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A Novel Contract Based Incentive Framework Model to Avoid WI-FI Network Crowd Sourcing Problems

Professor&Principal Dr.P.Chitti Babu, Assistant Professor D.J.Samatha Naidu , Jalli Naveen
MCA Department & APGCCS,Rajampet,YSR Kadapa, India
drpcbit@gmail.com, samramana44@gmail.com, naveenjalli1@gmail.com

Abstract – **In this paper, we provide proper incentives to the users to share their private access point and this mechanism is known as crowdsourced wireless networks. Here the network operator consists of designs and pricing strategies to the user. In our contract model, each user's best choice depends not only on his private information but also on other user's choices. This reduces problems in the contract design, as the operator needs to analyze the equilibrium choices of all users, rather than the best choice of each single user. We perform some safety measures to reduce the disclosure of private information of community members and then derive the optimal (and feasible) contract that yields a maximal profit for the operator. Our paper analyses the regardless of the user mobility pattern. Increase in wifi quality the operator can gain more profit, but (counter-intuitively) offer lower Wi-Fi access prices and subscription fees for users.**

Keywords – **Crowdsourcing, Mobility patterns, Access point. Wi-Fi- Bandwidth, Incentive Mechanism.**

I. INTRODUCTION

These days Wi-Fi technology is playing an increasingly important role in today's wireless communications. According to Cisco, more than 50% of global mobile data traffic will be carried via Wi-Fi in 2021. However, each Wi-Fi access point often has a limited coverage, generally tens of meters . Hence, to provide a city-wide or nation-wide Wi-Fi coverage, the network operator needs to deploy a huge number of Wi-Fi APs, which is usually very expensive. This motivates us to study a new type of Wi-Fi network that relies on aggregating (crowdsourcing) the large number of existing home Wi-Fi APs already deployed by individual users, instead of deploying new Wi-Fi APs. Such a novel Wi-Fi network based on crowdsourcing is often called Crowdsourced

Wireless community network. A Wireless community network is a group of people who owns a private access points or home wi-fi's share their access points with each other to form a community and to share network. These AP owners (APOs) are often called community members. By crowdsourcing the massive home Wi-Fi APs, it is possible to achieve a large (e.g., citywide or nation-wide) Wi-Fi coverage with a small deployment cost. A successful commercial example of such a network is FON, the world largest Wi-Fi community network with more than 20 million members globally. In practice, however, individual APOs may not know each other personally, hence lack the proper incentive to share Wi-Fi APs with each other . Therefore, one of the important issues in such a community network is to provide sufficient economic incentive for APOs, such that they are willing to join the community and share their Wi-Fi APs with each other. In this work, we focus on studying the incentive issue in crowdsourced wireless community networks.

In particular, we consider the network scenario where each APO has certain private information (e.g., his mobility pattern and his provided Wi-Fi access quality) not known by the operator and other APOs. We aim to design an incentive mechanism that (i) encourages individual APOs to Background and Motivation Wi-Fi technology is playing an increasingly important role in today's wireless communications. According to Cisco, more than 50% of global mobile data traffic will be carried via Wi-Fi in 2021.

II. SYSTEM MODEL

We consider a set = 1,... ,N of N individual APOs, each owning a private home Wi-Fi AP, who form a community and share their Wi-Fi APs with each other, leading to a crowdsourced wireless community network. The community network is managed (coordinated) by a network operator, who is responsible for the necessary security, privacy, and incentive issues in such a Wi-Fi network crowdsourcing. The community network is open not only to APOs but also to a set of NA = aN users (called Aliens) who do not own Wi-Fi APs, where a 0 is the ratio between Aliens and APOs. Aliens have to pay for accessing the community network (as they do not contribute APs) through, for example, purchasing Wi-Fi passes from the operator.

