ABSTRACT
Mobile Ad-hoc network (MANET) is collection of wireless mobile nodes forming temporary network dynamically without the help of any fixed infrastructure. Routing in MANET differs from conventional routing in fixed networks in various ways. These differences lead to different issues with routing techniques in MANET. The idea behind Probabilistic Routing is to select a route based on a probability. These probabilities will be assigned to possible paths considering the local information available at each node. By selecting good links with high probability gives more reliable routing. The technique gives more probability to the best route in order to not compromise the reliability of the network. This technique is useful to overcome the various issues in routing within MANET. For minimizing routing overhead in MANET we can use this technique. For probability calculation we are using Monte Carlo probability theory. Simulation results show that this technique shows less routing load, total broadcast send and number of dropped packets.

I. INTRODUCTION
In common terms, Probability is the relative frequency of any event if that event is performed for sufficient number of time. In routing we can use this property of probability for making decisions about transmission of packets. Using this approach some probabilistic routing methods are introduced by many researchers. Probabilistic routing is the limited flooding mechanism, where the node receiving a packet makes the localized decision about next course of action. Hence, concept of probabilistic routing is tagged as “Think globally, but act locally”. Probabilistic routing mechanism works on the selective flooding or limited flooding, which results into reliable routing while keeping their robustness. A number of traditional routing protocols such as Dynamic Source Routing (DSR), Ad Hoc on Demand Distance Vector (AODV), Zone Routing Protocol (ZRP), and Location Aided Routing (LAR) use broadcasting or one of its derivatives to discover and establish routes. Broadcasting is a fundamental operation in MANETs whereby a source node transmits a message to all the neighbor nodes in the network to find route towards destination. Every node which receives message from source node transmits that message forwards to its all neighbors. The only ‘Optimization’ applied to this technique is that nodes remember broadcast messages received and do not act if they receive repeated copies of the same message. However, a straightforward flooding of the network with broadcast messages is usually costly. These can be results in serious redundancy and collisions in the network. Such scenario has often been referred to as the broadcast storm problem, and has generated many challenging research issues. A number of researchers have identified this problem by showing how serious it is through analysis and simulations. A probabilistic approach to flooding has been suggested as a means of reducing redundant rebroadcast messages and alleviating the detrimental effects of the broadcast storm problem. Many researchers have proposed various probabilistic approaches to minimize broadcast storm problem. For minimizing routing overhead in network we can use probabilistic technique. By using local information like node density, remaining energy of network, traffic load, distance between two nodes we can calculate message forwarding probability. In this paper, section II describes overview of present probabilistic routing techniques and their performance with respect to routing overhead. Section III presents Probabilistic technique to minimize routing overhead in MANET. Section IV discussed about the implementation details and simulation results. Finally section V is conclusion about proposed technique and future direction.

II. RELATED WORK
M Bani Yassein et. al. [1] has done performance analysis of the Fixed Probabilistic Broadcasting technique and Dynamically Adjustable Probability Broadcasting. In Fixed Probability Broadcasting technique every node rebroadcast the message with pre-defined fixed probability. Here, every node has same probability to rebroadcast the message regardless of its number of neighbours. In Dynamically Adjustable Probability Broadcasting technique when a node receiving the message first time and having number of neighbours less than average number of neighbours then broadcasting probability is
set to be high else it is set to be low. In this paper analysis is done with varying the node speed and pause time. The result says that as node speed increases reachability and saved rebroadcast increases. Authors have also examined performance trend on other system parameters like node density and traffic load. They found great impact on degree of reachability and number of saved rebroadcast achieved by probabilistic broadcasting scheme. In next research [2] he proposed the Smart Probabilistic Broadcasting (SPB) as a new probabilistic method to improve performance of existing AODV by reducing RREQ overhead. In this approach one parameter known as ‘Avg’ is used as a threshold. Avg is a count of average number of neighbours of all nodes in the network. From the simulation results they found lower routing overhead and end-to-end delay. The packet collision and congestion in network are reduced. Results shows that the traffic load is increased but the normalized routing load is low. V Kanakaris et. al. [3] presents a RREQ message forwarding technique to reduce routing overhead. This approach is applies to tradition routing protocol named as AODV. In this scheme, one hop neighbour maintains a table of nodes. When a RREQ is forwarded then only selected subset of nodes in each neighbourhood is allowed to forward. That subset of nodes is depends on the application and required quality of service. Each node transmit rout request message if and only if the condition based on its neighbourhood density is satisfied. Results analysis concludes that there is 60% reduction in number of dropped packets because of reduced packet collision and increased data throughput. This technique reduces redundant transmission based on transmitting node neighbourhood density, which has produced better results than standard protocols. But it shows poor performance in large network. A Jamal compared in his thesis [4] work the techniques such as simple flooding, fixed probability broadcasting and adjusted probabilistic route discovery is done. He proposed a route discovery technique which works dynamically. The probability function in this technique depends on node density and covered node set at a forwarding node. This algorithm partitions the network into sparse and dense regions according to local neighbour density at a node. This partition is done by using average neighbour density which is calculated by area of network, total number of nodes and signal transmission range of a node. Result shows that, the routing overhead generated by each of the routing protocols increases almost linearly as the network density increases.

