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ON-DEMAND ROUTING PROTOCOL FOR MANETS USING FLOODING DISTANCE WITH NEIGHBORHOOD NODES

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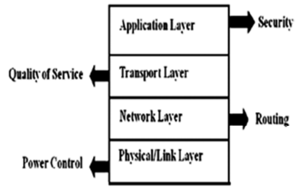
ABSTRACT: The Flooding technique is often used for route discovery in on-demand routing protocols in Mobile ad hoc networks (MANETs). Recently, many flooding techniques for Mobile Ad Hoc Networks (MANETs) have been proposed because the flooding distance is an important parameter in the design and evaluation of a routing protocols of Manets, which effects the delay time in the route discovery, the stability and reliability of the route and hence in turn also the overhead of the whole network. In this paper, the average is being taken of flooding distance for a mobile ad hoc network (MANET) which is based on the on-demand routing protocols such as dynamic source routing (DSR) protocol to improve the performance of flooding based route discovery in Manets. A smaller value of the average flooding distance means a smaller overhead of the network and a shorter delay in information transmissions. Reducing the flooding distance will significantly improve the performance of the MANET.

Keywords: Mobile Ad hoc network (MANET), Dynamic source routing (DSR), Flooding Distance, Neighborhood Nodes.

1. INTRODUCTION

A mobile ad hoc network (MANET) is a self organized mobile wireless network without the aid of any pre-existing infrastructure or centralized administration in communication. The nodes can move and their network topology may be temporal. Each node acts as a customer, server and router. Each node can join the network or it leave at whichever time. Due to the highly dynamic topology, how to quickly and efficiently construct and choose a multi-hop route is crucial for the MANETs. Many routing protocols have been proposed and can be classified into two categories: proactive protocols (*e.g.* DSDV), and reactive protocols (*e.g.*, TORA, DSR, AODV). The dynamic source routing (DSR) protocol is a simple and efficient routing protocol specifically used in the MANETs, which consists of route discovery and route maintenance. Each mobile host participating in such a network may dynamically discover a route to any other host in the MANET by initiating a route discovery, no matter whether it is directly reachable within the limited wireless transmission range. The DSR uses flooding based on a query-reply mechanism to search for a new route. Flooding is well suited for the MANETs as it requires no topological knowledge.

Issues Related To MANETs



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Comparison of Routing Protocols

Parameters	AODV	DSR	TORA
Source Routing	No	Yes	No
Topology	Full	Full	Reduced
Broadcast	Full	Full	Local
Update Information	Route error	Route error	Node's Height

In flooding, each node transmits a message to all of its neighbors (which are directly within its transmission range) upon receiving the message for the first time. The neighbors in turn transmit the message to their neighbors and so on. Such blind flooding may generate a number of redundant messages, which will waste valuable limited resources, such as the bandwidth and energy. The flooding distance between any two nodes is the number of hops which passed through by a route request (RREQ) packet flooded from one node to another in the process of the route discovery. A smaller value of the flooding distance (FD) means a smaller overhead of the network and a shorter delay in information transmissions.

In the message flooding process, if only one node can transmit the information to its neighbors at the same time, the space cannot be reused; if there are more than one node can transmit the message to their neighbors at the same time, then the space is reusable. In this paper, the Flooding Distance FD is studied with the influence of neighborhood nodes. It shows that the FD with the Neighborhood nodes treatment is much smaller than that without the usage of neighborhood nodes. Neighbor discovery is the process by which a node in a network determines the total number and identity of other nodes in its vicinity.

2. FLOODING DISTANCE WITH NEIGHBORHOOD NODES APPROACH

The DSR protocol adopted here consists of route discovery and route maintenance. The route discovery allows any host in the ad hoc network to dynamically discover a route to any other hosts in the network, no matter whether it is directly reachable within wireless transmission range or indirectly reachable through other hosts as intermediate hops. When one host attempts to send a data packet to another, the sender first searches for a source route to its destination in its route cache and use the existing route which is found in its cache to transmit the packet. If no source route is found, the sender may use a route discovery process to dynamically determine such a route. The sender generates an RREQ packet and floods it all over the network. As the RREQ is forwarded, each node receiving an RREQ packet for the first time will rebroadcast it, but if the node is the destination or it has a route to the destination in its route cache, it will reply to the RREQ with a route reply packet which is returned to the original source. The query packet is updated at each retransmission so that it contains the addresses of the nodes it has passed through. When the destination receives the query packet it returns to the source where the path contained in the first packet received. Thus the route between the source and the destination is built.

