Volume: 4 Issue: III Month of publication: March 2016
DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Energy Efficient Routing Protocol Considering Residual Energy in Wireless Adhoc Networks

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Abstract-* Wireless networks adapt easily to changes and offers flexibility in the configuration of the network. In MANET, each node will change its location dynamically and configure itself according to the environment. An effective mechanism for route discovery in such networks is broadcasting, but routing overhead associated with broadcasting can be large in high dynamic networks. To reduce this routing overhead in MANETs, a neighbor coverage based probabilistic rebroadcast protocol is used. To determine the rebroadcast order, a novel rebroadcast delay is used and it obtains the more accurate additional coverage ratio by sensing neighbor coverage knowledge. The rebroadcast probability is calculated by merging the additional coverage ratio and connectivity factor. In the proposed method Energy Efficient Neighbor Coverage Protocol(NCPR) is introduced. In this, the node does not forward RREQ unless there is sufficient energy (battery lifetime), and until the node density in its surrounding exceeds a particular threshold. These two parameters are defined taking into consideration various statistics. NCPR analyzes these two parameters, when implementing routing discovery, and avoiding the unnecessary information sending efficiently and avoid unnecessary information transfer.

Keywords: AODV, DSR, MANET, NCPR, Overhead, coverage ratio;

I. INTRODUCTION

Mobile Ad hoc Networks (MANETs) are self-configuring mobile wireless networks. A temporary network without the aid of any infrastructure or centralized administration will be formed by ad hoc networks which are a collection of wireless mobile hosts. The structure of the network changes dynamically in mobile ad hoc networks, which is a self organizing and self-configuring multihop wireless networks. It is because of the mobility of the nodes[3]. To engaging in multihop forwarding the nodes in these networks utilizes some random access wireless channel, cooperating in a friendly manner.

The node in the mobile ad hoc network not only acts as hosts, it may be intermediate hosts, source host or destination hosts but also as routers that helps to route data to/from other nodes in network. There is no infrastructure support and there may be the destination node might be in out of range of a source node, which transmits the packets; so it is important that a routing procedure is needed to find a path for forwarding the data packets between the source and the destination. A base station within a cell can reach all mobile nodes without routing via broadcasting in common wireless networks[6]. Each node in ad hoc network must be able to forward data to the other nodes. This creates additional problems with dynamic topology which is unpredictable connectivity changes.

Thus MANETs are suitable for emergency situations like natural or human-induced disasters, military conflicts, emergency medical situations, etc because of its random topology. Using random mobility model, the nodes in Mobile Ad hoc Network can get the service to communicate each node in network .Due to high mobility in network, there is no base station service to network and routing path cannot be define constantly for data transmission, so data loss and path failure is the major issues in Mobile Ad Hoc Networks.

To reduce this routing overhead in MANETs, neighbor coverage based probabilistic rebroadcast protocol[2] is used.

Mobile ad hoc networks consist of mobile nodes those operate on battery. A mobile node has a decreasing finite energy. Therefore to make best use of the battery life, these nodes need to be energy conserved. Energy management is the duty of MAC (Medium Access Control) layer while the network layer can take decisions based on current traffic characteristics or topology. Energy consumed by the sleeping state node is significantly less than the transmit/receive/idle state node. Path which consumes less power can be chosen to reduce the consumption of energy.

II. RELATED WORKS

A probabilistic broadcasting based on coverage area and neighbor confirmation in mobile ad hoc networks. The coverage area of a node is used to adjust the rebroadcast probability. If a mobile node is located in the area closer to sender, which means it has small additional coverage and rebroadcast from this node can reach less additional nodes, so its rebroadcast probability will be set lower[6].

An angle-aware probabilistic broadcasting scheme is proposed to yield higher performance in term of delivery ratio and number of retransmitting nodes. In addition, it is simple enough for easy implementation without the use of neighbor's information or maintaining a counter for duplicate packets[1]. The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol optimized for mobile ad-hoc networks, which can also be used on other wireless ad-hoc networks. OLSR is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad-hoc network[8].