Q Zhang et. al. [5] proposed in paper, the probabilistic algorithm that dynamically adjusts the rebroadcasting probability as per the node distribution and node movement. This scheme combines the fixed value probability approach with counter-based approach. The required information for counter-based function is collected locally. Author set rebroadcast probability of node according to its density in neighbourhood area. When several hosts move toward each other at that time their probabilities are set to be lower and vice versa. The packet counter in counter-based approach is used to adjust the probability. If the packet counter is high then the host is in a dense area so that it can receive a large amount of rebroadcasts from its neighbours. Hence at that node probability is set to be low. Comparison of this approach is done with the simple flooding approach and the fixed probabilistic approach. Author says that this algorithm can generate less rebroadcast than fixed probabilistic broadcasting scheme. Xi Hu and et. al. [6] proposed stability-oriented route discovery algorithm to limit routing overhead and decrease transmission delay. In this algorithm, after receiving an identical RREQ all neighbour nodes of some node will play a mix strategy game named stability-based RREQ forwarding game. Node independently determines the RREQ forwarding probability based on Nash equilibrium. In the route discovery of stability-oriented routing algorithm, intermediate nodes need to forward same RREQs more than once which leads to the broadcast storm problem. The simulation results show that this algorithm enhances the stability of route and increase the packet delivery ratio and reduces the routing overhead and the average delay. Xin Ming Zhang et. al. [7] proposes a rebroadcast delay to determine the rebroadcast order, and then obtain the more accurate additional coverage ratio by sensing neighbour coverage knowledge. Author defines a connectivity factor to provide the node density adaptation with help of combining the additional coverage ratio and connectivity factor. Their approach combines the advantages of the neighbour coverage knowledge and the probabilistic mechanism that can significantly decrease the number of retransmissions. Zang use the upstream coverage ratio of an RREQ packet received from the previous node to calculate the rebroadcast delay. The additional coverage ratio of the RREQ packet and the connectivity factor used to calculate the rebroadcast probability, which requires that each node needs its 1-hop neighbourhood information. This approach generates less rebroadcast traffic than simple flooding. That results in reduction of the network collision and contention, to increase the packet delivery ratio and decrease the average end-to-end delay. Gaurav et. al. [8] proposed a probabilistic approach for the stability of the neighbouring nodes in finding and maintaining the routing paths in Ad-hoc networks. The probability of a node being stable in the path is calculated by using queuing theory. The stability of a node is measured by number of packets arrived at a node and the number of packets being serviced by the node per unit time. The arrival of packets is calculated by the difference between current time and time when the previous packet was arrived. The simulation results indicate that the packet drop reduces by around 27% for 150 node network and throughput increases by 21% for 150 node network. V. Kanakaris et al. [9] presents an article which talks about the impact of a different message forwarding probability techniques on the RREQ and a RREQ message forwarding scheme based on Bayesian probability in AODV. The probability function designed by using the neighbour density and the posterior probability. The simulation result shows that there is a reduction in route request transmissions in a network using AODV_EXT_BP, which is resulted in 3.3% that is 0.3% better energy efficiency savings compared to AODV_EXT [3]. There is a 70% reduction in the number of dropped packets because of reduced packet collision and increased data throughput.
III. PROPOSED METHODOLOGY

M Bani Yassein [1] say that, there is great need of new broadcasting strategy that can dynamically adjust the broadcast probability which calculated by help of current state of the node in two hopes. The various techniques which are studied in section II are calculate probability by using neighbour density of the forwarding node. We are proposing a technique which can calculate forwarding probability dynamically by using current neighbourhood density and other network parameters like remaining energy power, traffic load, distance between two hopes and hop count to the destination etc. By using different parameters we can achieve our goals. If we want minimum end-to-end delay then we can use hop count towards the destination. In this article we have used neighbour density and remaining energy power. The threshold values which we have generated in [2], [3], [6], [7], [9-11] are randomly generated. In this probabilistic technique threshold values are calculated from current scenario of network. The probability calculation formula is derived from the Monte Carlo Probability Theory [12], [13]. In article [9], Author says that different probability approaches including Monte Carlo for implementation for rout discovery can be the challenging research. In this technique we are also using selection of subset of neighbour nodes which are different from previous node. Using this scheme we are minimizing retransmission of same RREQ message. Because of this we reduce some broadcast storm problem.

