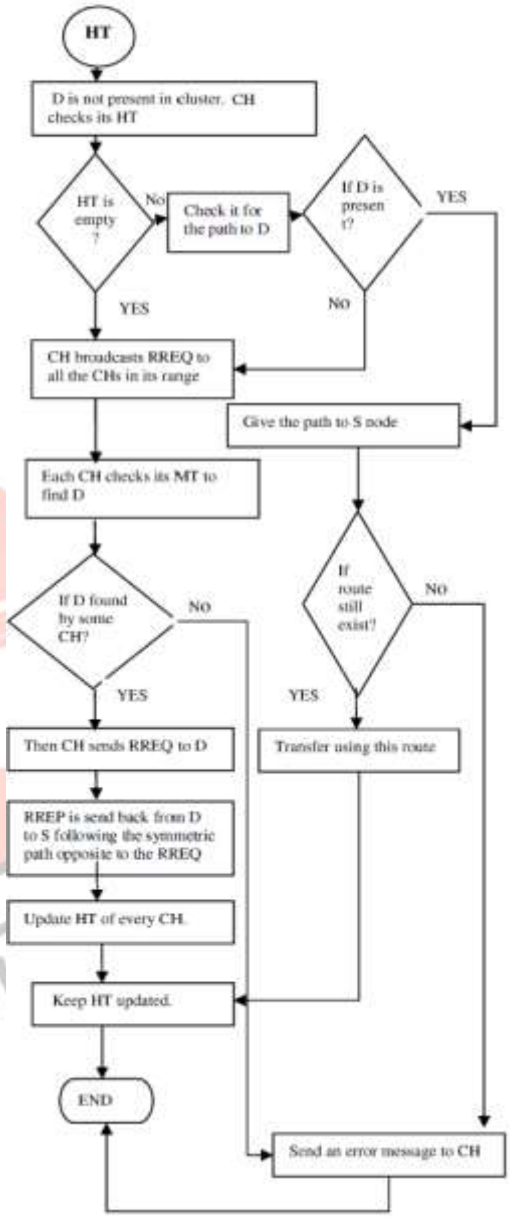


Fig 4: Sub flowchart



V.Simulation and evaluation and analysis

The NS2 tool is used to evaluate performance. When simulation started, 50 nodes were placed randomly within a 600 m x 600 m area and the transmission range was fixed at 250m. The random waypoint mobility model [11] was used to simulate mobility with a 40 second pause time. Other simulation parameters are seen in Table 1.1

Parameter	**Default Value**
Traffic type	CBR
Simulation time(second)	3600
Field Dimension	600m × 600m
Packet size	200 byte
Number of node	>40

Table 1.1

VI.Analysis of cluster performance

Throughput: It indicates no. of data received successfully by the all destination. Throughput of system is shown in fig 5.

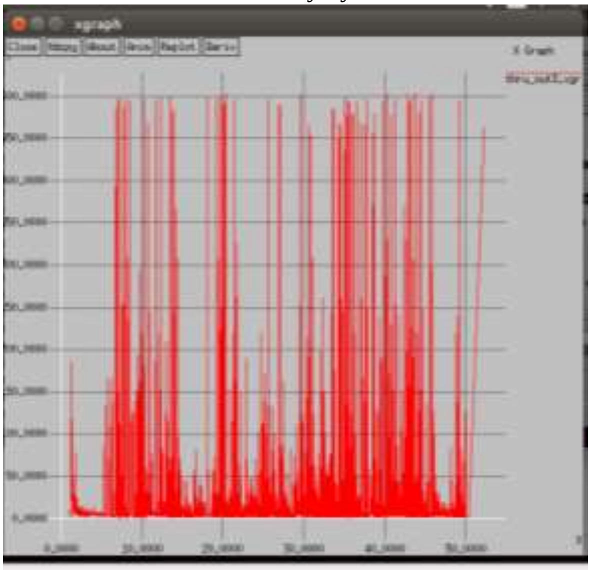


Fig 5

End-to-End delay: The average time it takes data packet reach to the destination. End to end delay is shown in fig 6.

