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Optimal DSR and Load Balancing in MANET

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ABSTRACT

MANET (Mobile Ad-hoc Network) is an infra-structure less dynamic network in which each nodes are free to move anywhere any time without any prior knowledge. As mobile communication is growing day by day, so it is very common for mobile nodes to be congested at any time in the network. Our goal is to distribute the load from over loaded nodes to under loaded nodes in an optimal way. Also DSR algorithm for routing is optimized using minimum CFD (Cumulative Forward Distance).

Keywords- Load Balancing, DSR, Forward Distance (FD), Cumulative Forward Distance (CFD).

I. INTRODUCTION

MANET (Mobile Ad hoc Network) is a dynamic infra-structure-less network in which nodes are free to move anywhere, anytime without any prior knowledge. Due to dynamic topology it is mandatory that each node has updated route table having proper routes to other nodes. For this each node has to communicate with other nodes time to time. The main characteristics of MANET are:

1.1 Dynamic Topology MANET is highly dynamic in nature i.e. nodes are free to move anywhere at any moment according to its transmission range.

1.2 Limited Bandwidth: In MANET radio band will be limited and hence data rates are much lower than a wired network. So the routing protocols must optimally use the offered bandwidth to reduce overhead.

1.3 Higher Packet loss: Due to unstable links, transmission errors there are more chances of packet loss in MANET which is not desirable.

MANET APPLICATIONS MANET can be used in any of the daily life application as described below:

A. **Military Operations** Manet is very useful in military operations for safety purposes, by wireless communication in sensitive regions. It is also useful in automating battlefields through sensor networks.
B. **Emergency services-** In emergency services like supporting hospital services, search and rescue operations, disaster recovery and in help lining these networks are very useful.
C. **Commercial Activities:** E-banking and e-commerce, dynamic database access, mobile offices i.e business anywhere anytime make use of these networks.
D. **Home and Entertainment Facilities:** In home/office networking, multi user gaming, robotic pets, theme parks, wireless services Manet helps a lot.
E. **Education:** For setting of virtual classrooms, adhoc communication through meetings and lectures, online distance education and in setting of university and college campuses Manets play an important role.

II. LITERATURE SURVEY

MANET has a dynamic network topology, and constraint resources, such as bandwidth, buffer space, battery and transmission power and so on. Distributing traffic fairly among the mobile hosts, based on measurement of path statistics, is beneficial in order to take full advantage of the limited resources and to use network resources better so that the congestion and end-to-end delay are minimized.

Purpose of Load-Balancing Schemes

The overall purpose of various load-balancing schemes is to:

- Select non-congested paths or to disseminate excessive load of a node to its neighbours.
- Balances energy consumption of the network.
- Ensure efficiency and robustness.
- Reduce end to end delay and number of packet lost by queue overflow.
- Enhance the utilization of resources.
- Improve the overall network performance and reduce collision by load distribution.

Alternate Path Routing [1] provides load balancing by distributing the data traffic along set of alternative paths. By using set of alternate paths, APR also provide failure protection, i.e. if one path fails to transfer the data, it can use another alternative paths. Due to Route coupling resulted from geographic proximity of different candidate paths between common endpoints (nodes) APR are not fully utilized.

Dynamic Load Aware Routing (DLAR) [2] makes use of number of packets buffered in the interface as main route selection criteria. Source node floods the

RREQ packet to its immediate neighboring nodes to discover a new route. When the intermediate nodes along the path to destination receives RREQ for first time, they make an entry for the <source, destination> pair and also record the previous hop to that entry (to proceed Backward Learning).Nodes then also attach their load information and broadcast the RREQ packet After receiving the first RREQ packet, the destination waits for few amount of time so that it can learn about all possible routes. In this protocol, intermediate nodes cannot send a RREPLY back to the source.

