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Distributed Adaptive Opportunistic Routing for Wireless Ad Hoc Networks

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Abstract— Provide the routing scheme for the wireless ad hoc networks is somewhat difficult problem. Here we propose Distributed adaptive opportunistic routing scheme for multi hop wireless ad hoc networks. 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.

Keyword: *Opportunistic routing, reward maximization, wireless ad hoc networks*.

INTRODUCTION

We considers the problem of throughput optimal routing/scheduling in a general constrained queuing network with random connectivity whose special case includes opportunistic routing in multi-hop wireless network and input-queued switch scheduling. While it is often possible to intuitively design and propose various routing/scheduling policies, providing theoretical guarantees for the corresponding controlled Markov chains is far from straight forwards with the exception of the throughput optimality of backpressure routing and maximum weight scheduling. These guarantees are obtained using Foster- Lyapunov theorem which ensures the stability of a controlled Markov chain if a Lyapunov function with negative expected drift is shown to exist. More specifically, the throughput optimal backpressure-based policies as well as maximum weight schedules are reverse-engineered to be the very rule under which the known quadratic Lyapunov function is ensured a negative expected drift. While reverse engineering routing/scheduling in this function has the advantage of obtaining theoretical guarantees, it may result in schemes with undesirable structure. In particular, under the strict Schur-convexity of quadratic Lyapunov function with respect to the (weighted) backlog vector, the negativity of the expected drift is only achieved when nodes with large queues are prioritized in favor of those with small number of buffered packets (e.g. a node with small backlog must refrain from routing packets to a neighbor with large backlog).This very need to ensure a negative drift of the Lyapunov function (equivalently to balance the queues in a network), goes against the intuition behind many promising routing/scheduling schemes. For instance, consider the wired network. where packets are to be routed from node 1 to node 8. It is intuitively desirable for the routing decisions in this network to be such that the bottle-neck link (7,8) is maximally utilized. we discuss an opportunistic routing policy (ORCD) which attempts to achieve this goal. However, these very intuitive properties cause a positive expected drift in the quadratic Lyapunov function in an infinite number of states. This means that theoretical guarantee for this algorithm requires a significantly different approach (non-Schur-convex Lyapunov function).

The most efficient method to save energy in wireless Ad hoc networks (WSNs) is to put nodes to sleep when there is no need to relay or transmit packets. Such mechanisms are called *sleep-wake scheduling* and have been used to dramatically reduce energy consumption in energy-constrained WSNs. However, it is well known that sleep-wake scheduling can significantly increase the packet-delivery delay because, at each hop, an event-reporting packet has to wait for its next-hop node to wakeup .Such additional delays can be detrimental to delay-sensitive applications, such as Tsunami/fire detection, environmental monitoring, security surveillance, etc. we study how to improve this tradeoff between energy-savings and delay, by using a technique called “*anycasting*” (to be described later) that exploits the broadcast nature of the wireless medium.

In these Many synchronous sleep-wake scheduling protocols have been proposed. In these protocols, sensor nodes periodically exchange synchronization messages with neighboring nodes. However, this message exchange inevitably incurs additional communication overhead, and consumes a considerable amount of energy. we focus on asynchronous sleep-wake scheduling, where nodes do not synchronize their clocks with other nodes and thus wake up

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independently Asynchronous sleep-wake scheduling is simpler to implement, and it does not consume energy required for synchronizing sleep-wake schedules across the network. However, because nodes do not know the wake-up schedules of other nodes, they have to estimate the wake-up schedule, which can result in additional delays that could detrimental to delay-sensitive applications.

Recently, *anycast packet-forwarding schemes* have been shown to substantially reduce the one-hop delay under asynchronous sleep-wake scheduling . Note that in traditional packet-forwarding schemes, nodes forward packets to their designated next-hop nodes. In contrast, in anycast-based forwarding schemes, nodes maintain multiple candidates of next-hop nodes and forward packets to the *first* candidate node that wakes up. Hence, an anycast forwarding scheme can substantially reduce the one-hop delay over traditional schemes, especially when nodes are densely deployed, as is the case for many WSN applications. However the reduction in the one-hop delay may not necessarily lead to a reduction in the expected end-to-end delay experienced by a packet because the first candidate node that wakes up may not have a small expected end-to-end delay to the sink. Hence, the anycast forwarding policy (with which nodes decide whether or not to forward a packet to an awake node) needs to be carefully designed.

Existing solutions that exploit path diversity attempt to address this issue by dealing with some local metrics. The anycast protocols in each node use the geographical distance from each neighboring node to the sink node to prioritize the forwarding decision to its neighboring nodes. The work in proposes anycast packet-forwarding protocols that work on top of a separate routing protocol in the network layer. The anycast protocols in use the hop-count information (i.e., the number of hops for each node to reach the sink) such that at each hop the forwarding decision is chosen to reduce the hop count to the sink as soon as possible. However, these aforementioned approaches are heuristic in nature and do not directly minimize the expected end-to-end delay.

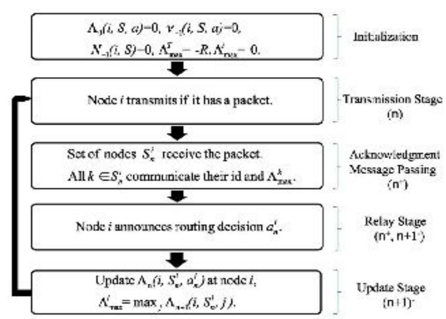
METHODOLOGY

To provide the optimal routing in wireless ad hoc networks I implement the Distributed adaptive opportunistic routing scheme.