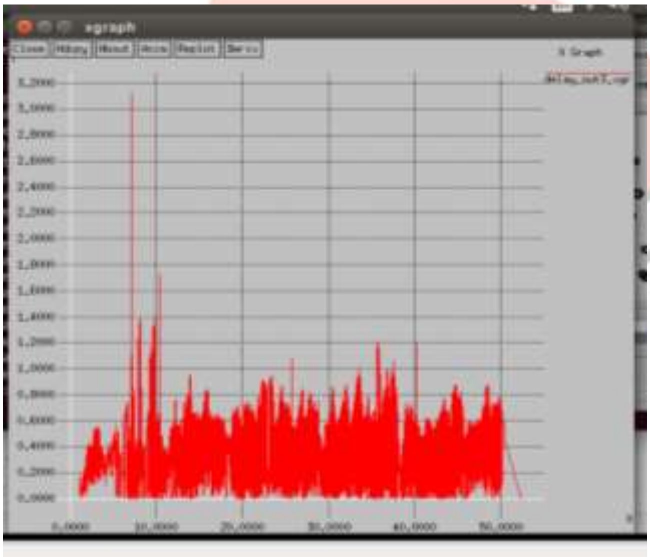


Fig 6

Packet deliver Ratio: It is calculated by difference between no. of data packet sent by source and no. of data packet received by destination. PDR of the system is shown in fig 7.

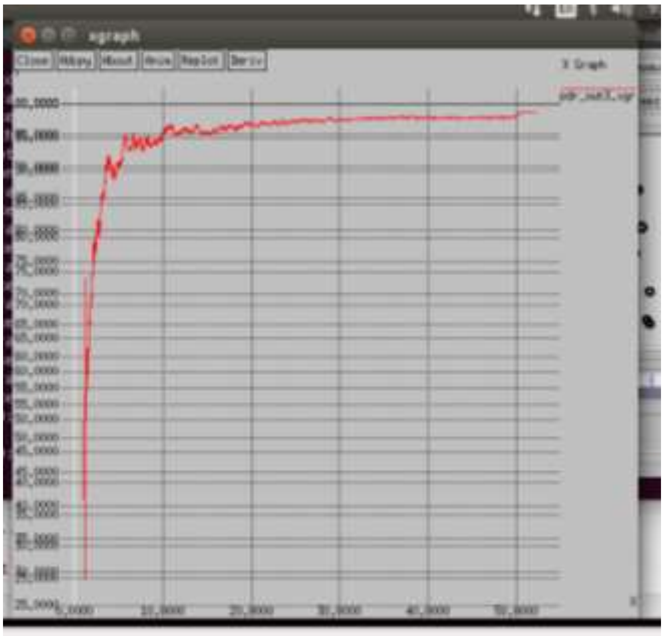


Fig 7

Average delay: Average delay of data from source to destination. Average delay of the system is shown in fig 8.

Fig 8

VII.CONCLUSION AND FUTURE ENHANCEMENT

Reducing routing overhead is very challenging task in MANET. As per our previous discussion, in MANETs, when network's size exceeds a certain threshold decreases the performance, resulting in many routing algorithms performing only when network's size is small. To overcome reduce routing overhead, and increase in End-to-End delay it is mandatory to make network organization smaller and manageable.

The scheme is used for integrated routing and message delivery in clustered networks. The proposed clustering architecture was evaluated using simulation experiments. The proposed technique shows that the algorithm builds stable clusters with low communication overhead due to its localized, distributed and reactive nature. Which will not only reduces the routing overhead, it will also decrease End-to-End delay and increase Packet Delivery ratio with improving efficiency.

If number of node increase the execution time increase in future we will simulate to increase the execution time for the more number of node.

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