In the following, Here consider an MANET composed of n (n tends to infinity) nodes under the following three assumptions:

1. When several nodes are waiting for transmission, only N nodes can transmit at a time and the transmitter nodes are randomly selected among the waiting nodes.
2. The node X_i transmits a packet, and this transmission can be successfully received by the node Y, for every other node X_k simultaneously transmitting over the network for any positive ε. When $\{|X_k - Y| > (1 + \varepsilon)\}$, $|X_i - Y|$ refers to the distance between the node X and the node Y.
3. The events 'a node A correctly receives the packets transmitted by a node B' are independently identically distributed (IID).

3. FLOODING DISTANCE WITH NEIGHBORHOOD NODES

The flooding distance between any two nodes is the number of hops which passed through by an RREQ packet flooded from one node to the other node. Since the retransmission is random, the flooding distance between any two random nodes is a random variable whose expectation is thus the FD. The aim is to find an estimation of the FD with N-times neighborhood area Reus age when the size of the network tends to infinity.

Theorem: For the approach with neighborhood usage, the *FD* $d(N)$ between two random nodes in the network is given by

$$d(N) = \sum_{k=0}^{\infty} \frac{pq^k + (q - q^N)q^{(N+1)k}}{1 - q^{(k+1)N}}, \tag{1}$$

Where $q = 1 - p$ and N is the number of times of neighbor nodes usage.

Proof: For N number of times neighbor nodes usage, there are N nodes and only N nodes retransmitting the query packet at the same time. Here consider any two nodes one of which is considered as the source and the other as the destination. In the flooding process, the query retransmissions can be classified such that the retransmissions made at the same time belong to the same class. Thus here we can find retransmission classes according to their transmission time order. The 0-th class is in fact the 0-th retransmission of the query made by the source node. The k-th ($k > 1$) class has and only has N retransmissions. Here call d_k the AFD of a node which belongs to the k-th class. It can be easily proved that the N nodes which belong to the k-th ($k > 1$) class have the same AFD d_k. It is clear that $d_0 = 0$ and $d_1 = 1$ for the N nodes which belong to the first class is centered at the source. Here suppose that none of the nodes in the MANET has any particular properties except that for any integer k the node which belongs to the k-th class must have received at least once from the k first classes. The interconnections between any two nodes in the network are independent with the fixed probability p. Thus the probability that any given node receives the query packet for the first time at i-th class is given in equation (2). Since the node belonging to the k-th class must have received the query at least once from the k first classes, the conditional probability that the node receives the query for the first time at i-th class conditioned on the event that the node belongs to the k-th class is given by equation (3) and thus by applying the formula of total expectation, we get equation (4) Here have $d_k = k - 1$

$$\begin{cases} qq^{(i-1)N}(1-q^N), & i \geq 1, \\ p, & i = 0 \end{cases} \tag{2}$$

$$\begin{cases} \dfrac{qq^{(i-1)N}(1-q^N)}{1-qq^{(k-1)N}}, & 1 \leq i \leq k-1, \\ \dfrac{p}{1-qq^{(k-1)N}}, & i = 0, \end{cases} \tag{3}$$

By introducing the generating function here express the equation (4) as equation (5)

$$d_k = \sum_{i=1}^{k-1} \frac{qq^{(i-1)N}(1-q^N)}{1-qq^{(k-1)N}}(d_i + 1) + \frac{p}{1-qq^{(k-1)N}}, \tag{4}$$

$$(1-z)D(z)=\frac{q}{q^N}(1-q^N z)\,D(q^N z)+\frac{pz+(q-q^N)z^2}{1-q^N z}, \quad \text{GF}$$

This resolves into

$$\boxed{D(z)=\sum_{k=0}^{\infty}\left(\frac{q}{q^N}\right)^k \frac{pzq^{kN}+(q-q^N)(q^{kN}z)^2}{(1-z)(1-q^{(k+1)N}z)}.} \qquad (5)$$

4. CONCLUSION

The paper shows that the FD for N number of times neighbor nodes usage is less than that of the model without neighbor nodes usage, and even tends to $1 + q$ when N is large enough. The FD is a function of q for different N. It is clear that for a given N, the value of FD increases with increasing q, while for a given q, the value of FD decreases with increasing N and finally reaches its extreme value of $1+ q$, where the FD as a function of N for several values of q is shown. Hence it shows that the FD with the Neighborhood nodes treatment is much smaller than that without the usage of neighborhood nodes. Neighbor discovery is the process by which a node in a network determines the total number and identity of other nodes in its vicinity.

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