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The proposed algorithm takes part in simulation when any intermediate node receives a RREQ packet from its neighbour node. Here, we have modified the packet format of original RREQ message by introducing new field as RREQ received node’s ID. The value of Avg is calculated as expression (1). In thesis [4], Author uses this expression to calculate average number of neighbour nodes. Other parameters of the algorithm are stated in Table-I. The algorithm is shown in Algo. 3.1.

\[
Avg = \frac{(N - 1) \times \prod_{i=1}^{n} R^2}{A}
\]  

(1)

When any intermediate node receives RREQ packet at that time proposed algorithm starts executing. The nx that is number of neighbour nodes is compared with Avg value calculated by using expression (1). If nx is less than Avg value then for balancing reachability that packet is broadcasted without consideration of probability, else further procedure takes place. Here Procedure1() calculates probability for forwarding node by using expression (2). This probability is depends on node number of neighbour nodes that is density and remaining energy of forwarding node. This probability value is compared with threshold obtained by expression (3). If probability value is greater than threshold that is node is in denser area hence we set low_probability else node is in sparse area hence it set to be high_probability. Procedure2() is the function for calculating receiving nodes that is neighbour nodes of forwarding node probability. First step of this function is to select the subset of neighbour nodes which are different from neighbour nodes of previous node. For this we have modified original format of RREQ message by introducing new field that is RREQ received node ID. This field updated by every RREQ forwarding node before forward it further. Every node adds IDs of neighbour nodes which are going to receive RREQ by that node. Hence RREQ receiving node aware that these nodes have received already same message and will skip that nodes to forward again that RREQ if they belongs to its neighbour. Second step of function Procedure2() is calculating receiving probability of each selective neighbour node by using expression (4). As shown in expression (4), probability value is calculated using neighbour density and remaining energy of neighbour node. We are forwarding that RREQ message to Pn number of nodes having best probability values.

Algo. 3.1 Probabilistic Routing Algorithm PAODV
IV. SIMULATION RESULTS

We have used NS2 (Network Simulator v2.35) to evaluate probabilistic algorithm in AODV protocol. Performance of proposed technique is examined with RREQ message forwarding technique based on Bayesian Probability [9] and standard AODV protocol by varying network sizes as 10, 20, 30, 40, 50 numbers of nodes. The mobility mode used in all simulation is the random way point. Here, nodes in a specific area choose some destination, and move there at a random speed uniformly. Destination is chosen from \((0, V_{max})\), where \(V_{max}\) is the maximum speed of the simulation. Other simulation parameters used for this performance analysis are stated in Table II. Performance of above mentioned protocols is measured by various metrics such as total broadcast sent, number of dropped packets and routing load. Fig. 4.1 show the graph of number of nodes Vs total broadcast sent. In this graph our proposed probability technique shows less number broadcast message sent over the network than other two protocols. This is because; we are avoiding rebroadcasting of RREQ messages. In AODV simple flooding is used to forward RREQ messages. Here, we are using probabilistic flooding which helps to reduce total broadcast sent. Fig. 4.2 shows the graph of number of nodes Vs total number of packets dropped. From this graph it is clear that Bayesian technique shows more packet drop because there is rebroadcasting of RREQ packet and if the probability is less than threshold, it simply drops that packet. In proposed technique we have used less rebroadcast and if the probability is less than threshold, we are forwarded message with high probability hence our proposed technique shows less number of packet drop. Fig. 4.3 shows graph of total number of nodes Vs Routing load per node. In our algorithm we are avoiding rebroadcasting and forwarding RREQ messages by using probabilistic flooding. Hence our proposed probability technique gives less routing load than Bayesian based technique and standard AODV protocol.

These simulation results say that our PAODV reduces routing load by 40% than AODV_EXT_BP [9] standard AODV protocol. PAODV shows better results with respect to number of packet drops by 20% than AODV_EXT_BP.

Table-II. Simulation Parameters
CONCLUSION

In this paper, we proposed new probabilistic technique to reduce routing overhead in MANET. This technique calculates probability dynamically by using local information such as number of neighbour nodes and remaining energy of node. Simulation results shows that routing overhead is reduced by 40% than Bayesian based technique and number of dropped packets is reduced by 20% than Bayesian based technique. In future, we are going to improve this technique to improve throughput by using different local information to dynamically calculate probability.

REFERENCES