Enhanced Routing with Congestion Diversity in Wireless Ad Hoc Networks

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Abstract- **A wireless ad hoc network is a decentralized type of wireless network. If the network is adhoc since it does not rely on a pre accessible infrastructure, such as routers in wired networks and access points in managed wireless networks. As a alternate for, each node contribute in routing by forwarding data for remaining nodes, so the determination of which nodes forward data is made energetically on the basis of network connectivity. In adding together to the characteristic routing, ad hoc networks can use flooding for forwarding the data. A distributed adaptive opportunistic routing design for multihop wireless adhoc networks is projected. The projected scheme makes use of a support learning framework to opportunistically route the packets even in the absence of dependable information about channel statistics and network model. The proposed scheme is to be most select with respect to an expected average per-packet recompense criterion. The proposed routing scheme in cooperation addresses the issues of knowledge and routing in an opportunistic background, where the network structure is characterized by the transmission success probabilities. In exacting, this knowledge framework leads to a stochastic routing scheme that optimally "explores" and "exploits" the opportunities in the network.**

Index Terms- **Wireless Ad Hoc Networks, Opportunistic Routing, Reward Maximization, Routing Algorithm**

I. INTRODUCTION

A distributed adaptive opportunistic routing scheme for multihope wireless ad hoc networks is proposed. The proposed scheme utilizes a reinforcement learning framework to opportunistically route the packets even in the absence of reliable knowledge about channel statistics and network model. This scheme is shown to be optimal with respect to an expected average per-packet reward criterion. The proposed routing scheme jointly addresses the issues of learning and routing in an opportunistic context, where the network structure is characterized by the transmission success probabilities. In particular, this learning framework leads to a stochastic routing scheme that optimally "explores" and "exploits" the opportunities in the network. Opportunistic routing for multihop wireless adhoc networks has seen current research interest to overcome absence of conservative routing as applied in wireless background motivated by traditional routing solutions in the internet, conservative routing in ad hoc networks attempts to find a fixed path along which the packets are forwarded.

such fixed-path methods fail to take advantage of broadcast nature and chances provided by the wireless medium and result in redundant packet retransmissions. The opportunistic routing conclusions, in disparity, are made in an online manner by choosing the next relay based on the actual transmission results as well as a rank ordering of neighboring nodes. opportunistic routing moderates the impact of poor wireless links by using the broadcast nature of wireless transmissions and the path diversity.

The opportunistic algorithms proposed in depend on a precise probabilistic model of wireless connections and local topology of the network. In a realistic 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. Authors in provide a sensitivity analysis for the opportunistic routing algorithm given in. However, by and large, the question of learning/estimating channel statistics in conjunction with opportunistic routing remains unexplored. The optimal routing decision at any period is to select the next communicate node based on a distance-vector shortening the expected cost to forward from the neighbors to the objective. This “distance” is shown to be computable in a dispersed manner and with low complexity using the probabilistic explanation of wireless links.

Fig.1: Multi hop wireless ad hoc networks

Here we have first investigated the problem of opportunistically routing packets in a wireless multihop network when zero or erroneous knowledge of transmission success probabilities and network topology is available. Using a reinforcement knowledge framework, we propose a disseminated adaptive opportunistic routing algorithm (d-AdaptOR) that minimizes the expected average per-packet cost for routing a packet from a source node to a destination. This is accomplished by both sufficiently exploring the network with data packets and exploiting the best routing opportunities. Our projected reinforcement learning framework allows for a low-overhead, low- complexity and distributed asynchronous implementation. The important characteristics of d- AdaptOR are that it is oblivious to the initial knowledge about the network, it is distributed and asynchronous. In this article provide an opportunistic routing algorithm that: 1) Assumes no knowledge about the channel statistics and network, but 2) Uses a reinforcement learning framework in organize to enable the nodes to adapt their routing strategies 3) Optimally exploits the statistical opportunities and receiver diversity. There are a lot of learning-based routing solutions both heuristic and analytically driven for conservative routing in wireless or wired networks. None of these solutions uses the receiver range gain in the context of opportunistic routing. We focus on heuristic routing algorithms that adaptively identify the least congested path in a wired network. If the network congestion, therefore delay, were to be replaced by time-invariant quantities, the heuristics in would become a special case of d-AdaptOR in a network with deterministic channels and with no receiver diversity. In, analytic results for ant routing are obtained in wired networks without opportunism. Ant routing make use of ant-like probes to find paths of best possible costs such as expected delay, hop count and packet loss probability. This dependence on ant-like probing corresponds to a stark difference with our move toward where d-AdaptOR relies solely on data packet for exploration.

II. LITERATURE SURVEY

Markov decision theoretic formulation for opportunistic routing is developed. It is shown that the optimal routing decision at any epoch is to select the next relay node based on a distance-vector summarizing the expectedcost-to-forward from the neighbors to the destination. This “distance” is shown to be computable in a distributed manner and with low complexity using the probabilistic description of wireless links. A unifying framework for almost all versions of opportunistic routing such as SDF, Geographic Random Forwarding (GeRaF) , and ExOR , where the variations in are due to the choices of cost measures to optimize. For instance, an optimal route in the context of ExOR is computed so as to minimize the expected number of transmissions (ETX), while GeRaF uses the smallest geographical distance from the destination as a criterion for selecting the next-hop. \ According to the design of routing protocols for wireless adhoc networks is guided by the dual requirements of throughput optimality and minimum delay.Lately, there has been a movement from the traditional routing approach, which identifies a best path to the destination before transmission and routes all the packets through it, to opportunistic approaches which make routing decisions adaptively based on actual transmission outcomes. We compare the stable rate region of both the approaches and find, interestingly, that opportunistic routing schemes do not always support a larger stable-rate region than traditional routing protocols. Backpressure based schemes are known tobe throughput optimal but compromise on delay performance instead. We study the behavior of various schemes and propose a routing policy that considers both the goals of throughput optimality and minimizing expected delay in its design.