To ensure the necessary security, privacy, and quality-of-service (QoS), each AP's channel is divided into two sub-ls: a

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The Wi-Fi access quality provided by different APOs for traveling users (on their public channels) may be different, due to the different wireless characteristics (such as Wi-Fi standard, backhaul, public channel bandwidth, channel fad- ing, and network congestion) and location popularities. For example, the Wi-Fi access in a popular location may be more valuable than that in a unpopular location, and hence the APO may choose to install an AP with a carrier grade Wi-Fi standard that provides a better quality than a regular home Wi-Fi. The Wi-Fi access quality provided by an APO will affect traveling users' lengths of connection on this APO's Wi-Fi, hence affect the APO's potential revenue from sharing his AP (see Section IV-A.2 for more details).
simultaneously

1. APO type

The Wi-Fi access quality provided by different APOs for traveling users (on their public channels) may be different, due to the different wireless characteristics (such as Wi-Fi standard, backhaul, public channel bandwidth, channel fad- ing, and network congestion) and location popularities. For example,

2. APO Membership

To facilitate the later analysis, we consider a discrete APO (quality) model with a discrete set of K possible WiachieFi access qualities. the same type APOs will provide the same Wi-Fi access quality
$\theta 1 < \theta 2 < \cdots < \theta K$.
It cannot be observed by the network operator or other APOs. Similar as in many existing works , we assume that the distribution information regarding APO type has some public information.
As in , an APO can share his Wi-Fi AP in two different ways, corresponding to two different membership types: Linus and Bill. Specifically,

Table I: A Summary of Three User types

Type	Pay for using other APs	Paid by sharing his AP	Subscription fee
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

As a Linus, an APO can get free Wi-Fi access at other APs in the community, and meanwhile he has to share his own AP without any monetary compensation.
As a Bill, an APO needs to pay for accessing other APs in the community, and meanwhile he can earn some money from sharing his own AP with others.
Moreover, Aliens always need to pay for accessing any AP in the community, as they do not contribute APs. Thus, from the network operator's perspective, she will get all of the money collected at Linus APs (paid by Bills and Aliens), while only part of the money collected at Bill APs (paid by other Bills and Aliens). Here Network operator designs the pricing strategies for users and community members for joining the network.

III. RELATEDWORK

we explore this question in the context of markets for online labor and crowdsourcing where workers make strategic choices about whether to undertake a task, but do not strategize over quality conditional on participation. platforms such as fixed prices or base payments with bonuses (as on MTurk or oDesk), or open-entry.
We first show that with expected utility agents, the optimal contract—for any increasing objective of the principal always takes the form of an output-independent fixed payment to some optimally chosen number of agents. we show that a winner-take-all contest can dominate the fixed-payment contract, for large enough total payments, under a certain condition on the preference functions; we show that this condition is satisfied for the parameters given by the literature on econometric estimation of the prospect theory model [Tversky and Kahneman 1992; Bruhinetal. 2010]. Since these estimates are based on fitting the prospect theory model to extensive experimental data, this result provides a strong affirmative answer to our question for 'real' population preferences: a principal might indeed choose a fundamentally different kind of mechanism an output-contingent contest versus a 'safe output-independent scheme and do better as a result, if he accounts for deviations from the standard economic models of decision-making that are typically used in theoretical design

Proposed ALGORITHMS

Algorithm 1 Dual Algorithm

Input: {p†k : k ∈ B}

Output: {pLk: k ∈ B}

1: Initiate λ0 = 0,−1 = −1, t = 0, {ptk : k ∈ B} = {p†k :k ∈ B}

2: while If ∃ i such that |λti− λt−1i| > do

3: For all k = m, . . . , K − 1, update
λt+1 k = max{λtk +1 √t + 1(ptk− ptk+1), 0}. (26)
4: Calculate pt+1 = argmin0≤p≤pmax L(p,λt+1).
5: Set t = t + 1.
6: end while
7: Set λL = λt, pL = pt.

the dual algorithm fully takes advantage of the separable structure of the objective function in problem(20); it is easy to implement, since the optimal solutionof the Lagrangian can be obtained easily; it provides an upperbound of problem (20); it is possible to return the global
solution of problem (20) with a certificate (if the returned solution is feasible); if not, it returns a good approximatesolution, which can be used as an initial point for local.

