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Energy Saving DSR and Probabilistic Rebroadcast Mechanism are used to Increase Routing Performance in MANET

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Abstract- MANETs are infrastructure less and can be set up anytime anywhere. Due to high mobility of nodes in mobile ad hoc networks (MANETs), there exist frequent link breakages which lead to frequent path failures and route discoveries. The overhead of a route discovery cannot be neglected. In a route discovery, broadcasting is a fundamental and effective data broadcasting mechanism, where a mobile node blindly rebroadcasts the first received route request packets unless it has a route to the destination, and thus it causes the broadcast storm problem and without consider the nodes energy level of route selection it leads to reduce the network lifetime. In this paper proposed to focus is on a two mechanism ESDSR and Neighbor coverage based Probabilistic rebroadcast to overcome those problems. A Energy Saving Dynamic Source Routing in MANETs (ESDSR) which will efficiently utilize the battery power consideration in the route selection time of mobile nodes in such a way that the network will get more life time and Neighbor coverage based Probabilistic rebroadcast mechanism, which can significantly decrease the number of retransmissions so as to reduce the routing overhead, and can also improve the routing performance. The simulation was carried out using the NS-2 network simulator.

Index Terms—Mobile ad hoc networks, Energy Saving Dynamic Source Routing, probabilistic rebroadcast, routing overhead.

1 INTRODUCTION

A mobile ad hoc network (MANET) is a self organizing network, it comprising a set of wireless mobile nodes that move around freely and can able to communicate among themselves using wireless radios, there is no any centralized administration. In ad hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner and each node can act as sender, receiver and router at the same time. These nodes can be dynamically self-organized into arbitrary topology networks without a fixed infrastructure. Ad hoc routing protocols can be classified into three main categories based on the number of senders and receivers in group computing environment: Unicast, Multicast and Broadcast routing protocols. In unicast routing the communication is simply one-to-one that is a separate transmission stream from source to destination for each recipient. Multicast communications are both one-to-many and many-to many traffic pattern i.e. to transmit a single message to a selective group of recipients where as in broadcast routing communications is one-to-all traffic pattern. It is a basic mode of operation in wireless medium that provides important control and route establishment functionality for a number of on demand unicast and multicast protocols. When designing broadcast protocols for ad hoc networks, developers seek to reduce the overhead such as collision and retransmission, while reaching all the network nodes. One of the fundamental challenges of MANETs is the design of dynamic routing protocols with good performance and less overhead with maximize network lifetime. Many routing protocols, such as Ad hoc On-demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR), have been proposed for MANETs. The above two protocols are Ad-hoc on demand routing protocols, and they could increase the scalability of MANETs by limiting the routing overhead when a new route is requested. Node mobility in MANETs, frequent link breakages results to frequent path failures and packet collision, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay. Reducing the routing overhead in route discovery is an essential problem. In a route discovery, broadcasting is a fundamental and effective data dissemination mechanism, where a mobile node can

rebroadcasts the first received route request packets unless it has a route to the destination, and thus it causes the broadcasting problem in the network. The conventional on-demand routing protocols use the simple flooding to discover a route. They broadcast a Route REQuest (RREQ) packet to the networks, and the broadcasting induces increased redundant retransmissions of RREQ packet and causes the broadcast storming problem, it results to a considerable number of packet collisions and congestion, especially in dense networks. Some methods and mechanisms have been proposed to optimize the broadcast problem in MANETs in the past few years. By categorized broadcasting protocols into five classes: “simple flooding method, probabilistic rebroadcast-based methods, coverage area-based methods, neighbor knowledge methods, and Energy consideration routing”. In the simple flooding method, the initializing node i.e. source node first broadcast a packet to all neighbors by consider each node energy level. It is forwarded by every neighbor in the network exactly once until all reachable network nodes have received that packet. Though simple flooding method ensures the complete coverage, it has the largest forward node set and may cause broadcast storm problem in the network. Probabilistic rebroadcast and neighbor coverage based methods are proposed to solve the broadcast storm problem. They showed that an increase in the number of nodes in a static network will degrade the performance of the probability-based and area-based methods. Energy efficiency routing is of paramount significance for MANETs design since the mobile nodes in such networks are typically run by a battery power. Minimum Power or Power failure of a mobile node does not only affect the node itself but also its ability to forward packets on behalf of others and thus the overall network lifetime. For this reason, many research efforts have been devoted to prolong the mobile node battery capacity at different aspects. Energy considerable routing is based on each nodes energy capability at the time of route request. For limiting the number of rebroadcasts can effectively optimize the routing, and neighbor knowledge methods perform better than the area-based ones and the probability-based ones, then propose an Energy considerable routing with neighbor coverage based probabilistic rebroadcast. Therefore1. in order to send a RREQ by considering the energy level of each neighboring node. 2. in order to effectively exploit the neighbor coverage knowledge, need a novel rebroadcast delay to determine the rebroadcast order,
and then can obtain a more accurate coverage ratio. 3. in order to keep the network connectivity and reduce the redundant retransmissions, need a metric named connectivity factor to determine how many neighbors should receive the RREQ packet. After that, by consider the both additional coverage ratio and the connectivity factor, originate a probabilistic rebroadcast, can be used to reduce the number of rebroadcasts of the RREQ packet, it can improve the routing performance.

