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Selfishness Aware Adaptive Opportunistic Routing for Wireless Ad-hoc Network

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ABSTRACT : *The performance of opportunistic routing in wireless ad-hoc network depends on selection of next relay node. While selecting next relay node should consider the selfish nodes and congestion present in the network. In this paper, propose a technique to improve performance of the distributed adaptive opportunistic routing protocol for multi-hop wireless ad-hoc network. This algorithm utilizes 3-way handshake to find next forwarder. If any of the packets; DATA, ACK, and FO is lost, the performance will significantly reduce. Loss of packets may be due to selfish node or congestion present in the network, the proposed work overcome this and produces a better and efficient routing.*

Keywords: *Congestion, Opportunistic Routing, Regret, Selfishness.*

I. INTRODUCTION

Wireless Ad-hoc Networks operates without a fixed infrastructure. Multi-hop, mobility, large network size combined with device heterogeneity and bandwidth and battery power limitations, all these factors make the design of routing protocols a major challenge. Lots of researchers did tremendous work on the wireless ad-hoc routing protocols. Two main kinds of routing protocols are existed today: one is called table-driven protocols (including distance vector and link state), another is on-demand protocols. In table driven routing protocols, the protocols consistent and up-to-date routing information to all nodes is maintained at each node whereas in on-demand routing the routes are created only when desired by the source host. While for the on demand routing protocols, “on demand” means that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. There are many kinds of wireless ad-hoc networks routing protocols, as LAR (Location-Aided Routing), DSDV (Destination-Sequenced Distance-Vector Routing), AODV (Ad-hoc On-Demand Distance Vector Routing), and DSR (Dynamic Source Routing Protocol). All these routing protocols are all have inherent drawbacks and cannot be considered as good routing protocols for wireless ad-hoc networks. Just like Windows operating systems need patch at all the time, the wireless ad-hoc networks routing protocol are all needs patches too.

The main problems about the routing protocols are as following: first, the topology of the network changed rapidly, which will lead to the lost of packets. Second, modify every node’s routing table that within the communication distance of the rapid-passing node, that will greatly improve the consumption of the bandwidth and the overhead of the networks. Third, obviously there will be tremendous delay of the data sending to the rapid-moving node. Transmission between two hosts over a wireless network does not necessarily work equally well in both directions. Thus, some routes determined by some routing protocols may not work in some environments. Many routing protocols may create redundant routes, which will greatly increase the routing updates as well as increase the whole network’s overhead.

Opportunistic routing for multi-hop wireless ad-hoc networks has seen recent research interest to overcome deficiencies of conventional routing as applied in wireless setting. Motivated by classical routing solutions in the Internet, conventional routing attempts to find a fixed path along which the packets are forwarded. Such fixed path schemes fail to take advantages of broadcast nature and opportunities provided by the wireless medium and result in unnecessary packet retransmissions.

The opportunistic routing decisions, in contrast, are made in an online manner by choosing the next relay based on the actual transmission outcomes as well as a rank ordering of neighboring nodes as in Fig 1. Opportunistic routing mitigates the impact of poor wireless links by exploiting the broadcast nature of wireless transmissions and the path diversity. The opportunistic algorithms proposed in [4] depend on a precise probabilistic model of wireless connections and local topology of the network. In practical setting, however, these probabilistic models have to be “learned” and “maintained”. In other words, a comprehensive study and evaluation of any opportunistic routing scheme requires an integrated approach to the issue of probability estimation.

The proposed work allows routing by dealing with selfish and congested nodes. A selfish node is a node which acts according to its own interests. The paper is organized into, section I, brief introduction about the area, and section II, the discussion about the related work. Section III, is system model and discussion about the problem. Section IV, the protocol overview, discusses how the protocol will work and Section V concludes the work.

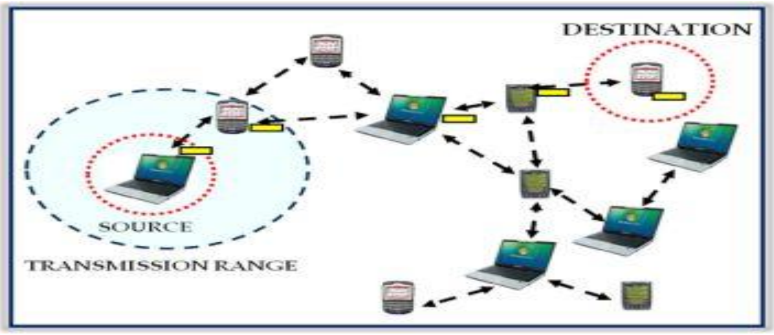

Fig 1. Multihop routing in ad-hoc network

II. RELATED WORKS

S. Biswas and R. Morris [2] described an integrated routing and MAC protocol that increases throughput of large unicast transfers in multi-hop wireless networks. The source broadcast the packet; the subset nodes receive it, and perform a protocol to discover which node to forward the packet.