Algorithm 2 Dynamic Algorithm

Input: $\{pLk: k \in B\}$

Output: $\{pDk: k \in B\}$

1: Initiate $\{pDk: k \in B\} = \{pLk: k \in B\}$

2: while $\{pDk: k \in B\}$ is infeasible do

3: Find the first and shortest infeasible sub-sequence $\{pDi, pD\ i+1, . . . , pDj\}$ of $\{pDk, k \in B\}$.

4: Set pDk= arg max0≤p≤pmaxj_t=ift(p), $\forall k = i, . . . , j$.

5: end while

2) Dynamic Algorithm: Now we deal with the case where$\{pLk: k \in B\}$ is not feasible. We denote a subsequenceof $\{pk : k \in B\}$, say $\{pi, pi+1, . . . , pj\}$, as aninfeasible sub-sequence, if $pi \geq pi+1 \geq \cdots \geq pj$ and $pi > pj$.

IV. COMPARITVE RESULTS

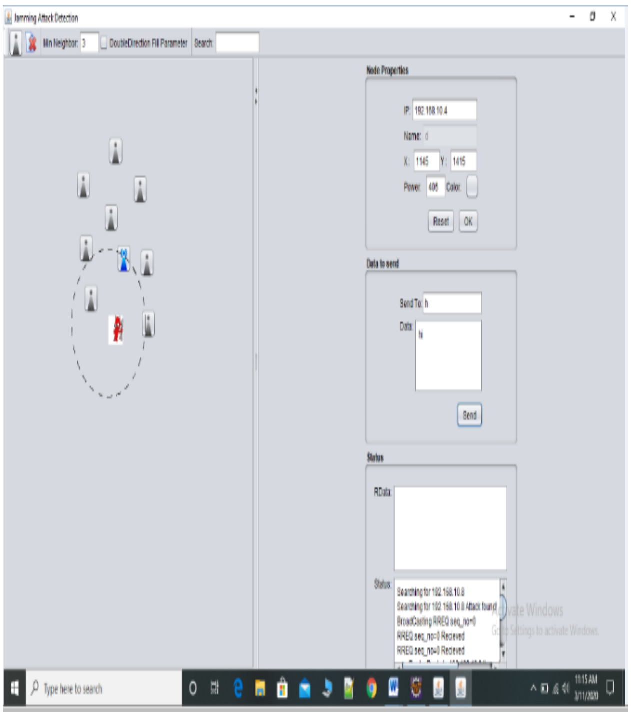

Fig. 1.Jamming detection.

In this paper, we proposed a novel contract mechanism for crowdsourced wireless community networks under incomplete information. Different from existing contract mechanisms in the literature, the proposed contract considers the coupling among users' contract item choices, hence is more complicated to design. We analyzed the feasibility and optimality of the proposed contract systematically based on the user equilibrium analysis. We also provided simulation results to illustrate the optimal contract and the profit gain of the operator. Our analysis helps us to understand how different users choose their Wi-Fi sharing schemes, which facilitates the network operator to better optimize her profit in different network and information scenarios. As for the future work, it is important to study a more general model with heterogeneous users, where different users may have different traffic demands and mobility patterns. It is also interesting to study the competition among multiple network operators.

V. FINAL RESULTS

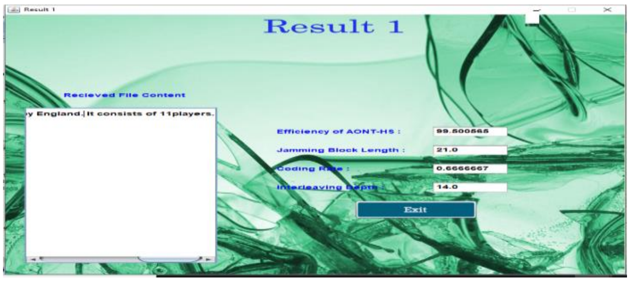

Fig. 2. Receiver page.

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