Load Sensitive Routing (LSR) protocol [3] is based on the DSR protocol. This protocol utilizes network load information as the main path selection criterion. It uses a re-direction method to find better paths effectively. The source node can quickly respond to a call for connection without losing the chance to obtain the best path. Based on the initial status of an active path, LSR can search for better paths dynamically if the active path becomes congested during data transmission. In route discovery we use a redirection method similar to we developed in Multi path routing to forward Route Reply (RREP) messages. This method can let the source node to obtain better path without any increase in flooding cost and waiting delay on the destination nodes. In LSR, we adapt the active routes in a route in a different context, by using network load information. When a used path becomes congested, LSR tries to search for a lightweight path. The source node continues to send data traffic along the congested paths until a better path is found. Route adaptation strategy is based on the initial status and current status of an active path.

Weighted Load Aware Routing (WLAR) [4] protocol selects the route based on the information from the neighbor nodes which are in the route to the destination. In WLAR, a new term traffic load is defined as the product of average queue size of the interface at the node and the number of sharing nodes which are declared to influence the transmission of their neighbors. In WLAR, each node has to measure its average number of packets queued in its interface, and then have to check whether it is a sharing node to its neighbor or not. If it is a sharing node itself, it has to let its neighbors know it. After each node gets its own average packet queue size and the number of its sharing nodes, it has to calculate its own total traffic load.

Delay-based Load-Aware On-demand Routing (D-LAOR) [5] protocol that utilizes both the estimated total path delay and the hop count as the route selection criterion. D-LAOR allows the intermediate nodes to relay duplicate RREQ packets if the new path (P’) to the source of RREQ is shorter than the previous path (P) in hop count, and DP’ is smaller than DP (i.e., DP’ < DP). Each node updates the route entry only when the newly acquired path (P’) is shorter than the previous path (P) in hop count, and DP’ is smaller than DP (i.e., DP’ < DP).D-LAOR does not allow the intermediate nodes to generate a RREP packet to the source node to avoid the problem with stale path delay information.

Workload-Based Adaptive Load Balancing (WBALB) [6] protocol makes each node react to RREQs according to a simple rule based on the local information of the node and it runs on top of existing routing protocols. This protocol is motivated by the observation that ad hoc on-demand routing protocols flood route request (RREQ) messages to acquire routes, and only nodes that respond to those messages have a potential to serve as intermediate forwarding nodes. In other words, a node can completely be excluded from a path if the node drops the RREQ in a route discovery phase for the path.

Load Balanced Dynamic Source Routing (LBDSR) [7] Existing approaches try to improve the performance of routing protocols with respect to traffic balancing or energy consumption balancing. In this paper author improve the well known Dynamic Source Routing (DSR) protocol to the so called Load Balanced DSR (LBDSR) protocol. We modify the RREQ (Route Request) and RREP (Route Reply) messages in DSR in order to maintain the remaining energy of intermediate nodes which forward RREQ and RREP. Route structure, available in the nodes cache, is modified so that the remaining energy of nodes can be calculated. LBDSR shows better traffic balancing and energy consumption balancing, end-to-end delay and route reliability metrics than DSR.

Distributed Load Balanced Routing (DLBR) [8] is a new distributed load based routing algorithm intended for a variety of traffic classes to establish the best routing paths. The proposed algorithm calculates the cost metric on the basis of the load on the links. The dynamic traffic can be classified as multimedia and normal traffic. Multimedia traffic is considered as high priority and normal traffic as low priority. The routing of high priority traffic is performed over the lightly loaded links, in such a manner that the links with lighter loads are chosen instead of links with heavier-loads. In addition, the resources can be shared between the high priority traffic’s path and low priority traffic. In the absence of multimedia traffic, the lightly loaded path can be utilized by normal traffic.