III. NEIGHBOR COVERAGE BASED PROBABILISTIC REBROADCAST PROTOCOL

The number of rebroadcasts can effectively optimize the broadcasting and the neighbor knowledge methods perform better than the probability based ones and the area based ones , then a neighbor coverage based probabilistic rebroadcast protocol is proposed. Therefore,

A. A novel rebroadcast delay is needed to determine the rebroadcast order, and more accurate additional coverage ratio is obtained, in order to effectively exploit the neighbor coverage knowledge.

B. A metric named connectivity factor is needed to determine number of neighbors that should receive the RREQ packet, to keep the network stay connected and to reduce the redundant transmissions.

After that, by combining the connectivity factor and additional coverage ratio , a rebroadcast probability is introduced. This probability can be used to decrease the number of rebroadcasts of the RREQ packet, which in turn improves the routing performance.

A fresh scheme to calculate the rebroadcast delay is to determine the forward-ing order. The node that has more common neighbors with the preceding node has the lower delay when compared with other nodes. If this node rebroadcasts a packet, then more common neighbors[1][2] can recognize this fact. Therefore, this rebroadcast delay enables the information that the nodes have transmitted the packet, reach to more neighbors, and this becomes the success factor of the proposed scheme.

In order to calculate the rebroadcast probability, a novel scheme considers the information about the connectivity metric, uncovered neighbors and local node density. The rebroadcast probability consists of two parts:

Connectivity factor, which reflects the relationship of network connectivity and the number of neighbors of a given node.

Additional coverage ratio, which is the ratio of the number of nodes that should be covered by a single broadcast to the total number of neighbors.

IV. ENERGY EFFICIENT NEIGHBOR COVERAGE PROTOCOL

Each node has a certain battery life and node density in its surrounding which is saved in the routing table of proposed EENC protocol. The intermediate node doesn't forward the RREQ message immediately if there is a route to destination. In fact, it will first check its lifetime and calculate the node density of its surrounding. Second parameter is taken into consideration because; there should be sufficient number of nodes to forward RREQ. Hello messages are used to determine neighbor connectivity or node density. Two thresholds are introduced say for RREQ rebroadcasting and for node density of the environment. If the battery life and node density of the intermediate node, who receives the RREQ is greater than and, it can be concluded that, the broadcast of RREQ successfully reaches the destination node and so the intermediate node can rebroadcast RREQ message. If the ratio is less than and, the intermediate node buffers the packets and repeats the above process iteratively until either the broadcast is successful or the number of attempts exceeds a threshold. This process helps to decrease unnecessary packet rebroadcasting and increase the throughput.

Volume 4 Issue III, March 2016
ISSN: 2321-9653

Energy Efficient Neighbor Coverage Protocol (EENCP) algorithm

Initialize the nodes in the network randomly
S broadcasts RREQ packet to intermediate node
Intermediate node will first check its lifetime and calculate the node density of its surrounding
Check own battery life
Calculate the node density of the surrounding;
If Battery life is less than the Threshold ( )
Remain silent, drop RREQ.
Else If count is less than the Threshold ( )
Packets are stored in node's buffer;
else
RREQ is broadcasted further.

A. Simulation Environment

Simulation parameter	Value
Simulator	Matlab r2007b
Topology Size	1000m X 1000m
Number of nodes	50,100,150,……, 300
Transmission Range	250m
Bandwidth	2Mbps
Traffic type	CBR
Number of CBR connections	10
Packet Size	512 bytes
Pause time	0s
Min speed	1 m/s
Max speed	5 m/s

Table 1: Simulation Parameters

V. PERFORMANCE EVALUATION

A. Battery Lifetime

Remaining energy is calculated as shown in equation

Remaining energy = initial energy – used energy

There is a reduction in energy consumption of network for EENCP as compared to AODV and NCPR because each node is now aware of its energy constraints for data communication.

