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RESEARCH ARTICLE

Implementation of Novel Approach to Enhance Routing Performance

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Abstract*— *In Mobile Ad-Hoc Networks (MANETs) or Opportunistic Networks, nodes are dynamically self organized without fixed infrastructure. Therefore there are frequent link breakages which lead to frequent path failures and route discoveries. But communication still desirable in such network without available of end to end path and also traditional protocols not capable of deliver messages between hosts. This paper propose, novel approach by combining functionalities of flooding based routing and LAL Random Early Detection, is based on principle of RED congestion avoidance mechanisms of active queue management technique. It combines advantages of these techniques, which can significantly reduce the overhead and improve routing performance.

Keywords*— *Active Queue Management, Epidemic Routing, Probabilistic Routing, LALRED, MANET

I. INTRODUCTION

Mobile Ad-Hoc Network (MANET) consists of collection of different nodes like Laptops, Mobile Phones, and Personal Digital Assistant (PDA's) and so on, these nodes are dynamically self-organized without fixed infrastructure. Therefore, they can communicate with each other even if a route connecting them never exists and without any centralized network. Such networking can be used in context like disaster recovery management, military operations, sensor networking, monitoring and places where deployment of infrastructure is either difficult or costly. High mobility of nodes in Mobile Ad-Hoc Network (MANET), there exist frequent link breakages which lead to frequent path failures and route discovery. Therefore, congestion is occurring, the occurrence of congestion control result must be reduction in the link bandwidth utilization that degrades throughput performance. Hence, for good performance, there must be control network congestion is necessary. Various strategies of congestion control measures have been implemented for to control the sending rate of data entering in internet by regulating size of the congestion window. These strategies include Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery [5]. MANET's most interesting evolutions are opportunistic network and this network is typically separated into several network partitions called regions. The opportunistic network enables the devices in different regions to interconnect by operating message in a store-carry-forward fashion. The intermediate nodes implement the store-carry-forward message switching mechanism by overlaying a new protocol layer, called the bundle layer [4].

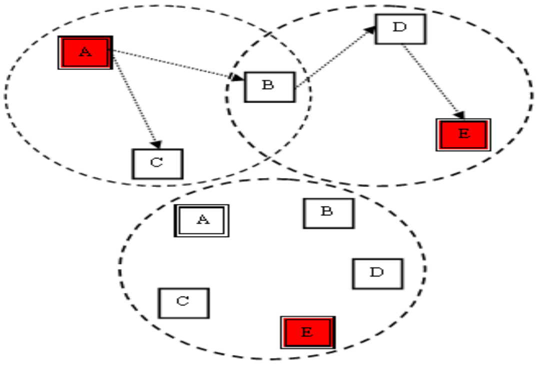

Fig 1: A message is passed from node A to node E via nodes B and D through mobility nodes

In Fig. 1, source A wants to send message to a destination E, but there is no exits a path between node A to E mobility of nodes allow the message first transfer to node B and node C, then node D and finally node D moves within the range of node E and deliver the message to its final destination [11].

The main contribution of this paper is as, a novel approach calculate probability between nodes using probabilistic based routing approach before communication take place between nodes by sending message same as epidemic approach. Due to that flooding of multiple copy of message can be avoided. Additionally, a novel approach also implements LALRED [3], to every node message queue that, minimizing the queue size to lower the message loss.

II. LITERATURE SURVEY

Chung-Ming Huang, et al [4], provides a quick overview of the various issues in opportunistic network. Opportunistic network as one type of challenged network where link performance is highly variable. Therefore, the path can be highly unstable and may change or break quickly. Basically, applications of opportunistic network are typically an environment that is tolerant of long delay and high error rate, Sami network connectivity and Zebranet. As mentioned above, MANETs depend on forwarding data packets that sent by other nodes, so power consumption is a serious issue in an ad hoc networks. Therefore it say that, ad hoc networks nothing but self-dependent. There are two specific challenges in an opportunistic network. Contact Opportunity and Node storage. As mentioned in Section I. Based on the number of copies of a message forwarded by the node, define two different routing schemes,

- **Forwarding Approach**

  Also called as single copy approach, there is only one single custodian for each message to forwarding message to destination. Forwarding based approach can be classified into three categories: Direct Transmission, Location based and Estimation-based. Direct-transmission is a simple single-copy routing called direct transmission routing. In this approach, after the source node generates a message, the message is hold by the source node until it reaches the destination node. The main advantage of this scheme is that it incurs minimum data transfers for message deliveries. In Location-based approach, nodes will choose the neighbours who are closest to the destination to pass the message. As compared to epidemic routing, this approach has less control packet overhead and buffer usage. Knowledge-based, based on certain knowledge about the network, the source and intermediate nodes decide which node to forward the messages as well as whether it should transmit the message immediately or hold the message until it meets a better node [4].