R. Bruno et.al., [5] proposed a flexible and adaptive opportunistic routing algorithm, able to select at each hop, and at run-time, the candidate forwarders that can maximize the opportunistic throughput gain. Localized routing decision process that selects the forwarding node's link state protocol collects link quality and disseminating information. Next forwarder is selected on the basis of an opportunistic gain.

C. Lott and D. Teneketzist [3] investigated a network routing problem where a probabilistic local broadcast transmission model is used to determine routing. Here discuss probabilistic transmission models and distributed algorithm for optimal routing.

III. SYSTEM MODEL

Consider the problem of routing packets from source node 'o' to destination node'd' in a wireless ad-hoc network of d + 1 nodes. Let the set S denote the neighbor nodes. The time is slotted and indexed by n>=0. A packet indexed by m >=1 is generated at the source node 'o'. The data packets are forwarded from source 'o' to'd'. The packets are routed by utilizing 3-way handshake and d-AdaptOR algorithm by keeping the information g(S, a) reward obtain by taking routing decision a when the set of S nodes received the packets. Re(S, a) is the regret obtained when a node does not perform any routing action.

A node i transmit packet to its neighbor. The routing decision at any given time is made based on the reception outcome and the routing decision involves retransmission, choosing the next relay, or termination. The d-AdaptOR makes such decisions in a distributed manner via the following three-way handshake between nodes. 1) Node transmits a packet. 2) The set of nodes who have successfully received the packet from node, transmit acknowledgment (ACK) packets to node. In addition to the node's identity, the acknowledgment packet of node includes a value known as estimated best score (EBS). 3) The node checks whether all of its neighbors has responded if not it will mark it as selfish and send request to stop its local process and join the routing process. 4) Node announces the next transmitter or announces the termination decision in a forwarding (FO) packet. 5) If the ACK packet is received after FO packet has send will mark it as congested. The values Sd (j, s) for denoting the selfishness of node j and Cd (j, s) for congestion.

IV. PROTOCOL OVERVIEW

The major challenge in opportunistic routing is the selection of node which will forward the DATA packet, when a node wants to send data to a destination it broadcast the data all of its neighbors. Nodes that receives the data packets will send ACK to node that after waiting time the node check whether ACK from all of its neighbor has received if any of neighbors that does not respond with ACK at first will mark it as selfish by setting relative variable Sd(j, s)=1where j $\in s$ and i $\neq j$, and will send a request to request to that node to participate in routing after dropping its own memory consuming application, if it receives ACK after the FO broadcast then mark it as Sd(j, s)=0 and Cd(j ,s)=1 that is the node is congested will send request to drop it queue.

Table 1. Notations

Symbol	Definition
Sd(j,s)	Selfishness of node
Cd(j,s)	Congestion of node
Re(S, a)	Regret obtained by not performing action a when a subset of nodes receive a packet
g(S, a)	Reward obtained by taking decision a when set S have received the packet
A(S)	Set of available actions [1]
N(i)	Neighbor of node i including node i
V n(i,S, a¿	Number of times nodes S have relieved the packet and action is taken
Λ_n(i, S, a)	Score for node i
Λ^i_{max}	Estimated Best Score

The forwarding node is selected on the basis of reward and regrets obtained by the node there are different phases in routing the first stage is initialization stage node are in network will be initialized with values V n(i,S, a¿ =0, Λ_n(i, S, a)=0 , Λ^i_{max} =0, Sd(j, s)=0,Cd(j, s)=0, Re(S, a)=0 where j$\in$S and a$\in$A(s) [1]. Then transmission stage source node will broadcast the packet to all of its neighbors. Next stage forwarding node i selected on basis of equation Λ_{n+1} (i, S, a)= Λ_n(i, S, a)+ α_{vn}(i, S, a)X((-Λ_n(i, S, a)+(g(S, a)-Re(S, a))+ Λ^i_{max})) based of reception of acknowledgement the ACK packets here will check whether all neighbor have respond with ACK if not will set it corresponding selfish or congestion variable, upon reception of ACK packet the counting variable N_n is incremented [1]. Then relay stage node i announces the forwarding node by broadcasting FO packet and all other nodes will update their corresponding beliefs. The Algorithm is,

I.1 THE ALGORITHM

Step1: Initialize the adaptive score vectors.
Step2: Node i want to transmit will broadcast the data packet to the neighbor node.
Step3: Neighbors who receives the packet will send ACK packet along it identity and its score.
Step4: Node i checks whether ACK from all neighbors are available. If not, mark that node as selfish by setting Sd (j, s) =1. Send a request to that node to participate in routing after dropping its own memory consuming application.
Step5: Select the forwarding on the basis of adaptive score vector which considers reward and regret obtained by the node and broadcast the FO packets.
Step6: If node i receives a packet after the FO broadcast mark the corresponding node as congested Cd (j, s) =1 send request to drop its queue.
Step 7: Update the adaptive score vector.

V. CONCLUSION

The performance of opportunistic routing increases in the proposed scheme. It deals with selfishness and congestion present in network and provides a better routing methodology. At the same time it finds whether a node is congested or selfish and will request the corresponding node to take necessary action for forwarding.

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