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Discovering Of Neighbor in an Wireless Networks Based On Efficient Algorithm

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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 ALOHA-like neighbor discovery algorithm when nodes cannot detect collisions, and an order-optimal 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. We finally show that receiver feedback can be used to achieve a running time, even when nodes cannot detect collisions. We then analyze neighbor discovery in a general multihop setting. We establish an upper bound of on the running time of the ALOHA-like algorithm, where denotes the maximum node degree in the network and the total number of nodes. We also establish a lower bound of on the running time of any randomized neighbor discovery algorithm. Our result thus implies that the ALOHA-like algorithm is at most a factor worse than optimal.**

***Index Terms*— Aloha, neighbor discovery**

1. INTRODUCTION

Three types of collision-free channel access protocols for ad hoc networks are presented. These protocols are derived from a novel approach to contention resolution that allows each node to elect deterministically one or multiple winners for channel access in a given contention context (e.g., a time slot), given the identifiers of its neighbors one and two hops away. The new protocols are shown to be fair and capable of achievingmaximum utilization of the channel bandwidth. The delay and throughput characteristics of the contention resolution algorithms are analyzed, and the performance of the three types of channel access protocols is studied by simulations. The time-complexity of deterministic and randomized protocols for achieving broadcast (distributing a message from a source to all other nodes) in arbitrary multi-hop radio networks is investigated. In many such networks, communication takes place in synchronous time-slots. A processor receives a message at a certain time-slot if exactly one of its neighbors transmits at that time-slot. We assume no collision-detection mechanism; i.e., it is not always possible to distinguish the case where no neighbor transmits from the case where several neighbors transmit simultaneously. We present a randomized protocol that achieves broadcast in time which is optimal up to a logarithmic factor. In particular, with probability 1 --E, the protocol achieves broadcast within O((D + log n/s) 'log n) time-slots, where n is the number of processors in the network and D its diameter. On the other hand, we prove a linear lower bound on the deterministic time-complexity of broadcast in this model. Namely, we show that any deterministic broadcast protocol requires 8(n) time-slots, even if the network has diameter 3, and n is known to all processors. These two results demonstrate an exponential gap in complexity between randomization and determinism.

II. IMPLEMENTATION

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

Algorithm 1: Collision Detection-Based ND(i, n)

```
b ← 0 //Number of neighbors discovered by node i
flag ← 0 //Has node i been discovered by other nodes?
NbrList ← [] //List of neighbors of node i
loop
    p_xmit ← 1/(n − b)
    if ((flag = 0) and (Bernoulli(p_xmit) = 1)) then
        Transmit DISCOVERY(i) in first subslot
        if second subslot not idle then
            flag ← 1 //"Drop out"
        end if
    else
        if successful reception in first subslot then
            Transmit bit "1" in second subslot
            NbrList[b++] ← DISCOVERY.source
        end if
    end if
end loop
```

We present 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:

P1 do not require nodes to have *a priori* knowledge of the number of neighbors;

P2 do not require synchronization among nodes;

P3 allow nodes to begin execution at different time instants;
P4 enable each node to detect when to terminate the neighbor discovery process.

To the best of our knowledge, our work provides the first solution to the neighbor discovery problem that satisfies all of the properties P1–P4. Our approach is to start with a single-hop wireless network in which nodes are synchronized and know exactly how many neighbors they have. As we will see, the analysis in such a simplistic setting yields several valuable insights about the neighbor discovery problem. These insights allow us to progressively relax each of the assumptions leading to a complete and practical solution to the neighbor discovery problem in a multihop network setting.

Algorithm 2: Asynch. Collision Detection-based ND(i, n)

```
b ← 0 //Number of neighbors discovered by node i
flag ← 0 //Has node i been discovered by other nodes?
NbrList ← [] //List of neighbors of node i
loop
    λ ← 1/(2κ(n − b))
    Alarm(TIMEOUT, Exp(1/λ)) //Set Listen duration
    try:
        loop
            Listen for DISCOVERY messages
            if collision detected then
                Transmit bit "1" at the end of busy period
            else
                NbrList[b++] ← DISCOVERY.source
            end if
        end loop

    catch TIMEOUT:
        if (flag = 0) then
            Transmit DISCOVERY(i)
            if feedback period idle then
                flag ← 1 //"Drop out"
            end if
        end if

end loop
```

Algorithm 3: ND Without Collision Detection(i, n)

```
b ← 0 //Number of neighbors discovered by i
flag ← 0 //Has i been discovered by other nodes?
id ← −1 //id of most recently discovered node
NbrList ← [] //List of neighbors of node i
for r = 1 to ⌈log log n⌉ − 1 do
    p_xmit ← 2^(r−1)/n
    for t = 1 to ⌈(8n/2^r) + 8 log 2n⌉ do
        if (flag = 0) and (Bernoulli(p_xmit) = 1) then
            Transmit DISCOVERY(i, id)
        else
            if successful reception then
                if (DISCOVERY.id = i) then
                    flag ← 1 //"Drop out"
                else
                    id ← DISCOVERY.source
                    NbrList[b++] ← id
                end if
            end if
        end if
    end for
end for
Switch to ALOHA-like neighbor discovery
loop
    p_xmit ← log n/n
    if (flag = 0) and (Bernoulli(p_xmit) = 1) then
        Transmit DISCOVERY(i)
    else
        if successful reception then
            NbrList[b++] ← DISCOVERY.source
        end if
    end if
end loop
```

III. SYSTEM PRELIMINARIES

A. ALOHA-BASED ND

Clique of size n known to all nodes Slotted, synchronous system Prob. node i is discovered in a time slot: $p_s = \frac{1}{n}\left(1 - \frac{1}{n}\right)^{n-1} \approx \frac{1}{ne}$ Prob. of "unsuccessful" slot:

Probability that the slot is idle or collision occurs = 1

– n p_s = 1/e . Given an urn with n coupon types (each corresponding to unique neighbor) draw a coupon (i.e. discover a neighbor) with probability 1/ne draw a "blank" coupon (i.e. a collision or an idle slot occurs) with probability 1/e W: time to discover all n neighbors

Same as waiting time to complete coupon collectionE[W] = ne(log N + Θ(1)) = O(n log n) Concentration result: W = Θ(n log n)

B. ASYNCHRONOUS ALOHA-BASED ND

Exponential "receive" durations implies transmission events are Poisson Prob. a given transmission is successful is 1/e Asynchronous algorithm can again be viewed as a coupon collection problem Prob. of drawing a coupon Time to discover all neighbors (W) E[W] = 2σne(log n + Θ(1)) Two times slower than synchronous version W = Θ(n log n)

IV. CONCLUSION

We analyzed the neighbour node discovery problems in static and dynamic multihop Sensor Networks. Conventional node discovery techniques were found to be inadequate and they give less significance to the QoS parameters. So as to overcome these issues we proposed a new method for node discovery in which AOMDV protocol is implemented for node discovery and route establishment. The comparative study with other routing protocols, we came to the inference that, our method can produce high discovery rate. On the other hand, for reducing the overall power utilization Hybrid MAC protocol is implemented. Results show significant reduction in power. consumption with HMAC. Hence the end to end delay and routing over head and energy consumption are minimized and the throughput is increased remarkably.

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