DLFR [9] this algorithm proposed a new routing protocol for estimating the shortest path in such open networks by introducing a statistical metric for “the reliable routing path selection”. DLFR facilitated statistical treatment of stochastic behavior of unpredictable links between two random MDs in MANET and then extends the concept to the entire open network. Time metric followed in DLFR is forwarding time (FT) between a typical pair of MDs in the multi-dimensional feature space and is a dissimilarity measure that takes into account correlation between FTs and normalizes each feature to zero mean and unit variance (Box-Muller Transformation).

III. PROPOSED ALGORITHM

Step 1. For each node (mobile unit), generate random arrival pattern and service pattern of packets which are distributed according to Poisson and negative exponential distribution.

Step 2. Feed the generated pattern to each node's queuing system, which helps in determining an important factor namely Queue length for each node.

Step 3. Determine the probabilistic change in queue length which helps to set Threshold value for load balancing or set threshold of each node using

$$Sum\_qoc = \sum_{i=1}^{k} avg\_qoc_i$$

Step 4. For x=1 to n (for n links), for i=1 to k(for each node pair(with given source node and destination node)) generate k_s samples of stochastic distance FD(forward Distance) for moving packets between two immediate mobile nodes and normalized it.

Step 5. Append a new field of FD in the header of DSR RREQ packet. This new formatted packet is flooded to next immediate nodes by source node initially.

Step 6.Each node which receives RREQ packet with FD field checks whether waiting queue has space to accommodate it or not i.e. after adding this RREQ whether Queuelen>= Threshold for mobile node, if so it simply discard that RREQ packet; but if not node calculate its CFD by simply adding its FD with previous link's FD and save this into RREQ packet header. (When a packet is discarded by a node it is sent to destination via other nodes which are lightly loaded.)

Step 7. At destination node RREQ packets via different intermediate nodes are received with their respective path CFDs. These packets are sorted in ascending order and path with minimum CFD is replied back with RREPLY. Also 2 next minimum CFD paths are stored in cache for recovering through alternative paths in case of malicious node.In this way we can chose an optimal path for packet transmission with proper load balancing at each node. Also this algo helps to solve out the problem happened in case of malicious node as it store alternative paths in cache for route recovery and hence save time by avoiding source- destination route initialization again and again.

IV. WORKING OF ALGORITHM

When we implement the proposed algorithm on above network, let assume N1 as source node and N4 as destination node. Generate random FDs for all the paths in the network in Fig 1 and normalizes it by using Box- Muller Transformation method:-

$$\mathbf{FD=s*\sigma+\mu}$$

where **σ and μ** are Standard Deviation and mean and

$$s = sqrt(-2ln(r1))cos(2pi*r2)$$

where (r1, r2) is a pair of random numbers in the range (0, 1) and s is the desired sample from the standardized normal distribution. For implementation of proposed work we have made use of Java.