III. PROPOSED WORK

In this paper we propose a distributed adaptive opportunistic routing algorithm (d-AdaptOR) that minimizes the expected average per-packet cost for routing a packet from a source node to a destination. Assumes no knowledge about the channel statistics and network. Uses a reinforcement learning framework in order to enable the nodes to adapt their routing strategies, optimally exploits the statistical opportunities and receiver diversity. This is achieved by both sufficiently exploring the network using data packets and exploiting the best routing opportunities. Our proposed reinforcement learning framework allows for a low-complexity, low-overhead, distributed asynchronous implementation. The significant characteristics of d-AdaptOR are that it is oblivious to the initial knowledge about the network, it is distributed, and it is asynchronous.

IV. METHODOLOGY

We provide simulation studies in realistic wireless settings where the theoretical assumptions of our study do not hold. These simulations not only demonstrate a robust performance gain under d-AdaptOR in a realistic network, but also provide significant insight in the appropriate choice of the design parameters such as damping sequence, delivery reward, etc. We first investigate the performance of d-AdaptOR with respect to the design parameters and network parameters in a grid topology of 16 nodes. We then use a realistic topology of 36 nodes with random placement to demonstrate robustness of d-Adaptor to the violation of the analytic Assumptions 1 and 2. 1) Grid Topology: In Section VI-B, we study a grid topology consisting of 16 indoor nodes such that the nearest neighbors are separated by distance meters. If unspecified, is chosen to be 25 m. The source and the destination are chosen at the maximal distance (on diagonal) from each other. 2) Random Topology: In Section VI-C, we study a random topology consisting of 36 indoor nodes placed in an area of 150 X 150 m . Here, we investigate the performance under a multisource multi destination setting as the number of flows in the network is varied and each flow is specified via a randomly selected pair of source and destination

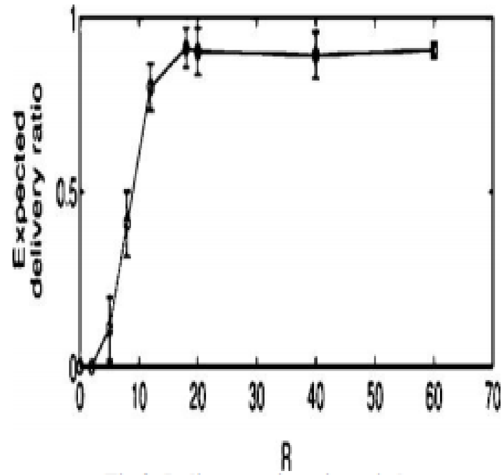

Fig.3: Delivery ratio as is varied.

We use NS2 to simulate our projected technique. In the model, the channel capacity of mobile hosts is set to the same value: 10Mbps. In the simulation, mobile nodes move in a 1k meter x 1k meter region for 50 seconds simulation time. Original locations and movements of the nodes are obtained using the random waypoint (RWP) model of NS2. It is assumed that each node moves autonomously with the same average speed. All nodes have the same communication range of 250 meters. The node speed is 6 m/s. and pause time is 6 seconds. In the model, for class1 traffic video is used and for class2 and Class3, CBR and FTP are used correspondingly

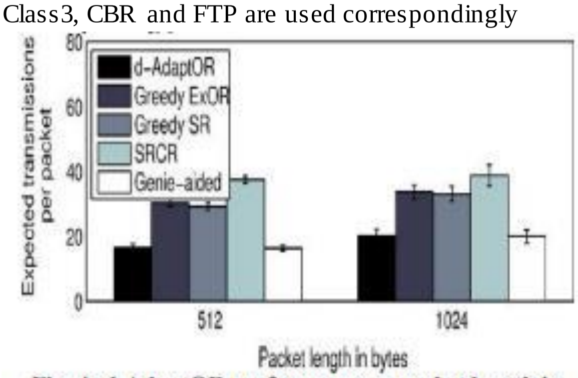

Fig. 4: d-AdaptOR performance as packet length is varied

V. CONCLUSION

In this paper, we proposed d-AdaptOR, a distributed, adaptive, and opportunistic routing algorithm whose performance is shown to be optimal with zero knowledge regarding network topology and channel statistics. More precisely, under idealized assumptions, d-AdaptOR is shown to achieve the performance of an optimal routing with perfect and centralized knowledge about network topology, where the performance is measured in terms of the expected per-packet reward. Furthermore, we show that d-AdaptOR allows for a practical distributed and asynchronous 802.11 compatible implementation, whose performance was investigated via a detailed set of QualNet simulations under practical and realistic networks. Simulations show that d-AdaptOR consistently outperforms existing adaptive routing algorithms in practical settings. The long-term average reward criterion investigated in this paper inherently ignores the short-term performance. To capture the performance of various adaptive schemes, however, it is desirable to study the performance of the algorithms over a finite horizon. One popular way to study this is via measuring the incurred “regret” over a finite horizon. Regret is a function of horizon N that quantifies the loss of the performance under a given adaptive algorithm relative to the performance of the topology-aware optimal one. More specifically, our results so far imply that the optimal rate of growth of regret is strictly sublinear in N, but fails to provide a conclusive understanding of the shortterm behavior of d-AdaptOR. An important area of future work comprises developing adaptive algorithms that ensure optimal growth rate of regret. The design of routing protocols requires a consideration of congestion control along with the throughput performance. Our work, however, does not consider this closely related issue. Incorporating congestion control in opportunistic routing algorithms to minimize expected delay without the topology and the channel statistics knowledge is an area of future research.

VI. REFERENCES

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