The remainder of this paper is as follows. Section II describes related work on routing protocol in MANETs. Section III describes the design and formulation details of our proposed routing scheme. Section IV The computer simulation, related experiment settings, and comparisons between DSR and existing. Section V concludes this paper.

2 RELATED WORKS

Ad hoc routing algorithms broadly can be categorized into proactive and reactive. The reactive routing algorithms originate to find out the suitable route when a route is needed or requested. The Proactive routing algorithms exchange each node routing information periodically and generates the routing table in advance of route request from source. These kinds of protocols select the routes based on the metrics of minimum hop count. Broadcasting is an effective mechanism for route maintenance and discovery, but the routing overhead associated with the broadcasting can be quite large, especially in high dynamic networks. Routing protocols are proposed for Ad hoc networks and their classification of these schemes according to the routing strategy (i.e., table driven and on-demand). Table-driven routing protocols, such as DSDV and OLSR, attempt to maintain consistent and up-to-date routing information from each node to every other node in the network. Each mobile node is required to periodically discover and maintain routes to every possible destination in the network. In the reactive routing protocols are, such as AODV and DSR, routes are discovered only when they are needed. Each node maintains a route for a perfect route of source to destination pair without the use of periodic routing table exchanges or full network topological view.

TABLE 1

COMPARISON TABLE

Sr. No.	AODV	DSR	DSDV
1	It is Reactive Protocol	It is Reactive Protocol	It is Proactive Protocol
2	It has low end to end delay	It has low end to end delay.	It has high for pause time 0 but it starts decreasing as time increases
3	It performs better for larger number of nodes	It performs better for larger number of nodes	It performs better for few number of nodes
4	It delivers virtually all packets at low mobility	It is very good at all mobility rates.	It performs almost as DSR, but requires transmission overheads of many packets.
5	For real time traffic AODV is preferred.	For real time traffic DSR is not preferred	For real time traffic DSDV is not preferred

Dynamic Probabilistic Route Discovery (DPR) scheme based on neighbor coverage knowledge. This approach, each node consider the forwarding probability according to the number of its neighbors and the set of neighbors which are covered by the before or previous broadcasting. This scheme only considers the coverage ratio by the prefix node, and it cannot consider the neighbors receiving the duplicate RREQ packet.

3 PROPOSED SYSTEM

On demand and Proactive protocols select the routes based on the metrics of minimum hop count. Energy efficiency routing is of paramount significance for MANETs design since the mobile nodes in such networks are typically battery has been powered. More Power consumption or failure of a mobile node does not only affect the node itself but also its ability to forward packets on behalf of others and thus it can affect overall network lifetime. Consider these reasons, many research efforts have been devoted to prolong the mobile node battery capacity at different aspects.