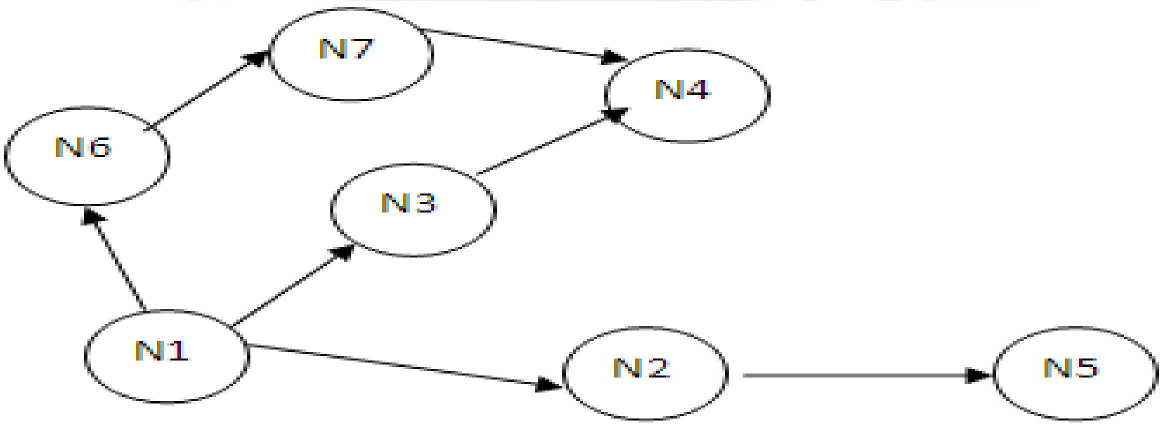

Fig 1: Network Example

When RRREQ packet reach to neighbor nodes N2, N3, and N6, they further broadcast that packet to their neighbors and also update their CFDs by calculating through its own + CFD of previous links. N4 sends RREPLY to each RREQ with their corresponding CFDs. Then N1 sends data packets through minimum CFD path which is here via N3 node. If this primary route fails then an alternative path having next minimum CFD which is via nodes N6 and N7 is used for sending data packets.

V. RESULTS

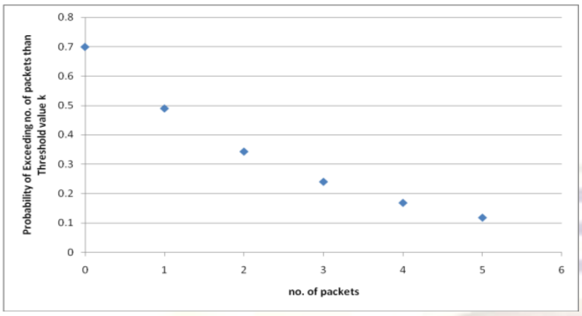

Fig 2: Probababilty of no. of packets Exceeding threshold value k

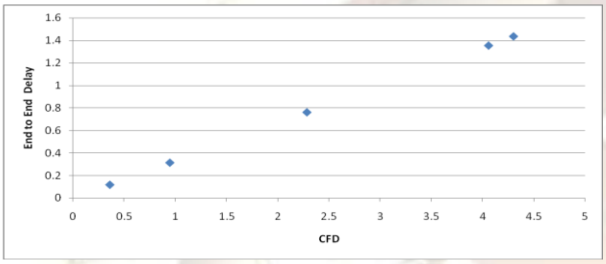

Fig 3: End to End Delay versus CFD

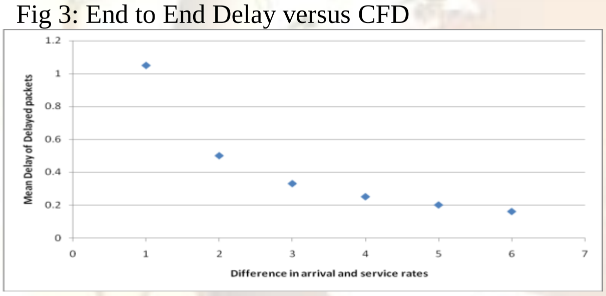

Fig 4: Mean Delay of delayed packets vs Arrival rates and service rates

From the graphs drawn above one can see that threshold can be set initially according to probability distribution with increase in number of packets in queue. Also we can say that end to end delay can be minimized by using optimal path of minimum CFD. Mean Delay of already delayed packets can also be minimized by varying the arrival rates and service rates for further better results in future.

VI. CONCLUSION AND FUTURE WORK

As MANET is an adhoc network so it is not efficient to use routing mechanism according to past knowledge.This algorithm provides an efficient way to tame stochastic nature of MANET in future and provide an optimal routing mechanism and sending data packets through minimum CFD path which further enhance the throughput of any network. Also it avoid congestion in any network by applying threshold based load balancing. We can evaluate performance of this algorithm for infinitely large number of packets in any simulation based environment.

In future researcher also try to implement this algorithm for other on-demand routing protocols and their comparison as well. Also to apply security mechanism to convert plain text into cipher text at intermediate nodes.

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