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Modified Expanding Ring Search Algorithm for Ad-hoc Networks

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Abstract-Ad-hoc on demand distance vector routing protocol is specially designed for mobile ad-hoc networks with reduced overhead using Expanding Ring Search technique (ERS). But energy consumption should also be considered in MANET due to battery constrain of nodes. In this paper, we propose an energy efficient route discovery process for AODV based on ERS .Our approach saves energy of nodes by avoiding the redundant rebroadcasting of the route request packets. It not only reduces the energy-consumption but also reduces the routing overhead occurs due to mobility between nodes.

***Keywords*: Mobile Ad-hoc Networks, Ad-hoc On-Demand Distance Vector Routing Protocol, Energy Consumption, Expanding Ring Search.**

INTRODUCTION

Network, a collection of interconnected nodes can be wired, wireless or wired cum wireless. A wireless Ad-hoc Network is decentralized type wireless network [5].It is known as Ad-hoc as it does not depend on pre-existing infrastructure. MANETS are self configuring wireless networks without any centralized control [6].They are highly dynamic and suffer from frequent unpredictable changes in the network topology [4]. The radio range of mobile node is usually very small so the node co-operate with each other to keep network alive. The communication between two nodes usually includes several intermediate nodes forwarding the data packets between the endpoints. The nodes can communicate without any established infrastructure.

There are many applications of mobile ad-hoc network in various fields such as [4] such as military communication, automated battle fields, Emergency Services, Commercial and civilian environment, Home and enterprise networking, Education Entertainment Sensor networks, Context aware services and Coverage extension. The specific characteristics and complexities of Ad-Hoc network imposes many challenges such as [4] Autonomous and infrastructure less, Multi-hop routing , Dynamic network topology, Device Heterogeneity, Energy constrained operation, Bandwidth constrained variable capacity links, Limited physical security, Network scalability ,Self-creation, self-organization and self-administration.

There are many protocols already have developed for MANETS environment [13]. All these protocols have been developed in many ways. Based on network structure the routing protocols can be classified as flat routing, hierarchical and geographical position assisted routing. In flat routing nodes communicate directly away with each other. The flat routing protocols can be further classified as proactive, reactive and hybrid. Proactive protocols follow the strategies which are mostly followed by conventional routing protocols. On-demand routing is a new emerging technology in ad-hoc networks. Hybrid protocols are includes the properties of both proactive and reactive types.

MANET routing protocols do not follow the properties of conventional protocols. Hierarchical routing plays a major role in large size networks where flat routing protocols are struggling with constraints. Now-a-days geographical location information also provides better routing performance in ad-hoc networks.

In proactive scheme, a very small delay is needed to determine the route but a significant amount of delay is needed for creating a route by routing protocols. Pure proactive scheme is not appropriate for the ad-hoc networking environment, because it has to keep the current information in a large network. Reactive protocols require significant control traffic due to the long delay and excessive control traffic. As a result pure reactive routing protocols can not be implemented in large networks. Geographical Position Assisted Routing needs to know their geo-coordinates routes to move packet closer to end point for example DREAM, GPSR, and LAR [11][12].

LITERATURE SURVEY

There has been significant work on routing in MANETs [7][8][9][10]. AODV is a reactive protocol which finds route between source destination pair only when it is required. Traditional AODV uses the concepts of blind flooding for forwarding the RREQ packets from source to all other nodes in the network to find route. The RREQ is broadcasted to entire network so every neighbor nodes will receive and process it. All nodes which receive RREQ for the first time check the routing table for route. If there is route, it unicasts the RREP to source, otherwise it rebroadcasts the RREQ to its neighbors. If RREQ is received, it will silently drop RREQ. If the node is destination, it unicasts the RREP to the source. Once the route is established it is maintained as long as it is required. However, when intermediates nodes loses connectivity, the RERR will be sent to the source and source sends packets either through alternate paths or it will restart route discovery process. Thus, route discovery process leads to consumption of energy.

So, to overcome the problem of energy consumption of concepts ERS [1][2](Expanding Ring Search) is applied using TTL(Time To Live) mechanism. The TTL value determines the maximum nodes that the RREQ message can go through. Initially in ERS scheme, the TTL value is set to a value say, N. Thus, the message is broadcasted in a ring with radius of N hops. If the route to destination is not found, N is increased by a value say K, and message is broadcasted again. This step is repeated until the value of TTL is more than the value named as “threshold”. When the value of TTL is more than threshold value it is set to a “limited value” then the RREQ message is broadcasted to entire network. Node D on receiving the RREQ message reply to the node S by sending RREP message which indicates the way to D. Figure 1 shows an example of the ERS concept.

