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Hexagonal based Clustering for Reducing Rebroadcasts in Mobile Ad Hoc Networks

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Abstract— In mobile ad hoc networks multihop routing is performed in order to communicate the packets from the source to destination. The nodes within these networks are dynamic due which frequent path change occurs which can cause frequent link breakages and induces route discoveries. These route discoveries can introduce overhead in terms of contention, collision and rebroadcasts which are non-negligible. Here, the paper discusses a hexagonal based clustering for reducing rebroadcasts thus maximizing the lifetime of the networks and providing coverage area thus reducing the end – end delays.

Index Terms— Mobile Ad Hoc Networks, Link Breakages, Route Discoveries, Overhead, Rebroadcasts.

1 INTRODUCTION

The mobile ad hoc network consists of autonomous nodes communicating among themselves. They do not require any fixed infrastructure since, they are self – configuring networks and does not require any central administrator. Due to the dynamic nature of nodes the major challenge occurs during routing a packet from the source to destination. As mentioned earlier the nodes are dynamic in nature so the path between the nodes changes periodically. For initiating a path to transmit data it is essential to identify (or) establish a path for transmission starting from the source to the destination using route discovery process. The mobile ad hoc network makes use of broadcasting for route discovery process. It involves flooding a message from one node to all other nodes within the network. The broadcasting technique forms the fundamental communication technique in MANET. The route discovery process involves transmission of route request (RREQ) packets from source to destination through every outgoing links which is also known as blind flooding. The transmitted RREQ packets are received by all the surrounding nodes which try to find out whether these packets are already contained (or) not. If the packets are not contained already they are to be retransmitted and this is performed till all the nodes have received and transmitted the broadcast packets at least once.

2 Reasons For USING BROADCASTING

The uniqueness of broadcasting are discusses below but are not limited to,

2.1 Unplanned

The broadcasting can be triggered by a node at any time. Due to this spontaneous triggering it retards synchronization and no prior information about the connectivity is known.

2.2 Undependable

The broadcasting involves transmitting the messages to all (or) some of the nodes within the network. It does not provide any acknowledgement due to,

- The host becomes independent from the network.
- It causes redundant retransmissions around the sender.
- Many applications do not need 100% broadcasting techniques.

The route discovery process using broadcasting introduces redundant retransmissions while sending route request packet. It due to the fact that the source floods the route request blindly to all nodes when the request are been made without knowing the actual path to the destination. When a node decides to rebroadcast a message to its neighbors where it already holds that message introduces broadcast storm problem.

3 RELATED WORK

Maminuus discussed that broadcasting play a vey important role in mobile ad hoc network since it transmits messages from a source node to every other nodes in the network. The mobile ad hoc network makes use of flooding for broadcasting during which every nodes retransmits the received messages only once. This creates redundant rebroadcasts thus causing contention and collision in the network called as broadcast storm problem. The author proposed pure probabilistic approaches to deal with flooding where the mobile nodes tries to rebroadcast a message based upon a fixed probability thus reducing the number of rebroadcasts by considering reachability. The counter based schemes were used to reduce broadcasting based on the number of copies of broadcast packets received by the node within a random access delay time. The technique offer better reachability and throughput but suffers a longer delay. The author made use of merits of pure probabilistic and counter based schemes for performance improvement.

Abdalla M. Hanashi described that the broadcasting technique are used for route discovery. The flooding algorithm increases the number of unnecessary packet rebroadcasting thus causing contention and collision. For reducing the number of rebroadcasts probabilistic method were used to reduce the contention and collision within the network. The author proposed a dynamic probabilistic approach where the nodes make use of way point mobility, simple flooding AODV and fixed probabilistic schemes. The rebroadcasting probabilities were set dynamically according to the number of neighboring nodes scattered in the ad hoc network.

Wei Peng described about the flooding in mobile ad hoc networks possess poor scalability thus causing redundancy, contention and collisions. The author proposes an approach for reducing the broadcast redundancy for which local topological and the statistical information related to the duplicate broadcasts were used for avoiding unnecessary rebroadcasts.

Seungjoon Lee described the wireless ad hoc network as a collection of mobile nodes without a fixed infrastructure thus facilitating dynamic and distributed environment. It requires collaboration among nodes. During route discovery from source to destination the intermediate node replies with the help of cached entries. The author proposes a route discovery process where the intermediate node requests its next hop for sending a confirmation message to the source. Upon receiving both the route reply and confirmation message, the validity of the path is determined by the source. This method discourages the malicious node and improves the throughput.

4 EXISTING APPROACHES

The main aim was to reduce the number of rebroadcasts of the route request packet (RREQ) and to improve the performance during routing. The dynamic nature of nodes in the mobile ad hoc networks (MANET) causes frequent link breakages thus leading to frequent path failures and route discoveries and reduces packet delivery ratio and increases the end – to – end delay. This creates overhead in terms of contention, collision and rebroadcasts during route discovery process which is non negligible. The ultimate aim is to reduce the overhead in route discovery process. The broadcasting technique is used for route discovery during which the mobile node blindly rebroadcasts the first received route request packets without knowing the route to the destination thus causing broadcast storm problem.