A. Opportunistic routing for multi-hop wireless networks has seen recent research interest to overcome deficiencies of traditional routing. Specifically, the routing decisions are made opportunistically, choosing the next relay based on the actual transmission outcomes in addition to an expected sense of future opportunities. First, we, briefly, cast opportunistic routing as a Markov decision problem (MDP) and introduce a stochastic variant of distributed bellman-ford which provides a unifying framework for almost all versions of opportunistic routing such as SDF, GeRaF, and EXOR.

To formulate and identify the optimal routing strategy, MDP formulations rely on the availability of probabilistic (Markov) models. However, a perfect probabilistic model of channel qualities and network topology is restrictive in practical network settings. In the second part of the talk, we provide an adaptive algorithms to deal with the estimation aspect of the problem when imperfect probabilistic model of channel qualities and network topology is available. Specifically, we build on our earlier work where the robustness of the proposed algorithms to modelling errors is investigated. We then use a reinforcement learning framework to propose an adaptive opportunistic routing algorithm which minimizes the expected average cost per packet independently of the initial knowledge about the channel quality and statistics across the network.

Lastly and time permitting, we touch upon the issue of congestion and throughput optimality under various traffic conditions. We propose a combination of the previous MDP framework and backpressure routing to arrive at policies with significantly more desirable delay/throughput performance.



System flow for the algorithm

B. The functions those i can perform in this algorithm are

1. Network formation
2. Packet Transmission
3. Acknowledgement function
4. Relay function
5. Update function

Network Formation

In this function we can construct a topology to provide communication paths for wireless ad hoc network. Here the node will give the own details such as Node ID through which the transmission is done and similarly give the neighbor nodes details.

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Packet Transmission

In this function the node has transmit the packet from source to destination. Transmission stage occurs at time in which node transmits if it has a packet in fig(1)..

Acknowledgement function

In this function the nodes send acknowledgement details. Set of nodes that have received the packet transmitted by node. In this module nodes send acknowledgement packet who received the packet from the source. In the reception and acknowledgment stage, successful reception of the packet transmitted by node is acknowledged to it by all the nodes. We assume that the delay for the acknowledgment stage is small enough (not more than the duration of the time slot) such that node infers by time. The acknowledgment packet of node includes a control message known as estimated best score (EBS).

Relay function

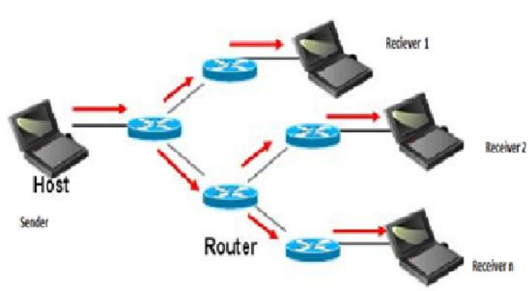
In this function the node select the routing action according to the randomized rule. Node transmits FO (forwarding), a control packet that contains information about routing decision at some time strictly between times. If termination action is chosen, i.e. all nodes in expunge the packet. Upon selection of routing action, the counting variable is updated.

Update function

In this function the node update the following details. After finishing the transmission and relay the node will update the score Vector. The node updates EBS Message for acknowledgements.

RESULT

Depending on the cost we can calculate the ESB. Depending on the we can consider the router. which node have the highest ESB those node will be consider as the router.



DESIGN ANALYSIS

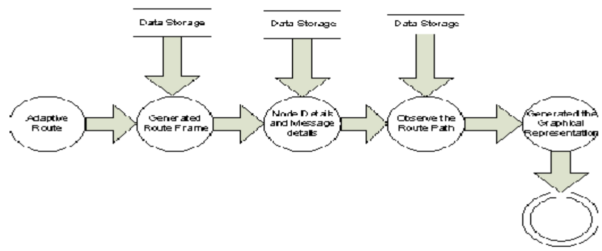
The main contribution to provide an opportunistic routing algorithm that:

1) Assumes no knowledge (assumptions) about the channel statistics and network.

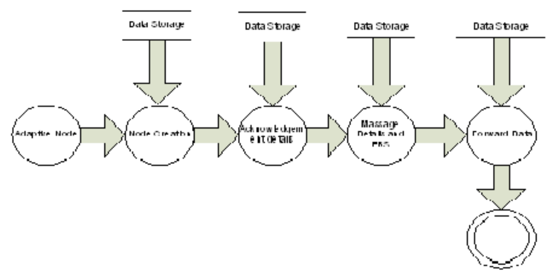
2) Uses a reinforcement learning framework in order to enable the nodes to adapt their routing strategies,

3) Optimally exploits the statistical opportunities and receiver diversity.

4) Graphically shows an information channel path from sender to receiver**.** Each node Behavior is able to catch with respect to the routing table .Node to Node connectivity distance based Routing phenomena is able to represent graphically**.** Acknowledgement details, Message details are maintained dynamically with system to system.



Fig(1). Data flow for Adaptive Routing



Fig(2).Data flow for Adaptive node

CONCLUSION

Here we propose the D-adaptive Routing Protocol (DAP) for routing packets across a wireless multi-hop network. DAP modifies the protocol stack at the routing layer to take into account the congestion in the network. In DAP, nodes route packets according to a rank ordering of the nodes based on a congestion measure which combines the important aspects of EBS with those of backpressure routing. The actual packet transmission can be corrupted by the signals from other nodes in connection oriented systems. In this case, a pair of the sending node and the receiving node retries the packet transmission

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