- **Flooding Approach:**

  Also called as multiple copies approach, Flooding based approach may generate multiple copies of the same message. Each message can be routed independently for increased efficiency. This approach provides lower delays and higher delivery ratio. Flooding based approach can be classified into two categories: Epidemic routing and Prediction routing. Vahdat and Becker [11], present a routing protocol for intermittently connected networks called Epidemic Routing. In epidemic routing mechanism, network is not connected whenever a node generates data to send. Also sender has no knowledge of destination location and network topology. Epidemic routing has some drawback such as message sender have inexact knowledge of location of nodes throughout the system and it transmits multiple copies of a message simultaneously in system. Anders Lindgreny, et al [9] consider problem of routing in intermittently connected networks and proposed PROPHET, a Probabilistic Routing Protocol using History of Encounters and Transitivity. Delivery predictability calculation divides into three parts, first one a high predictability. Secondly, aging equation and third a transitive property which are calculated using a scaling constant.

Sudip Misra, et al, presented a learning-automata-like (LAL) mechanism for congestion avoidance in wired networks [3], used for avoid congestion take place due to flooding of messages. This algorithm, named as LAL Random Early Detection, works on the principle of the operations of existing RED congestion-avoidance mechanisms, augmented with a LAL philosophy. The main objective of LALRED is to effectively use the value of the average size of the queue for congestion avoidance and to consequently reduce the total loss of packets at the queue, for achieve this at every time instant, the LAL scheme in turn chooses the action that controls the maximal ratio between the number of times the chosen action is rewarded and the number of times that it has been chosen. The Queue Size and Queue Lost metrics were used to comparatively evaluate the performances of RED and LALRED. Queue Size metric quantities the size of the queue. It is measured in terms of the number of packets or bytes. Queue Lost metric helps to evaluate the number of packets lost at the gateway due to congestion in the network. As the number of packets lost increases, the delay for a receiver to receive the message also increases. It can be determine, the number of packets lost at the gateway using LALRED is lower as compared to that using RED. The average queue size maintained when using LALRED is lower as compared to that using RED.

III. SYSTEM OVERVIEW

The proposed system overview as shown in Fig. 2, when two nodes meet, first calculate or update the probability of nodes using Delivery Predictability Calculation, then exchange there summary vector for message checking and all queue size manage through LALRED mechanism for maintaining average queue size with minimum packet loss.

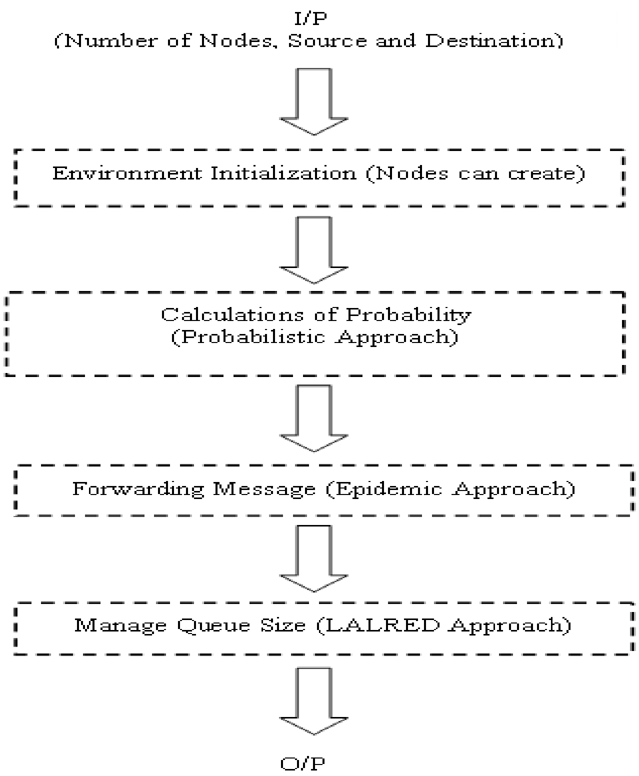

Fig.2: System Flow

A. ***Environment Initialization:***

Initial level of execution show environment like mobile network where nodes move freely. Therefore assign required number of nodes and show same environment.

B. Calculations of Probability:

For selecting best nodes for exchanging message, calculate probability between two nodes by considering history counter and transitivity property [9].

***C. Forwarding Message*:**

Maintain summary vector of messages for every node, forward to reachable nodes finding by using probabilities approach and exchange the message [9]. Also, by placing a LAL algorithm at the every node of evaluation and according to message status take corresponding actions on the message.

IV. **ALGORITHM STRATEGIES**

- ***Epidemic Routing***

In epidemic routing mechanism, network is not connected whenever a node generates data to send. Each host stores a bit vector called the summary vector. When two nodes meet they exchange summary vectors to determine if the other node has some message that was previously unseen to this node. In that case, the node requests the messages from the other node. This means that, messages will spread like an epidemic of some disease through the network as nodes meet and "infect" each other as long as buffer space is available.

