



Review on 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 analyze 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.

I. 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.

II. BRIEF LITERATURE SURVEY

V. Karthikeyan, A. Vinod propose a new method for neighbor discovery in wireless sensor networks (WSNs) which pays an eminent consideration for energy utilization and QoS parameters like latency, throughput, error rate etc. In the proposed method, the network routing is enhanced using AOMDV protocol which can accurately discover the neighbour nodes and power management with HMA C p r o t o c o l w h i c h reduces t h e e n e r g y u t i l i z a t i o n significantly. A complete analysis is being performed to estimate how t h e Q o S metrics varies in various scenarios of power consumption in wireless networks.

Wei Zeng, Sudarshan Vasudevan increase prevalence of multipacket reception (MPR) technologies such as CDMA and MIMO, we study neighbor discovery in MPR networks that allow multiple packets to be received successfully at a receiver. More specifically, we design and analyze a series of randomized algorithms for neighbor discovery in MPR networks. We start with a simple Aloha-like algorithm that assumes synchronous node transmissions and the number of neighbors, n , is known. We show that the time for all the nodes to discover their respective neighbors is $\Theta(\ln n)$ in an idealized MPR network that allows an arbitrary number of nodes to transmit simultaneously.

Guobao Sun, Fan Wu discuss the problem of ND in low-duty-cycle networks with MPR. Specifically, we first present an ALOHAlike protocol, and show that the expected time to discover all $n-1$ neighbors is $O(n \log n \log \log nk)$ by

reducing the problem to a generalized form of the classic *K Coupon Collector's Problem*. Second, we show that when there is a feedback mechanism to inform a node whether its transmission is successful or not, ND can be finished in time $O(n \log \log nk)$. Third, we point out that lacking of knowledge of n results in a factor of two slowdown in two protocols above. Finally, we evaluate the ND protocols introduced in this paper, and compare their performance with the analysis results.

J. Capetanakis designed a feedback-based neighbor discovery algorithm to operate in fading environments has been studied. However, the performance of these algorithms is not well understood, even in the case of single-hop networks. Each of these algorithms requires *a priori* estimates of node density and do not address the issue of termination of neighbor discovery.

A.Keshavarzian *et al.* propose a novel, deterministic neighbor discovery algorithm. However, nodes need to be synchronized with each other and need to know the maximum number of neighbors *a priori*. Furthermore, the neighbor discovery needs time-slots to discover all the neighbors.

D. Angelosante, have been propose Neighbor discovery algorithms using a multiuser detection approach. However, these algorithms require synchronization between nodes and also require each node to know the signatures of every other node in the network. An interesting approach to neighbor discovery based on group testing has been proposed in [21], but it also suffers from the same practical limitations.

G. Jakllari been numerous proposals for neighbor discovery when nodes have directional antennas. In general, these solutions propose antenna scanning strategies for efficient neighbor discovery. However, none of these proposals addresses the practical challenges considered in this paper. Furthermore, the analysis in this paper can be used to provide a more rigorous understanding of the directional neighbor discovery problem.

III. PROBLEM FORMULATION

- A. Neighbor discovery needs to cope with collisions. Ideally, a neighbor discovery algorithm needs to minimize the probability of collisions and, therefore, the time to discover neighbors.
- B. In many practical settings, nodes have no knowledge of the number of neighbors, which makes coping with collisions even harder.
- C. When nodes do not have access to a global clock, they need to operate asynchronously and still be able to discover their neighbors efficiently.
- D. In asynchronous systems, nodes can potentially start neighbor discovery at different times and, consequently, may miss each other's transmissions.
- E. Furthermore, when the number of neighbors is unknown, nodes do not know when or how to terminate the neighbor discovery process.

IV. OBJECTIVE

A neighbor discovery algorithms that comprehensively address each of these practical challenges under the standard collision channel model. Unlike existing approaches that assume *a priori* knowledge of the number of neighbors or clock synchronization among nodes, we propose neighbor discovery algorithms that:

- A. Do not require nodes to have a prior knowledge of the number of neighbours.
- B. Do not require synchronization among nodes.
- C. Allow nodes to begin execution at different time instants.
- D. Enable each node to detect when to terminate the neighbour discovery process.

V. PROPOSED METHODOLOGY

The main contributions of this paper are as follows:

- A. The collision 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
- B. We next describe the asynchronous collision detection-based algorithm, which is presented in algorithm each transmission is of fixed duration and is followed by a *feedback period* of duration σ .

VI. CONCLUSIONS

Thus we have presented efficient neighbor discovery algorithms for wireless networks that comprehensively address various practical limitations of the earlier approaches.

Our approach of neighbor discovery algorithms do not require estimates of node density and allow asynchronous operation.

ACKNOWLEDGMENT

We would like to thank Department of Computer Science & Engineering, RCERT Chandrapur for providing infrastructure and guidance to understand Wireless Ad-Hoc Network.

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