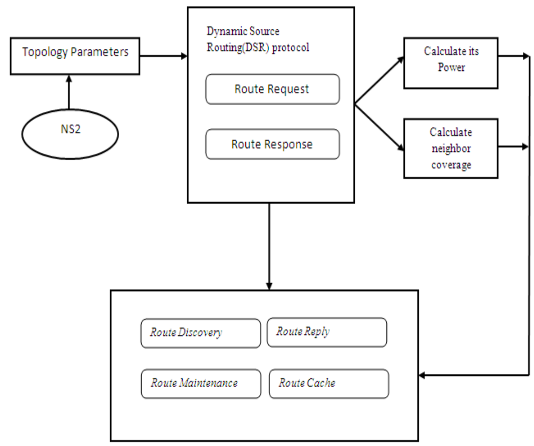

Fig 1. Architecture diagram

3.1 ENERGY SAVING DYNAMIC SOURCE ROUTING

Include communication energy consumption and Non communication energy consumption. Design and manufacturing of less energy consume components of mobile nodes are to reduce non communication energy consumed. In the communication energy is consumed in either inactive state of communication or active communication states. The energy consumption of active communication is more significant than the others for high traffic environment. Energy efficient routing protocols are designed to formulate energy efficient active communications. Energy efficient in the active communications increase the network life time. The life time of the network is defined as the time when a node runs out of its own battery power for the first time. The energy efficient routing protocols should consider the power consumption from the viewpoints of both the network and the node.

- Transmission power control approach
- Load distribution approach.
- sleep/power-down mode

A. Transmission Mode

A node is said in transmission mode when it sends data packet to other nodes in network. Those nodes need energy to transfer data packet, this kind of energy is called Transmission Energy (T_x) of that nodes. Transmission energy can be depended on the size of each data packet (in Bits). The transmission energy is given by:

$$T_x = (330 * P_{length}) / 2 * 10^6$$

And

$$P_T = T_x / T_t$$

Where T_x is refer as Transmission Energy, P_T is refer as Transmission Power, T_t is time taken to transmit data packet and P_{length} is length of data packet in Bits.

B. Reception Mode

When a node receives a data packet from other nodes then it said to be in Reception Mode and the energy taken to receive packet is called Reception Energy (R_x). Then Reception Energy can be given as:

$$R_x = (230 * P_{length}) / 2 * 10^6$$

And $P_R = R_x / T_r$

Where R_x is a Reception Energy, P_R is a Reception Power, T_r is a time taken to receive data packet and P_{length} is length of data packet in Bits.

C. Idle Mode

In this mode generally the node is neither transmitting nor receiving any data packets. But this mode consumes power because the nodes have to listen to the wireless medium continuously in order to detect a packet that it should receive so that the node can then switch into receive mode from idle mode. Despite the fact that while in idle mode the node does not actually handle data communication operations it was found that the wireless interface consumes a considerable amount of energy. Then power consumed in Idle Mode is:

$$P_I = P_R$$

Where P_I is power consumed in Idle Mode and P_R is power consumed in Reception Mode.

D. Overhearing Mode

When a node receives data packets that are not destined for it, then it said to be in overhearing mode and it may consume energy used in the receiving mode. Unnecessarily receiving those packets will cause energy consumption. Then power consumption in this overhearing mode is:

$$P_{over} = P_R$$

Where P_{over} is power consumed in Overhearing Mode and P_R is power consumed in Reception Mode

- The Source node consider as S wants to send data to the destination node D, it will first send REQ message to all its neighbor nodes.
- When neighbor nodes receive REQ message they will check their Route Cache, if this packet's ID is already in their Route Cache then packet will be discarded.
- Otherwise, node will calculate its power by using:

  $$P_{new} = P_{tx} - P_r + P_{th} + P_m + P_{over}$$

  and send this value as a route reply to source.
- Source node will calculate the mean value of all the values of P_{new} of all the nodes and send a RREQ message to the node whose P_{new} value is nearest to the mean value.
- When the node receives a RREQ message it will send REQ message to its own neighbors and this process will be continued till the destination node reaches.
- When destination node will receive the RREQ message it will send the RREP message back with the same route.
- RREP process is same as in the traditional protocol DSR

3.2 NEIGHBOR COVERAGE KNOWLEDGE-BASED PROBABILISTIC REBROADCAST MECHANISM

In this section, calculate the rebroadcast delay and rebroadcast probability of the proposed system. Use the upstream coverage ratio of an RREQ packet received from the previous node to calculate the rebroadcast delay, and then use the additional coverage ratio of the RREQ packet and the connectivity factor to calculate the rebroadcast probability, which requires that each node needed their one hop neighborhood information.