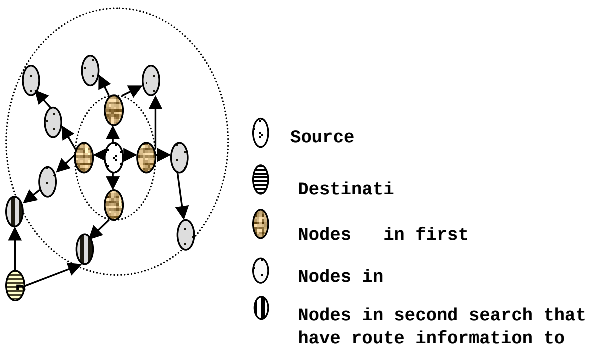

Figure 1 Example of ERS Techniques

In the figure 1 source node S wants to send packets to the node D i.e. destination node using TTL mechanism. So, it starts to search D by incrementing the TTL value, say N=1. So, in the first search source node S can send RREQ to its one hop neighbors. The nodes in the first search do not have information about destination so it increment the TTL value say K. In the figure above some nodes in second search have information about destination, so that nodes will unicasts the RREP (Route Reply) to the source. If the route to destination still not found in second search and TTL value becomes greater than “threshold value” it will set the TTL value to a “limited value” and the RREQ message is broadcasted to entire network.

The ERS mechanism reduces overhead and also uses the energy efficiently, however it has certain disadvantages. In this mechanism, if the destination node is far away from source node then source node has to rebroadcast RREQ message several times. As a result, the intermediates nodes have to receive the message and process again and again. This leads to consumption of lot of energy and routing overhead. To overcome this problem various methods have been proposed.

In [2], concept of overhearing scheme is used. In this the local topology information that has been collected during the first search at the nodes in the first search, has been used in the next search by the nodes in first ring. The nodes in the first ring forward the RREQ only when its RREQ is forwarded by its neighbors. However, the problem occurs with TTL value 2. When TTL value is less than 2 its neighbors will not able to forward the RREQ so the border nodes will not able to forward the RREQ again. Thus, it is not very efficient in finding routes.

In [1], reduction of energy consumption is done by making some nodes silent on the basis of information received in the RREQ. However, in this approach the initial states for relaying the message is set to “false” and is activated only when value is greater than 2.However, due to mobility of nodes it may happen that node whose TTL value is less than 2 is processed before, thus it will not take part in second search. So, in this paper modification is made to handle the nodes whose TTL value is less than 2. This approach not only provide an energy efficient routing, but also handles the overhead occurs due to mobility between nodes.

PROPOSED SCHEME

In the ERS scheme, the source node will broadcast the RREQ to its neighbors to find route. If the neighbor nodes receive it for first time, it will further forward the RREQ otherwise it will just drop the packet. Hence, much useful information gets lost due to dropping of the packet. Therefore we process a design which helps in utilizing the information before dropping the duplicate RREQ packets to make decision about node’s relay value. This helps in making some nodes silent without forwarding the redundant rebroadcast of the RREQ and thus reduces energy consumption for AODV routing protocol. This improved ERS scheme is named as MERS (Modified Expanding Ring Search).

In MERS, the state of the node is determined as relaying or being silent by using a variable named “Relay” in each node in the network. Initially the Relay and Forward value of all the nodes is set to be “true” which means that it will relay the RREQ. The value of variable “relay” is determined by a field in incoming message. This field is predecessor, which is the address of node which sends message to sender. For example, node A sends message to node B, node B forwards the message to node C. Node A becomes the predecessor of node C when it message to C. At an intermediate node, the value of predecessor is set to its address. At an intermediate node, the value of predecessor is set to its sender’s address. The sender’s address of a receive node can be extracted easily from the received message. This is because, before broadcasting a message, a node has to add its address into the source field of the packet header.

In this proposed scheme, when the node relay a RREQ with TTL value greater than 1 its both relay and forward value becomes “false”. When a node receives a duplicate RREQ the node will match its own address with the predecessor address. If it matches it will set the relay value “true” and drop RREQ.