Each message must contain a globally unique message ID to determine if it has been previously seen. The messages also contain a hop count field, this field is similar to the TTL field in IP packets and determines the maximum number of hops a message can be sent, and can be used to limit the resource utilization of the protocol. Messages with a hop count of one will only be delivered to their final destination.

- ***Probabilistic Routing***

As mentioned in Section II, if a node has visited a location several times before, it is likely that it will visit that location again. To make use of these observations and count probability using Delivery predictability calculation, the calculation of the delivery predictabilities update the metric whenever a node is encountered, so that nodes those are often encountered have a high delivery predictability. This is shown in Equation [9].

$$P(a,b) = P(a,b)old + (1 - P(a,b)old) \times P_{init} \qquad \text{(I)}$$

where $P_{init} \in [0, 1]$ is an initialization constant.

If node A does not meet with node B for some predefined time, they are less likely to be good forwarders of messages to each other, thus the delivery predictability values are aged, which are calculated in aging equation [9].

$$P(a,b) = P(a,b)old \times \gamma^{k} \qquad \text{(II)}$$

where, $\gamma \in [0, 1]$ the aging constant, and k is the number of time units that have elapsed since the last time the metric was aged.

The delivery predictability also has a transitive property, that is based on the observation that if node A frequently encounters node B, and node B frequently encounters node C, then node C probably is a good node to forward messages destined for node A as per equation [9].

$$P(a,c) = P(a,c)old + (1 - P(a,c)old) \times P(a,b) \times P(b,c) \times \beta \quad \text{(III)}$$

where $\beta \in [0, 1]$ is a scaling constant that decides how large impact the transitivity should have on the delivery predictability.

- **LALRED**

LALRED queue management strategy to renovate the value of the average size of queue used for congestion avoidance and reduce the total loss of packets at the queue, achieves high efficiency routing in network[3]. In LALRED algorithm input is nothing but set of actions {α1, α2, α3, α4}, where

- ***Forced_Drop (α1):*** $Avg > MAX_{th}$
- ***Minimum_Exceed (α2):*** $MIN_{th} < Avg < MAX_{th}$ and when Avg just crosses MIN_{th}
- ***Unforced_Drop (α3):*** $MIN_{th} < Avg < MAX_{th}$
- ***No_Drop (α4):*** $Avg < MIN_{th}$

This approach helps to improve the performance of congestion avoidance by adaptively minimizing the queue-loss rate and the average queue size.

ALGORITHM LALRED

Input: Set of actions {α1, α2, α3, α4}, where,

α 1: Forced Drop, α 2: Minimum Exceed, α 3: Unforced Drop, α 4: No Drop

Output: The output is the DROP-TYPE action chosen by the automaton.

Parameters:

m: Index of the maximal component of $\overline{D(t)}$, $\overline{dm(t)}$ = maxi=1,2,...,r{$\overline{di(t)}$ }

Wi(t): The number of times the i^{th} action has been rewarded up to the time t, with 1 ≤ i ≤ r

Zi(t): The number of times the ith action has been chosen up to the time t, with 1 ≤ i ≤ r

N: The resolution parameter, Δ : 1/rN is the smallest step size

Initialization

pi(t) = 1/r, for 1 ≤ i ≤ r

1: Initialize $\overline{D(t)}$ by picking each action a small Number of Times. Initially, choose an action α_m based on the

average initial queue size

2: The feedback β of the environment is given to the action α_m chosen by the machine. When the action No Drop is

chosen, it gets a reward (β = 0);otherwise, it gets a penalty (β = 1).

3: Update p(t) according to the following equations: For all j ≠m,

If β(t) = 0 and $p_m(t) \neq 1$

pj (t + 1) = max {pj(t) - Δ , 0}

$p_m(t+1) = 1 - \sum_{\forall j \neq m} pj(t+1)$

Else

pj (t + 1)=pj (t) for all 1 ≤ i ≤ r

4: Update $\overline{D(t)}$ according to the following:

$W_m(t + 1) = W_m(t) + (1 - \beta(t))$,

$Z_m(t + 1) = Z_m(t) + 1$

$\overline{dm(t)} = \frac{Wm(t+1)}{Zm(t+1)}$,

$W_j(t + 1) = W_j(t)$

$Z_j(t + 1) = Z_j(t)$ for all j = m,

$\overline{dj(t+1)} = \overline{dj(t)}$

5: Choose an action based on the maximal component of $\overline{D(t)}$.

6: Drop the packets based on the action chosen by the automaton.

