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A PATH FOR HORIZING YOUR INNOVATIVE WORK

EFFICIENT ALGORITHMS FOR NEIGHBOR DISCOVERY IN WIRELESS AD-HOC NETWORKS

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Abstract: Neighbor discovery is an important first step in the initialization of a wireless ad hoc network. In this paper, we design and analyse several algorithms for neighbor discovery in wireless networks. Starting with a single-hop wireless network of nodes, we propose a $\Theta(n \ln n)$ ALOHA-like neighbor discovery algorithm when nodes cannot detect collisions, and an order-optimal $\Theta(n)$ receiver feedback-based algorithm when nodes can detect collisions. Our algorithms neither require nodes to have a priori estimates of the number of neighbors nor synchronization between nodes. Our algorithms allow nodes to begin execution at different time instants and to terminate neighbor discovery upon discovering all their neighbors.

Keywords: Ad hoc networks, initialization, neighbor discovery, randomized algorithms, wireless networks.

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INTRODUCTION

WIRELESS ad hoc networks and sensor networks are typically deployed without any communication infrastructure and are required to "configure" themselves upon deployment. For instance, immediately upon deployment, a node has no knowledge of other nodes in its transmission range and needs to discover its neighbors in order to communicate with other network nodes. Neighbor discovery is an indispensable first step in the initialization of a wireless network since knowledge of one-hop neighbors is essential for medium access control protocols, routing protocols, and topology control algorithms to work efficiently and correctly.

Neighbor Discovery (ND) is a family of protocols designed to find nodes' one-hop neighbors, and is the first step in the initialization of WSNs. The information acquired through neighbor discovery protocols is extremely useful for further operations such as media access and routing. Existing protocols for ND can be classified into three categories: deterministic protocols , multi-user detection-based protocols, and randomized protocols. Deterministic protocols usually use leaders to schedule all nodes' transmissions, and multi-user detection-based protocols identify neighbors by their pre-defined signatures. Compared with the first two categories, randomized protocols are more commonly used to conduct ND. In randomized protocols, the nodes broadcast discovery messages in randomly chosen time slots to reduce the possibility of the collision from the other nodes.

Neighbor discovery algorithms can be classified into two categories, viz. *randomized* or *deterministic*. In randomized neighbor discovery, each node transmits at randomly chosen times and discovers all its neighbors by a given time with high probability (w.h.p.). In deterministic neighbor discovery, on the other hand, each node transmits according to a predetermined transmission schedule that allows it to discover all its neighbors by a given time with probability one. In distributed settings, determinism often comes at the expense of increased running time and, in the particular case of neighbor discovery, typically requires unrealistic assumptions such as node synchronization and *a priori* knowledge of the number of neighbors. We, therefore, investigate randomized neighbor discovery algorithms in this paper.

1. Related Works

1) We first study the ALOHA-like neighbor discovery algorithm proposed in [13] in a single-hop wireless network of nodes. We show that its analysis reduces to that of the *Coupon Collector's Problem* and that each node discovers all its neighbors in 1 time w.h.p.

2) When nodes can detect collisions, we propose an order optimal neighbor discovery algorithm that employs feedback from receiving nodes and allows each node to discover all its neighbors in time w.h.p. Interestingly, we find that receiver feedback can be used even when nodes cannot detect collisions, and we propose a novel algorithm that achieves a running time.

3) We next show that absence of an estimate of the number of neighbors, results in a slowdown of no more than a factor of two, compared to when nodes know.

4) We further show that lack of synchronization among nodes results in at most a factor of two slowdown in the algorithm performance from the case when nodes are synchronized.

5) We then describe how neighbor discovery can be accomplished even when nodes begin execution at different time instants. Furthermore, when nodes do not know, we propose a provably correct termination condition that allows each node to terminate neighbor discovery after discovering all its neighbors w.h.p.

6) Finally, we extend our analysis to a general multihop wireless network setting. Here, we establish an upper bound of for the running time of the ALOHA-like algorithm, where is the maximum node degree in the network and denotes the total number of nodes. We also establish a lower bound of on the running time for any randomized neighbor discovery algorithm. Our result thus implies that the ALOHA-like algorithm is at most a factor worse than the optimal.

2. Proposed Architecture

The main contributions of this paper are as follows:

1) The collition detection based algorithm will be present in algorithm The key idea behind the algorithm will divide each slot into two subslots. Upon successful reception of a *DISCOVERY* message in the first subslot, each receiving node transmits bit “1” to the source of the message

2) We next describe the asynchronous collision detection-based algorithm, which is presentedin algorithm each transmission is of fixed duration and is followed by a feedback period of duration б.

3. Implementation

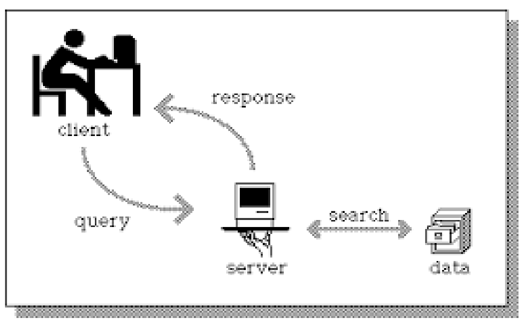
MODULES DESCRIPTION:-

Node IDs*:* We assume that the nodes have *locally unique* identifiers, i.e., no two neighbors of a given node have the same identifier. For example, the identifier could be the MAC address of a node or its location.

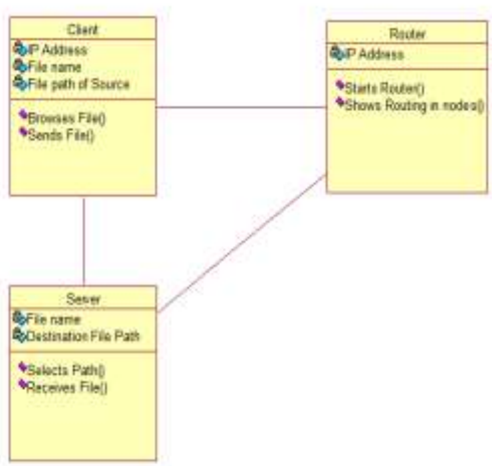
Radio model: Each node is equipped with a radio transceiver that allows a node to either transmit or receive messages, but not both simultaneously.

Collision model: Throughout this paper, we assume that when two or more nodes, each of which has a common receiver, transmit concurrently, a collision occurs at the receiver. We further assume that a collision is the only source of packet loss, i.e., we ignore packet losses due to effects such as shadowing and fading observed in wireless channels. The collision model, although idealized, will allow us to obtain a deep understanding of the neighbor discovery problem yielding valuable insights for designing practical neighbor discovery algorithms.

4. System Architecture



5. Class Diagram



6. CONCLUSION

In this paper, we have presented efficient neighbor discovery algorithms for wireless networks that is comprehensively address various practical limitations of the earlier approaches. Our neighbor discovery algorithms do not require estimates of node density and allow asynchronous operation. Furthermore, as the algorithms allow nodes to begin execution at different times and also allow nodes to detect termination. Our analysis shows a gap between the lower and upper bounds on the running time for neighbor discovery in the network case. Clearly, the quest for an order-optimal neighbor discovery algorithm remains an intriguing prospect. Of particular interest is the question of whether the feedback-based algorithms, which are order-optimal in the single-hop case, can be extended to the multihop network setting while outperforming the ALOHA-like algorithm. Another direction of interest is the extension of the various algorithms and the analysis presented in this paper to wireless channel models that incorporate phenomena such as fading and shadowing

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