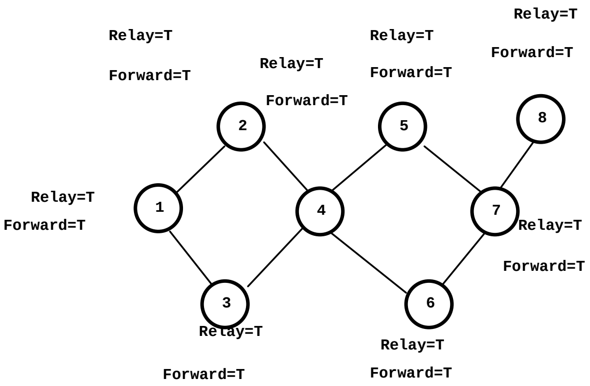

Figure2.a: Initial relay and forward value

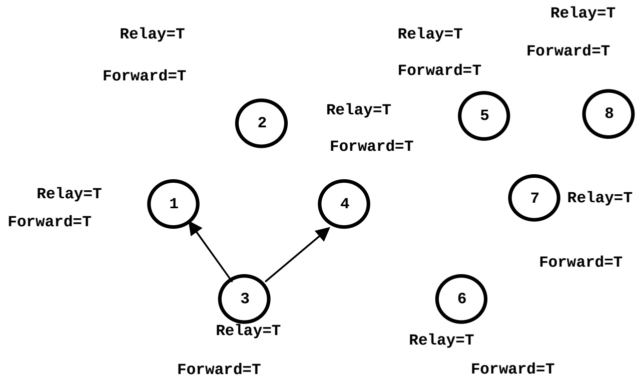

Figure2.b: node 3 broadcast RREQ to its neighbors

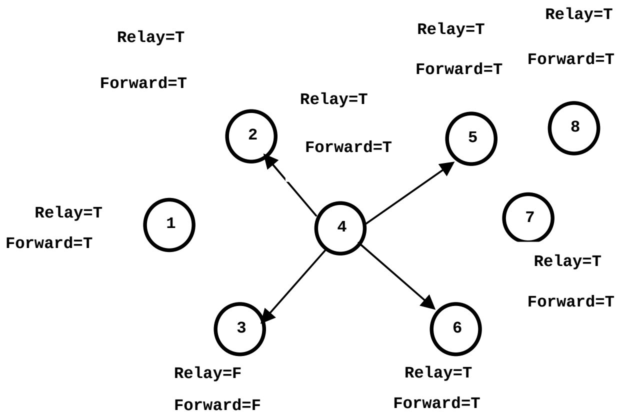

Figure2.c: node 4 broadcast RREQ to its neighbors

When a node receive RREQ with TTL value 0 it will simply match its own address with predecessor address, if it matches it will reset its "relay" value "true" and drop the RREQ. If it does not matches it just drop the RREQ. This is basically done to check whether the node with TTL value 0 is processed before or not due to mobility of nodes. For the nodes with TTL value 1 it will work as shown in figure 3.

The steps in MERS can be summarised as:

- The Initial Relay and Forward value of all nodes is set to "true", i.e. it will take part in first time forwarding of the RREQ.
- When a node with TTL value greater than 1 relay RREQ its both "relay" and "forward" value become "false".
- When a node receives a duplicate RREQ it will match its own address with its predecessor address, if it matches it will set the "relay" value "true" and drop the RREQ.
- For the nodes with TTL value 1 it will set the "relay" and "forward" value as shown in figure 3.
- For the nodes with TTL value 0 it will simply match its own address with predecessor address, if it matches it will reset its "relay" value "true" and drop the RREQ. If it does not matches it just drop the RREQ.
- If Relay value is "true", then the node will participate in the search process of the destination.
- If Relay value is "false", then the node will not forward the RREQ and do not participate in nex search.

In figure 2.b, if node 3 starts to broadcast RREQ, the Relay and Forward value of the nodes will be changed based on the MERS as shown in figure 2.c. Both "relay" and "forward" will set to "false". After receiving the RREQ packet node 4 and node 1 will rebroadcast the RREQ as shown in figure 2.c and 2.d respectively.

When node 3 will receive the packet its address will match with predecessor address, therefore its "relay" value will set "true" and it will simply drop the packet.