7: Repeat Steps 1-5 until some component pm (t) > 1

END

V. IMPLEMENTATION

For evaluation of the approach developed a simple utility. The utility focuses on the operation of the approach and does not simulate the details. When doing an evaluation of scheme or system, it is very important that models used are realistic. Since base algorithms on making predictions depending on the movements of node and action vector take action on every message in message queue considering current state. As mentioned above, Mobile Ad-Hoc network is self dependent network. Therefore, we have set some goal with their movement, so mobility is model in some better way. The evaluation focused on performance of Probabilistic and LALRED algorithm. Values of some parameter are fixed as shown in Table 1, reasonable for calculating probability between nodes.

TABLE 1: PARAMETER SETTING

Parameter	P_{init}	β	γ
Value	0.75	0.25	0.98

Probabilistic approach calculates probability by considering equation I, II, III mentioned in Section IV. Assume, at the beginning of execution set Number of nodes 20, Source node 5, Destination node 10, Hop count 3, and Queue size 5. We have to calculate the probability of every node with respect node 10 using delivery predictability calculation in Probability Routing approach we get values as shown in TABLE 2,

TABLE 2: NODES PROBBILITY VALUE WITH RESPECT TO NODE 10

Nodes	1	2	3	5	6	7	8	9
Probability Value	0.020	0.018	0.023	0.017	0.026	0.028	0.018	0.019

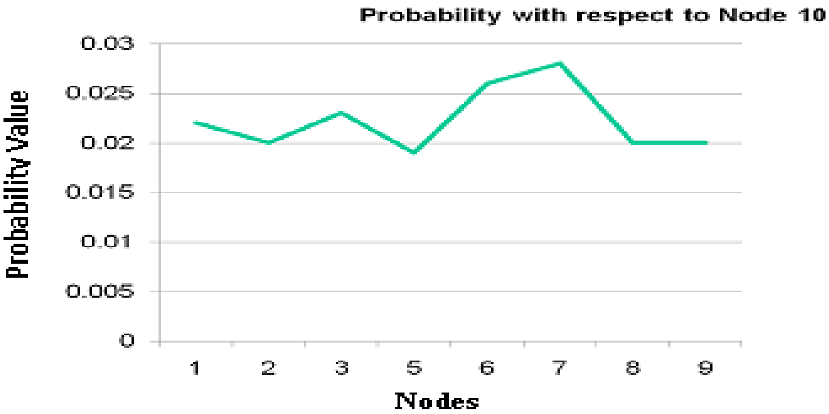

Fig.2: Graphical Representation o Probability of Nodes with respect node 10

Following Table 3 shows the result of varying different values of Number of nodes, Hop Count.

TABLE 3: Results

Hop Count=3			**Hop Count=5**			**Hop Count=11**		
Queue Size	Travel Time (ms)	Nodes	Queue Size	Travel Time (ms)	Nodes	Queue Size	Travel Time (ms)	Nodes
25	1893	100	25	3692	100	25	3762	100
25	350	50	25	783	50	25	1790	50
25	0	25	25	1096	25	25	411	25

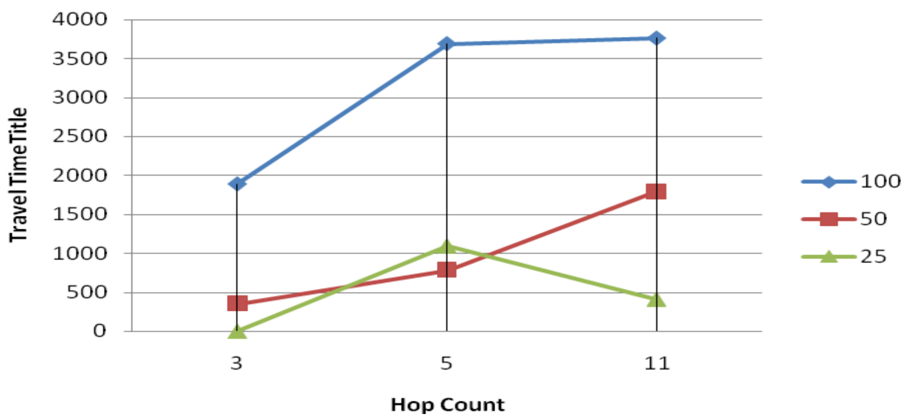

Fig.3: graphical representation of Result

Looking at the graphs in fig. 3, it seems like increasing the queue size means that more message can buffered an risk of drop message decreases. Also with a higher hop count messages can spread through a large part of the network and occupying maximum resources, while with a lower hop count, achieve minimum resource utilization.

VI. CONCLUSIONS

This paper present a novel approach, which combines observation of probabilistic and epidemic approach of flooding based routing with the LALRED technique. Novel scheme dynamically calculate probability of nodes for deciding path for sending message, which send message to only "reachable" node and achieve lower communication overhead and increase the efficiency and exchange message to those node only. Also, using learning automata like solution maintain average queue size minimum due to that congestion not occurs.

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