B. Average Throughput

Analysis on various scenarios based on different number of nodes is performed. As compared to the existing AODV, proposed schemes in forwarding a route request are more effective in reducing the flooding overhead and efficient network lifetime as well as throughput thereby, decreasing the network latency. Simulation results indicate that, the proposed scheme provides enhanced performance. EENCP generates good throughput as compared to AODV.

C. Performance of NCPR compared with AODV

In the conventional AODV protocol, the massive redundant rebroadcast incurs many collisions and interference, which leads to excessive packets drop. When the numbers of nodes increase, collisions and interference will be more severe. The packet

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drops and redundant rebroadcast caused by collisions must be reduced to improve the performance of the routing mechanism. When the NCPR protocol is compared with conventional AODV protocol, the first protocol reduces the collision rate than the second one. The NCPR protocol can considerably reduce the routing overhead which is incurred during the route discovery particularly in dense network. Then, the RREQ traffic is also reduced. For fairness, the statistics of normalized routing overhead also includes Hello traffic. Nonetheless, the NCPR protocol yields the best performance, so that the improvement of normalized routing overhead is considerable.

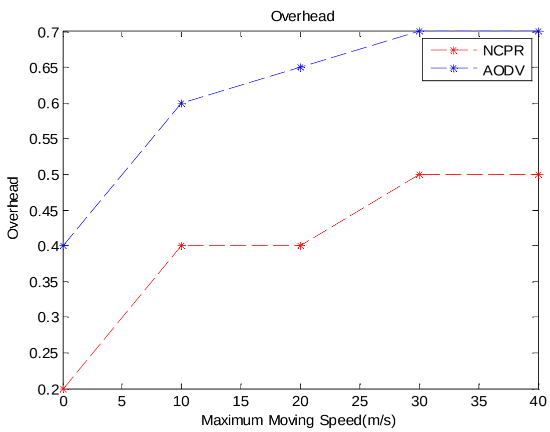

Figure 2: Graph for overhead

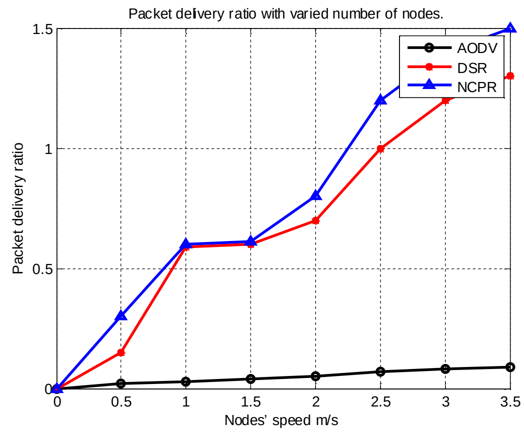

Figure 3: Graph for Packet delivery ratio

Features	AODV	NCPR
Routing Overhead	High	Low routing overhead
Mechanism	Combination of DSR and DSDV	AODV
Higher-mobility performance	Medium	High
Latency time	High	High
End to End Delay	High	Low
RREQ Traffic	High	RREQ Traffic is reduced
Packet Drops	High	Reduced compared with
Collision rate	High	Reduced compared with
Energy Consumption	High	Low

TABLE 2: Comparison of AODV with NCPR

VI. CONCLUSION

Neighbor coverage based probabilistic rebroadcast protocol has been implemented. This neighbor coverage knowledge includes connectivity factor and additional coverage ratio. The forwarding order can be determined using the rebroadcast delay and this also exploits the neighbor coverage knowledge to determine the order. This protocol generates less rebroadcast traffic than the flooding that would have occurred if such mechanism has not been used. Because of less redundant rebroadcast, this protocol mitigates the network contention and collision, and thus packet delivery ratio is increased and average end-to-end delay is decreased. When the network density is high or the traffic is heavy, this protocol shows good performance than the existing ones. The NCPR algorithm can be combined with energy optimization technique and the resulting Energy Efficient Neighbor Coverage protocol (NCPR) can be introduced to reduce rebroadcasting of packets more when compared with AODV and DSR.