4.1 Techniques Used

The neighbor knowledge based probabilistic rebroadcast protocols (Fig. 1) were employed in order to reduce the overhead during routing in mobile ad hoc networks (MANETs). The neighbor knowledge protocol is achieved using the proposed rebroadcast delay and rebroadcast probability which determines the packet forwarding order.

a) Delays for Rebroadcasts

The nodes which have more common neighbor with the previous node will have lower delay. During packet transmission the common node will know this fact first. These rebroadcast delay enables the information, that these nodes have transmitted the packets to more neighbors which forms the key to success.

b) Calculating Probabilities for Rebroadcasts

The scheme considers the uncovered neighbors (UCN). When a node receives a route request packet (RREQ) from its previous node it makes use of the neighbor list in the RREQ packet. This is done to estimate how many neighbors have not been covered by the RREQ packet of the previous node. In that case, the current node rebroadcasts the RREQ packet so that it can reach more additional coverage nodes. For calculating the rebroadcast probability each node needs its 1 hop neighborhood information.

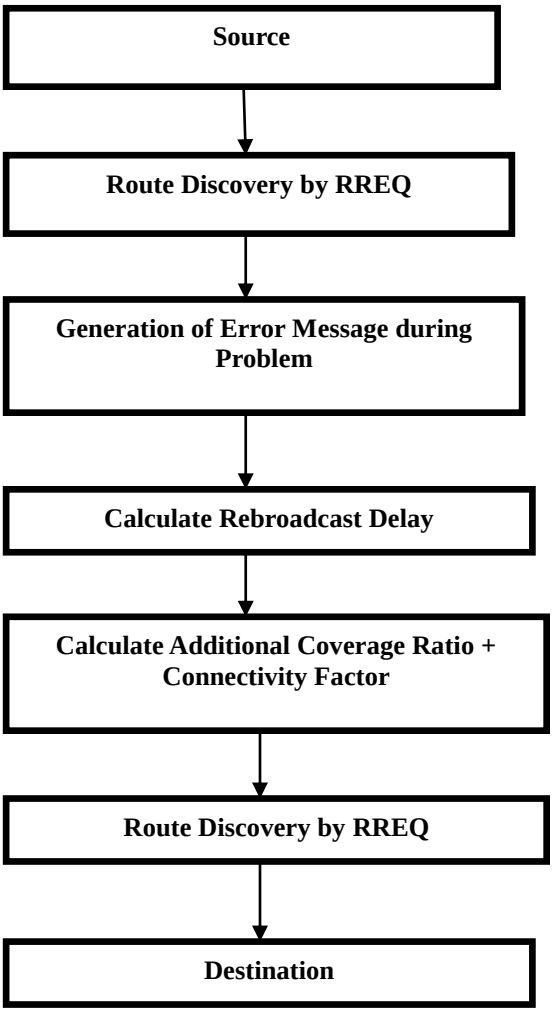

Fig.1: System Architecture

4.2 Routing Protocol

The routing protocols like Ad hoc On – demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) were used since these protocols are on – demand routing protocols. these protocols improves the scalability of MANETs by reducing the routing overheads during new route requests.

5 PROBLEM STATEMENT

The existing system made use of I hop neighborhood information in order to attain additional coverage area. Here, the node verify the neighbors covered by using the neighbor list maintained at the RREQ packet. In case, if there are any uncovered neighbors the broadcasting are made for attaining additional coverage area. The problem here is the scheme does not work well in all the situations. This can also minimize the lifetime of the network since the broadcasting to uncovered neighbors can induce rebroadcasts thus consuming battery power of the nodes.

6 PERFORMANCE EVALUATION

The evaluation of performance of the NCPR protocol was evaluated by comparing it with AODV protocol using NS - 2 Simulator. The data dissemination mechanism in MANETs makes use of broadcasting. Here, the analysis is done for route request in route discovery. For comparing the routing performance of NCPR protocol, a dynamic probabilistic route discovery is used for reducing the overhead of RREQ packet during route discovery.

6.1 Analysis for Collision Rate between AODV Vs. NCPR

In AODV protocol due to huge redundant rebroadcast introduces many collisions and interferences which lead to excessive packet drop. It is severe when the number of nodes increases. It is important to reduce redundant rebroadcasts and packet drops caused by collisions to improve the routing performance. Compared with AODV protocol, the NCPR protocol reduces the rate of collisions.

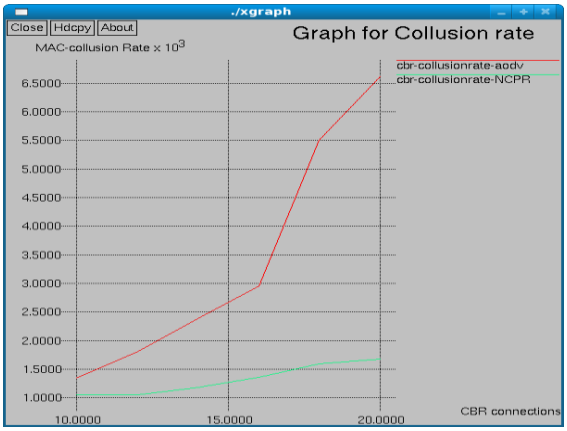

Figure 2: Performance Analysis for Collision Rate between AODV Vs. NCPR

.2 Analysis for Packet Delivery Ratio between AODV Vs. NCPR

The NCPR protocol can increase the packet delivery ratio due to the reduction in number of collisions and also in parallel reduces the packet drops. On average the packet delivery ratio in NCPR protocols is improved when compared with the AODV protocol.