A. Uncovered Neighbors Set and Rebroadcast Delay

When node n_i receives an RREQ packet from its previous node s, it can use the neighbor list in the RREQ packet to estimate how many its neighbors have not been covered by the RREQ packet from s. If node n_i has more neighbors uncovered by the RREQ packet from s, which means that if node n_i rebroadcasts the RREQ packet, the RREQuest packet can reach more number of additional neighbor nodes. To quantify this, define the UnCovered Neighbors set $U(n_i)$ of node n_i as follows:

$$U(n_i) = N(n_i) - [N(n_i) \cap N(s)] - \{s\}$$

where $N(s)$ and $N(n_i)$ are the neighbors sets of node s and n_i, respectively. s is the node which sends an RREQ packet to node n_i. In order to sufficiently exploit the neighbor knowledge and avoid collisions and congestion, each node in the network should set a rebroadcast delay. When a neighbor node receives a RREQ packet from its source, it could calculate the rebroadcast delay according to the neighbor list in the RREQ packet and its own neighbor list. The rebroadcast delay $T_d(n_i)$ of node n_i is defined as follows:

$$T_p(n_i) = 1 - \frac{|N(s) \cap N(n_i)|}{|N(s)|}$$

$$T_d = MaxDelay \times T_p(n_i)$$

Where $T_p(n_i)$ is the delay ratio of node n_i, and MaxDelay is a small constant delay. | . | is the number of elements in a set. The above rebroadcast delay is defined with the following reasons: initially, the delay time is used to determine the node transmission order. When node s sends an RREQ packet, all its neighbors n_i, i = 1, 2 . . . $|N(s)|$ receive and process the RREQ packet. Assume that node n_k has the largest number of common neighbors with node s, according to the above formula, node n_k has the lowest delay. The objective of this rebroadcast delay is not to rebroadcast the RREQ packet to more nodes, but to broadcast the neighbor coverage knowledge more quickly. If node n_i receives a duplicate RREQ packet from its neighbor n_j, it knows that how many its neighbors have been covered by the RREQ packet from n_j. Thus, UCN set according to the neighbor list in the RREQ packet from n_j. Then, the $U(n_i)$ can be adjusted as follows:

$$U(n_i) = U(n_i) - [U(n_i) \cap N(n_j)]$$

After adjusting the $U(n_i)$, the RREQ packet received from n_j can be removed. When the time of the rebroadcast delay of node n_i expires, the node obtains the final UCN set. Note that, if a node does not sense any duplicate RREQ packets from its neighborhood, its uncovered neighbor set does not changed, which is the initial UCN set. Define the additional coverage ratio $(R_a(n_i))$ of node n_i as :

$$R_a(n_i) = \frac{|U(n_i)|}{|N(n_i)|}$$

This metric indicates the ratio of the number of nodes that are additionally covered by this rebroadcast to the total number of neighbors of node n_i. R_a becomes bigger, more nodes will be covered by this rebroadcast, and several nodes need to receive and each node process the RREQ packet, and then the rebroadcast probability can set to be higher. If each node connects to more than 5:1774 log n of its coverage neighbors, then the rebroadcast probability of the selected network be in connected is approaching 1 as n increases, where n is the total number of nodes in the network. Then, use 5.1774 log n as the connectivity metric of the network. Assume the ratio of the number of nodes that need to receive the RREQ packet to the total number of neighbors of node n_i is $F_c(n_i)$. In order to keep the probability of network connectivity approaching 1, a heuristic formula:

$|N(n_i)|$. $F_c(n_i) \geq$ 5.1774 log n. Then, define the minimum $F_c(n_i)$ as,

$$F_c(n_i) = \frac{N_c}{|N(n_i)|}$$

where N_c = 5.1774 log n, and n is the number of nodes in the network. From ,observe that when $|N(n_i)|$ is greater than N_c, $F_c(n_i)$ is less than 1. That means node n_i is in the dense area of the network, then only part of neighbors of node n_i forwarded the RREQ packet could keep the network connectivity. And when $|N(n_i)|$ is less than N_c, $F_c(n_i)$ is greater than 1. That means node n_i is in the sparse area of the network, then node n_i should forward the RREQ packet in order to approach network connectivity. Combining the additional coverage ratio and connectivity factor, obtain the rebroadcast probability $P_{re}(n_i)$ of node n_i:

$$P_{re}(n_i) = F_c(n_i) \bullet R_a(n_i)$$

where, if the $p_{re}(n_i)$ is greater than 1, set the $P_{re}(n_i)$ to 1. Note that the calculated rebroadcast probability $P_{re}(n_i)$ may be greater than 1, but it does not impact the behavior of the protocol. It just shows that the local density of the node is so low that the node must forward the RREQ packet. Then, node n_i need to rebroadcast the RREQ packet received from s with probability $P_{re}(n_i)$.