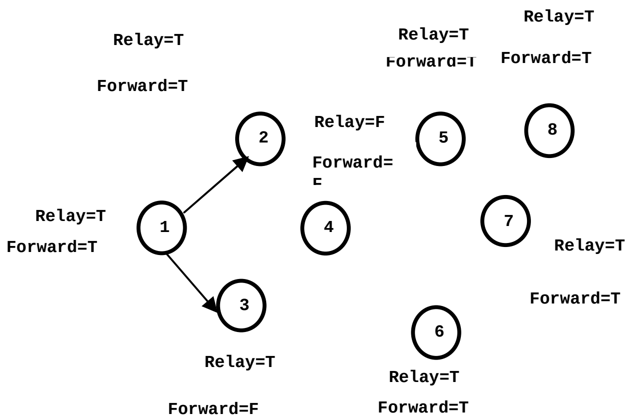

Figure2.d: node 1 broadcast RREQ to its neighbors

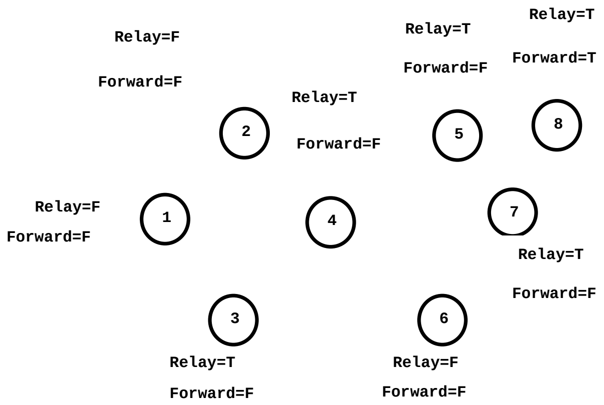

Figure2.e: Final values of RELAY and FORWARD

When node 7 will rebroadcast the RREQ it will change its "relay" and "forward" value as shown in figure 3.When node 8 will receive the RREQ it will match it own address with predecessor address. If it matches it will simply reset its "relay" value "true", and drop the packet. If it does not match it will simply drop the packet. The final "relay" and "forward" value is shown in figure 2.d.

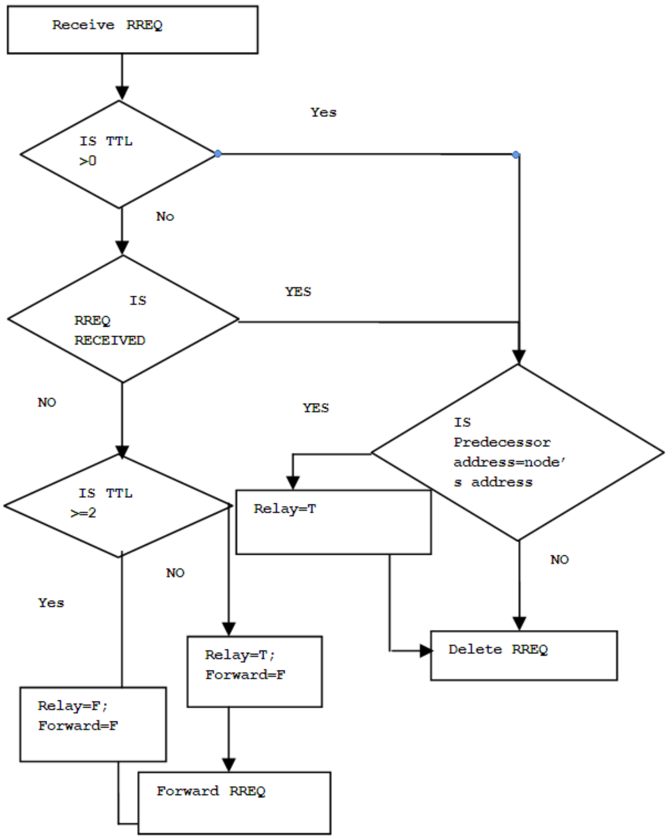

Figure 3 Flow Chart of MERS ALGORITHM

CONCLUSION

In the conventional AODV routing protocol, the redundancy of routing information can make overhead when node performs the routing process and spend more energy than required. In the proposed routing algorithm, the number of RREQ is reduced. Consequently, the energy for all nodes in the network can be efficiently used .Our proposed scheme not only reduces the energy consumption but also the routing overhead occurs due to mobility between nodes.

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