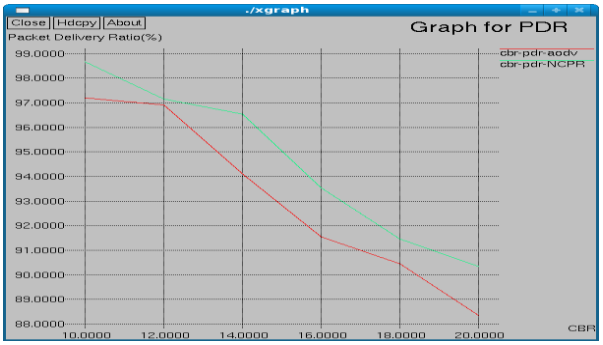

Figure 3: Performance Analysis for Packet Delivery Ratio between AODV Vs. NCPR

6.3 Analysis for Average End – to – End Delivery between AODV Vs. NCPR

The NCPR protocol reduces the average end – to – end delay due to a decrease in number of redundant rebroadcasting packets. The redundant rebroadcasts increases delay due to too many collisions and interferences thus leading to excessive packet drops and also increases the number of retransmissions. Thus, reducing the redundant rebroadcasts the delay can be decreased.

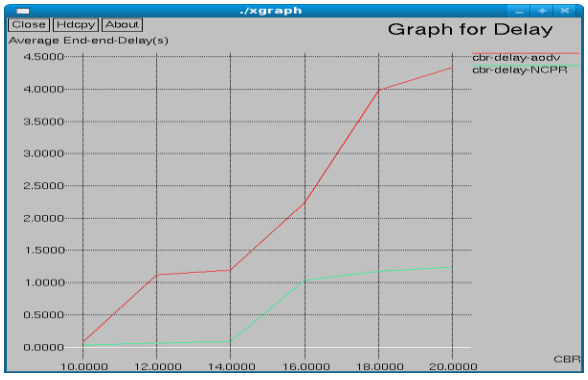

Figure 4: Performance Analysis for Average End – to – End Delay between AODV Vs. NCPR

6.4 Analysis for Reducing Overhead between AODV Vs. NCPR

The NCPR protocol significantly reduces the routing overhead caused during the route discovery especially in dense networks. Although the NCPR protocol increases the packet size of RREQ packets, it reduces the number of RREQ packets significantly. Thus reducing the RREQ traffic.

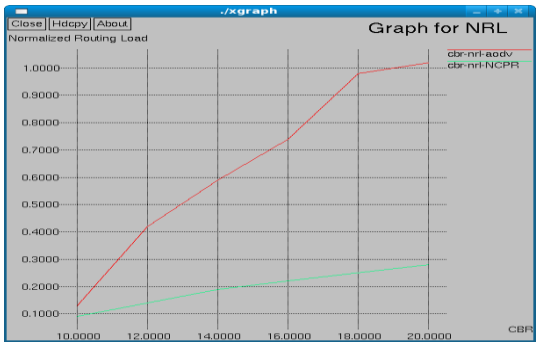

Figure 5: Performance Analysis for Reducing Overhead between ODV Vs. NCPR

7 PROPOSED SYSTEM

The main focus is to reduce the energy consumed by the nodes thus increasing the lifetime of the network. This is achieved by using a clustering technique which effectively utilizes the bandwidth used in the network.

7.1 Hexagonal Clustering

The technique divides the network into group of nodes which are closely located to each other. Here, the hexagonal clustering is employed since the mobile ad hoc network possesses bandwidth constraints. The bandwidth occupied by the entire system is C_b times the bandwidth occupied by a single cell where, C_b represents the bandwidth occupied by every single cell. The cell follows an orthogonal structure since it allows for frequency reuse and a single cell is considered as cluster and any node within the cell is able to communicate with other orthogonal neighbors. Here, the clustering allows the node within one cluster can cover one quarter of the adjacent cluster thus providing additional coverage area. This allows the node to obtain the information about the nodes present inside the adjacent orthogonal clusters.

8 CONCLUSION AND FUTURE WORK

The main focus of the paper is to reduce the overhead caused due to broadcasting during route discovery process. Instead of 1 hop neighborhood information a clustering technique is utilized to maximize the network lifetime thus increasing end – to – end delivery and packet delivery ratio. The work can be extended by choosing a head within each clusters using which the packets are transferred from the source to destination. OLSR protocol can be used for routing since, they discard all the possible routes to destination and use only cluster heads to communicate packets from source to destination.

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