Neighbor Discovery in Wireless Networks

***Abstract*—The abstract goes here.**

I. Introduction

II. Related Work

III. Preliminaries

In this section, we first give some notion definitions and introduce the collision detection mechanism. Then we formulate the Neighbor Discovery problem formally.

A. Sensor Node Model

The wireless sensor network consists of a number of sensors distributed separately in a target area. The deployed sensor nodes keep their most time in sleep pattern to avoid quick energy consumption and wake up timely to work on duty.

We assume that each node has a unique identifier ID_i. Time is assumed to be divided into slots of equal length t_0, which is sufficient to finish communications. In each time slot, a node transform its pattern according to a pre-defined duty schedule.

Definition 1: **Duty schedule** is a pre-defined sequence $S = \{s^t\}_{0 \le t < T}$ of period T and

$$s^t = \begin{cases} 0 & sleep \\ 1 & wake \end{cases}$$

Each node construct its own duty schedule according to a specific strategy and repeats it until finding all the neighbors. Since the waking-up duration has a significant affect on the battery's lifetime, duty circle is defined to restrict the energy consumption.

Definition 2: **Duty circle** represents the fraction of one period T where a node turns its radio on. It can be formulated as:

$$\theta = \frac{|\{0 \le t < T : s^t = 1\}}{T}.$$

When a sensor wake up on a time slot, it can turn to either the transmitting state or listening state.

- Transmitting state. A node turn to transmitting state will broadcast messages containing its own identify information to all its neighbors.
- Listening state. A node turn to listening state will monitor the frequency channel to collect its neighbors' information. However collision will occur when two or more neighbor nodes transmit concurrently and thus no valid information will be gathered

Transiting between the states only costs little time, compared to one complete time slot.

B. Collision Detection Mechanism

C. Problem Definition

We consider a partially-connected sensor network model, where two nodes are neighbors if they locate within the radio range of each other. A symmetric matrix is used to record the neighboring relations as:

$$M_{i,j} = \begin{cases} 1 & Neighbor \\ 0 & Else \end{cases}$$

each sensor follows its duty schedule to achieve neighbor discovery.

Notice that the neighbor discovery process is not bidirectional, which means any pair of neighbors need to find each other separately. A sensor node u_i find one of its neighbors u_j can be formulated as $L(i,j)$. Then we define the discovery latency that node u_i discovers all neighbors as:

Definition 3: **Discovery latency** of node u_i is the time to discover all neighbors:

$$L(i) = \max_{M_{(i,j)}=1} L(i,j).$$

Thus , the neighbor discovery problem can be formulated as:

Problem 1: Given a duty circle θ, design a duty schedule and transiting strategy which optimizes $L(i)$ to the most extent.

IV. A

V. B

VI. Evaluation

VII. Conclusion

The conclusion goes here.