4 SIMULATION RESULTS

The simulation work for the proposed Technique MESDSR is done in NS-2. The simulation result shows that he proposed method is more efficient than the existing method.

4.1 Throughput

Network throughput is the average rate of successful message delivery over a communication channel.

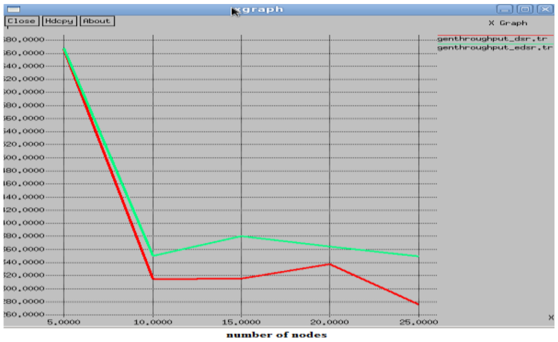

Fig 1. Throughput vs. Number of Nodes

4.2 Packet Delivery Fraction

Packet Delivery Fraction is the ratio of number of data packets successfully delivered to the destination. The figure 8 shows the better performance of MESDSR as compare to DSR. ESDSR provides considerable improvement of PDF.

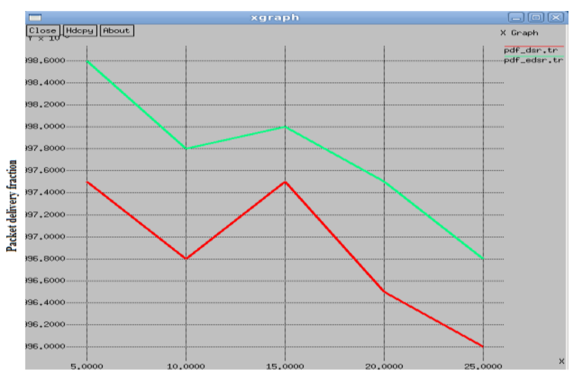

Fig 2. Packet Delivery Fraction vs. Nodes

4.3 Average Energy consumption

Average energy consumption is the ratio of total energy consumed by all the nodes in the network by the number of nodes. The figure 9 shows the graph of average energy consumption vs. number of nodes and the nodes in MESDSR will consume less energy as compare to the nodes in DSR.

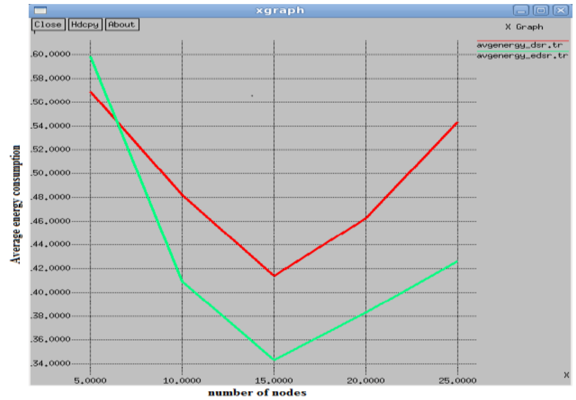

Fig 3 Average Energy Consumption vs. Number of Nodes

5 CONCLUSION

In this paper, proposed an ESDSR and probabilistic rebroadcast mechanism based on neighbor coverage to reduce the routing overhead and increase network lifetime in MANETs. This neighbor coverage knowledge includes additional coverage ratio and connectivity factor. Proposed a new scheme to dynamically calculate the rebroadcast delay, which is used to determine the forwarding order and more effectively exploit the neighbor coverage knowledge. Simulation results show that the proposed system generates the increasing throughput, PDR and reduce in End to End delay. Because of less redundant rebroadcast, the proposed mechanism mitigates the network collision and contention, so as to increase the packet delivery ratio and decrease the average end-to-end delay. The simulation results also show that the proposed has good performance when the network is in high density or the traffic is in heavy load.

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