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Data Offloading Through Target Selection In Mobile Social Network

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***Abstract*—**Increase in technological development has given rise to a variety of applications available for Smartphone. These uses Mobile Social Network like
Wechat; which provides multimedia communication with text messaging in social network.
WhozThat; a system that ties together online social networks with mobile smart phones to answer common and essential social questions.
There are also online social network services like Facebook, Google+, Twitter, etc. which are used worldwide that has led to increase the overload in 3G network. This paper proposes a solution based on opportunistic communication which is a promising solution to partially solve the data traffic problem in Mobile Social Network which has no monetary cost associated with it. In this work it is been aimed to exploit opportunistic communication to facilitate information dissemination in the emerging Mobile Social Networks (MoSoNets) and thus reduce the amount of mobile data traffic by investigating the target-set selection problem for information delivery.
In particular the target set with only k users are selected, such that it can minimize the mobile data traffic over cellular networks using three algorithms Greedy, Heuristic, and Random. These algorithms will investigate the problem and their performance is evaluated through an extensive trace-driven simulation study.

Key Words: Mobile data offloading, mobile social networks (MoSoNets), target-set selection, opportunistic communication, Random Algorithm, Heuristic Algorithm, Greedy algorithm.

1. INTRODUCTION

3G is "Third Generation" technology; the one which is currently used in most mobile communication which uses analog cellular technology. It is intended for the true multimedia cell phone like Smartphone's. This 3G provide the feature of increased bandwidth and data transfer rate to web-based applications, but due to the proliferation of Smartphone(e.g., Apple'siPhone and Nokia N95) and online social networking services, which has lead to the over load on the 3G network which has resulted in decreasing the performance and also slows down in information dissemination for all the requested user in MoSoNets. So, the solution for this problem chosen in this work is opportunistic communication to facilitate information dissemination in the emerging Mobile social network (MoSoNets) and thus helps in reducing the amount of mobile data traffic by investigating the target set selection. The target set selection is the first step towards bootstrapping mobile data offloading for information delivery in MOSoNet.

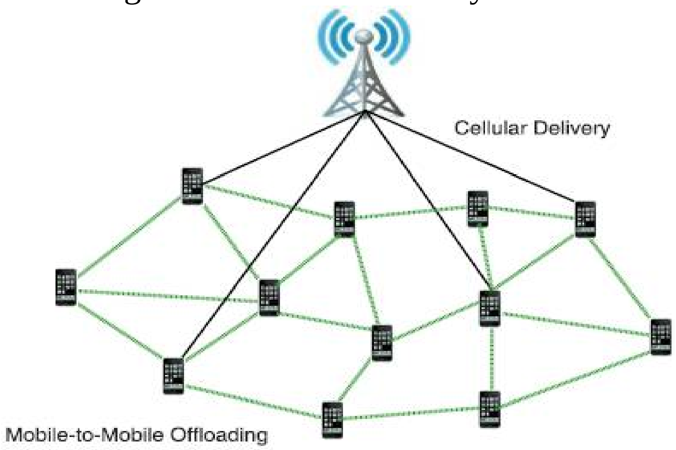

Figure 1: A snapshot of the contact graph for a small group of subscribed mobile users.

The Figure1 shows the contact graph of all the subscribed user which are requesting for the application to download From the Proposed solution where the base station will select some subscribed users as the target set, which helps to propagate further the information among all the subscribed users through their social participation. When non-target set user's mobile phones are within the transmission range of Target set user then they can communicate opportunistically and download the application from target-set. The Non-target users can also disseminate the information after they get it from target-users or others. The major advantage of this mobile data offloading approach is that there is almost no Monetary. Cost associated with opportunistic communications, which are realized through either Wi-Fi or Bluetooth technology. Initially target set with only 'k' users is selected, such that it can minimize the amount of mobile data traffic. The objective is to maximize the expected number of users that can receive the delivered information through opportunistic communications and also try to exploit the regularity of human mobility and apply the target set identified using mobility history for the future information delivery. The proposed three algorithms for the target-set selection problem will investigate the feasible solution as opportunistic offloading in mobile social network (MoSoNets).

2. EXISTING SYSTEMS

2.1 Cellular Traffic Offloading

There are two types of existing solutions to alleviate the traffic load on cellular networks: offloading to femtocells and Wi-Fi networks.