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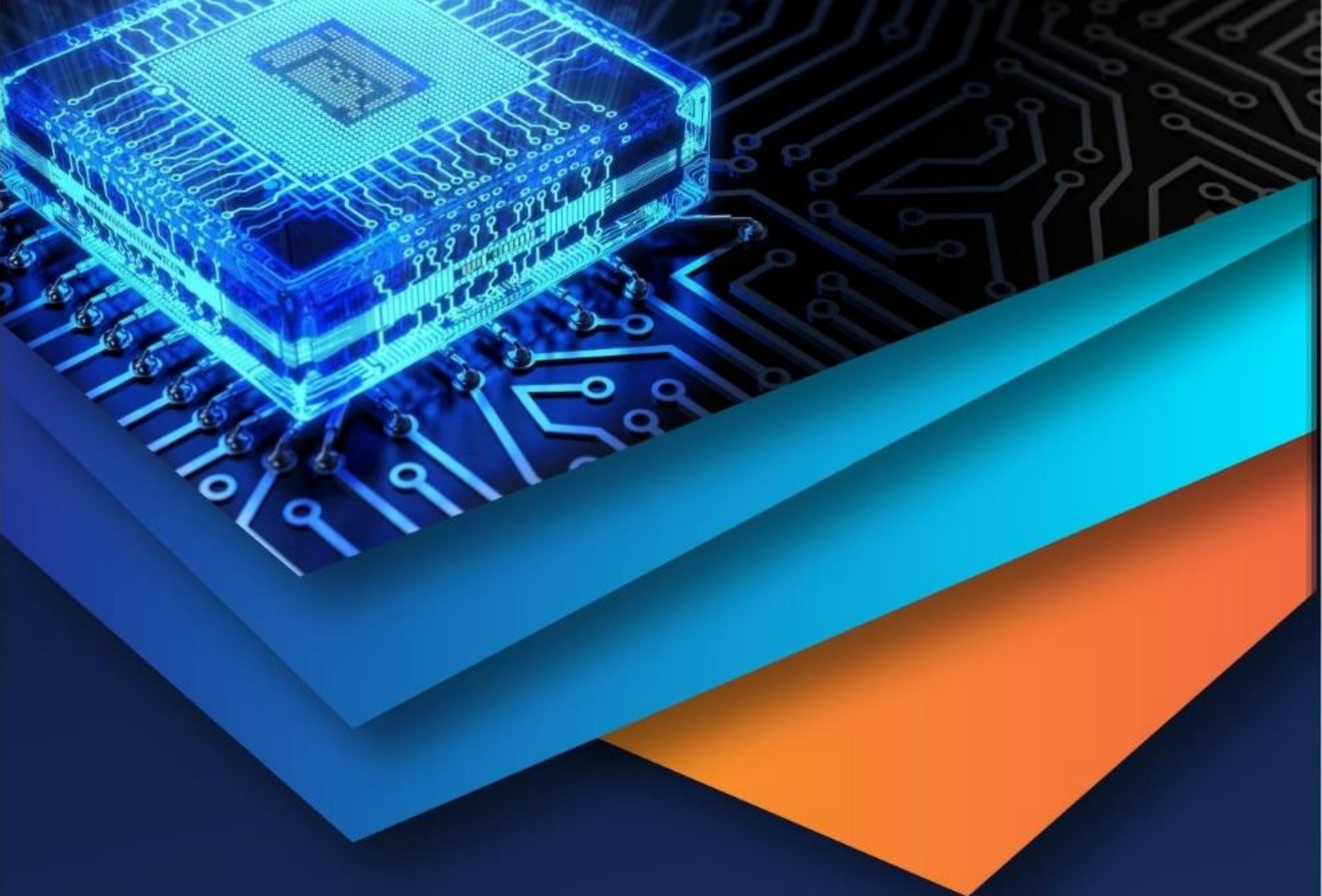

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