Data Broadcast by utilizing Approximation Algorithms in Multi-hop Wireless Networks

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Abstract
Broadcasting is a basic operation in wireless networks and plays a crucial role in the networks. Many past studies have studied the NP-hard, broadcast problem for always-on multi-hop networks Broadcasting refers to transmitting a packet that will be received by every device on the network. In multi hop wireless networks, however, interference at a node due to contemporaneous transmissions from its neighbors makes it nontrivial to design a minimum-latency broadcast algorithm, which is known to be NP-complete. We extant a 12-approximation algorithm for the one-to-all broadcast problem that effective to all previously known covenants for this problem. We present the average latencies for broadcast algorithms.

Keywords
Multi Hop Wireless Networks, Sensor Networks, Ad-hoc Networking, Approximation Algorithms, and Broad Cast Algorithms

I. Introduction

Wireless Sensor Network (WSN), sometimes called wireless sensor and actuator networks (WSAN). The broadcast nature of the radio transmission is called Wireless Broadcast Advantage. This enables a transmitting sensor node to broadcast to all the receiving nodes within its transmission range in a single transmission. Hence, their transmissions need to be scheduled to avoid interference, such scheduled transmissions are said to be interference-aware transmissions [2]. In WSNs, broadcasting from a source node to all the other nodes in the networks is one of the fundamental operations on which various distributed applications and protocols are based.

When two or more nodes transmit a message to a common neighbor at the same time, the common node will not receive any of these messages. We say that collision has occurred at the common node in such case. Interference range may be even larger than the transmission range, in which case a node may not receive a message from its transmitter, if it is within the interference range of another node sending a message. One of the earliest broadcast mechanisms proposed in the literature is flooding, where every node in the network transmits a message to its neighbors after receiving it. Flooding is used in bridging and in systems such as Usenet and peer-to-peer file sharing and as part of some routing protocols, including OSPF, DVMRP, and those used in ad-hoc wireless networks.

II. Overture

In one-to-all broadcast, there is a source that sends a message to all other nodes in the network. Even the one-to-all broadcasting problem is known to be NP-complete [1]. For this, we develop approximation algorithms. For one-to-all broadcast, we present a simple approximation algorithm that achieves a 12-approximate solution, thereby improving the approximation guarantee of 16 due to Huang et al. Our algorithm is based on the algorithm of Gandhi et al.

In wireless networks so many techniques involved for broadcasting. In order to reduce the broadcast redundancy and contentions, they make use of nodes' neighborhood information and determine whether a particular node needs to transmit a message. Basagni et al. present a mobility transparent broadcast scheme for mobile multi-hop radio networks. In their scheme, nodes compute their transmit times once and for all in the beginning. They provide two schemes with bounded latency [7]. These schemes have approximation factors which are linear and polylogarithmic in the number of network nodes. In effect, they assume that the topology of the network is completely unknown. Although their schemes are attractive for highly mobile environments, their approximation factors are far from what is achievable in static and relatively less mobile environments where the broadcast tree and schedule can be computed efficiently.

III. Problem Statement

When the interference range and the transmission range are identical, a wireless network can be modeled as a unit disk graph (UDG), G = (V, E). The nodes in V are embedded in the plane. Each node u € V has a unit transmission range. Let |u, v| denote the Euclidean distance between u and v. Let D (u) denotes the neighbors of u in G. A node v € D (u) iff |u, v| ≤ 1 [4]. We are given a disk graph G = (V, E) and a set of messages M = {1, 2. . . m}. We also have a set of sources for these messages: sources = {sj |sj is the source of message j}. A node can transmit message j only after it receives message j collision-free. A schedule specifies, for each message j and each node i, the time at which node i receives message j collision-free and the time at which it transmits message j. If a node does not transmit a message then it's transmit time for that message is 0. The latency of the broadcast schedule is the first time at which every node receives all messages. The number of transmissions is the total number of times every node transmits any message. Our goal is to compute a schedule in which the latency is minimized.

IV. One-to-All Broadcast

This algorithm takes the input and a source node s. If a node u is parent node of the node w then u is responsible for transmitting the message to w without any collision. In this module first we send the message to primary nodes. Second we send the message to all other nodes. It leads to guarantee that receiver node will receive the message collision free by overcoming broadcast problem

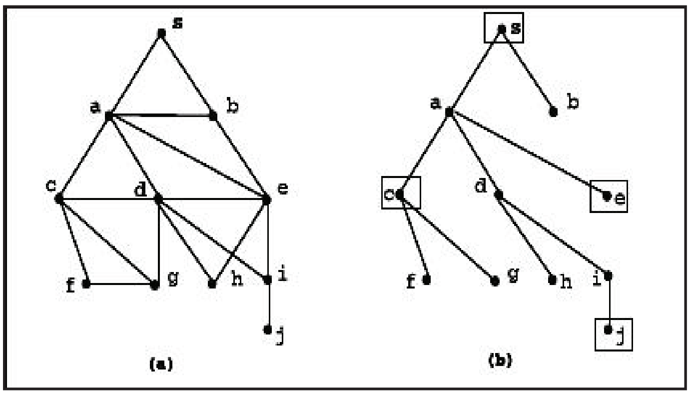
The algorithm takes as input a UDG G = (V, E) and a source node s. The algorithm first constructs a broadcast tree, Tb, rooted at s in which if a node u is a parent of a node w then u is responsible for transmitting the message to w without any collision at w [1]. The two key variations from the algorithm in that lead to a significantly improved approximation guarantee are:

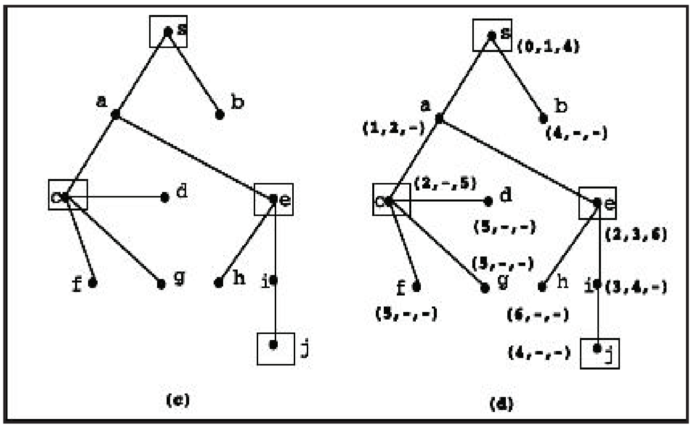
- Processing the nodes in a greedy manner while constructing the broadcast tree.
- Allowing a node to transmit more than once.

```
BROADCASTTREE (G = (V, E), s)
P ← P_0 ← {s} // P is the set of primary nodes.
T_BFS ← BFS tree in G with root s
ℓ ← maximum number of levels in T_BFS
// s belongs to level 0
for i ← 1 to ℓ do
    L_i ← set of all nodes at level i in T_BFS
    P_i ← ∅
    for each w ∈ L_i do
        if (P ∩ D(w) = ∅) then
            P_i ← P_i ∪ {w}
            P ← P ∪ {w}
    S_i ← L_i \ P_i
P_{ℓ+1} ← ∅
S ← V \ P
for each node u ∈ V do
    parent(u) ← NIL
for i ← 0 to ℓ do
    P'_i ← P_i
    while (P'_i ≠ ∅) do
        u ← node in P'_i with maximum
              |{w ∈ D(u) | parent(w) = NIL}|
        C(u) ← {w ∈ D(u) | parent(w) = NIL}
        for each w ∈ C(u) do
            parent(w) ← u
        P'_i ← P'_i \ {u}
    while (∃ w ∈ P_{i+1} s.t. parent(w) = NIL) do
        u ← node in S_i with maximum
              |{w ∈ D(u) ∩ P_{i+1} | parent(w) = NIL}|
        C(u) ← {w ∈ D(u) ∩ P_{i+1} | parent(w) = NIL}
        for each w ∈ C(u) do
            parent(w) ← u
V_b ← V
E_b ← {(u, w)|u = parent(w)}
return T_b = (V_b, E_b)
```

In ONE-TO-ALL BROADCAST, two phases are involved. In Phase 1, the algorithm schedules transmissions only to the nodes in set (denoted by X) which contains all primary nodes and non-leaf secondary nodes in Tb [1].

In Phase 2, transmissions are scheduled to send the message to all other nodes. Note that this leads to some nodes transmitting more than once which are again a significant departure In this algorithm each node transmits the message at most once. The instinct behind this is that it is not necessary to send a message to terminal nodes early as they are not responsible for relaying the message further





A. General Interference Range Model

Our algorithm can be easily extended to the case when the interference range of a node is different than its transmission range. The only variations are in lines 13 and 24 of the pseudocode ONE-TO-ALL BROADCAST, where D(u) (line 13) and D(v) (line 24) are to be replaced by "interference range of u" and "interference range of v," respectively. Note that if á, the ratio of interference range to the transmission range is a constant, then so is |Dp (v, á +1)|(note that Dp(v, á +1) remains the same) [2]. The rest of the analysis is very similar to the case when á = 1, only the values of some constants will change.

Another algorithm also involved for reducing the broadcasting time. In all to all broadcast, every node in the network will transmits the message to every other node in the network. We present 20 approximation algorithm based on Interleaved collect and distribute algorithm (ICDA) [5]. Here we first send the message to the root node from all the nodes in a network via upward transmission. At the time of sending the message from each node to root node all other nodes are in the idle mode. In that time that sending node also sends to child node via downward transmission. So there is no need send the message to the child node after receiving the message from the node. It reduces the broadcasting time of the network. Then we distribute the message to all the nodes in the network on the basis of flooding technique.

V. Application

Variant applications are developed based upon this broadcasting. In that Laravel 5.1, the framework includes functionality called broadcasting events that makes it easy to create real-time apps in PHP. With this new functionality, an app can publish events to various cloud-based real-time PubSub solutions, like Pusher, or to Redis. The default Laravel application structure is intended to provide a great starting point for both large and small applications.

VI. Conclusion

In computer science and operations research, approximation algorithms are algorithms used to find approximate solutions to optimization problems. Approximation algorithms are often associated with NP-hard problems. In this paper, an approximation algorithm for broadcasting in multi hop wireless networks will be existed. Our algorithm for ONE-TO-ALL BROADCASTING gives a 12-approximate solution. Our simulation results show that in practice, these proposed schemes perform much better than the theoretical bound and achieve up to 37 percent latency performance improvement over existing schemes.

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