2.1.1 Femtocell for Indoor Environments.

The femtocell technology was proposed to offer better indoor voice and data services of cellular networks. Femtocells work on the same licensed spectrum as the macrocells of cellular networks and thus do not require special hardware support on mobile phones. But customers may need to install short range base stations in residential or small-business environment, for which they will provide Internet connections. Due to their small cell size, femtocells can lower transmission power and achieve higher signal-to interference-plus noise ratio (SINR), thus reducing the energy consumption of mobile phones. Cellular operators can reduce the traffic on their core networks when indoor users switch from macrocells to femtocells [6].

2.1.2 Cellular Traffic Offloading to Wi-Fi Networks

Wi-Fi networks work on the unlicensed frequency bands and thus cause no interference with 3G cellular networks. As a result cellular network operator have deployed or acquired Wi-Fi network world wide iPassConnect enable user to switch between 3G cellular and Wi-Fi connection smoothly [3]. Recently have proposed a scheme called Wiffler which uses the predictor to estimate offload capability to the Wi-Fi network until the delay tolerance threshold. Wiffler offloading algorithm to determine if the data should be transferred over Wi-Fi or over 3G. Off-loading cellular traffic to femtocells and Wi-Fi networks is limited by their network deployment and relies on the availability of Internet access. Instead offload mobile data traffic through opportunistic communications for information dissemination [1].

2.2 Information Diffusion or Dissemination

Social networks can be thought of as the carrier of information flows in communities. As a result, information diffusion/dissemination has been widely studied in traditional social networks and wireless network [4].

2.2.1 Traditional Social Networks

The fundamental algorithmic problem of information diffusion is that initial subset of 'k' users should be target, if the information want to be propagated to the largest fraction of the network .To prove that it can influence maximization problem in social Networks ,There are several existing works for information dissemination in wireless networks like peer-to-peer data dissemination and sharing system for mobile devices, aiming at increasing the data availability for users who have intermittent connectivity [5]. Due to the heterogeneity of access methods and the spatial locality of information, when mobile devices fail to access Internet through their own connections, they can try to query data from peers which is cached or have Internet access and thus can download and forward the data to them.

2.2.2 Other Wireless Networks

Diffusion has also been widely studied in wireless sensor networks and cellular networks. Directed diffusion is a data-centric dissemination paradigm for sensor networks, in the sense that the communication is for named data (attribute-value pairs). It achieves energy efficiency by choosing empirically good paths by caching data and processing it in network.

2.2.3 Mobile Social Networks

A recent trend for online social networking services, such as Facebook has replaced Loopt. Loopt was one of the first applications to socialize location sharing from mobile devices. Foursquare is also one of the applications which give foursquare tips that gives the user location awareness as a tip, PeopleNet is application designed as a wireless virtual social network that mimics how people seek information in real life. In PeopleNet, queries of a specific type are first propagated through infrastructure networks to bazaars these queries are further disseminated through peer-to-peer communications to find the possible answers. WhozThat [7] is a system that combines online social networks and mobile smart phones to build a local wireless networking infrastructure. Micro-Blog is a social participatory sensing application that can enable the sharing and querying of content through mobile phones. All these application Motivates the fact that people are usually good resources for location, community, and time-specific information which helps in information dissemination.

3. SYSTEM MODEL AND PROBLEM STATEMENT

This section describes the system model of MoSoNets and the target-set selection problem which is proposed to solve.

3.1 Model of MoSoNets

No matter which online social networking service are used now, MoSoNets can incorporates not only friends using one social network services but also friends, colleagues and family members who are hidden from all the major online social networking services. MoSoNets can also provide a platform to signal face-to-face interactions among nearby people who probably should know each other. There are two kinds of typical connections in MoSoNets, similar to the small-world networks. 1. Local connections realized by short-range communications, through WiFi or Bluetooth networks. When two mobile phones are within the transmission range of each other, their owners may start to exchange information, although they may not be familiar with each other. This opportunistic communication heavily depends on the mobility pattern of users and can usually construct contact graphs(As shown in Figure 1, as a snapshot) for them. Their major advantage is that they do not require infrastructure support and there is no monetary cost.2.Remote connections realized by long-range communications, Through cellular networks (e.g., EDGE, EVDO, or HSPA). This communication happens only between friends in real life. It may be used sporadically, compared to the short-range communications. Usually users need to pay for such data transmissions. The social graph can construct, as shown in Figure 2, based on the social relationship of mobile users.

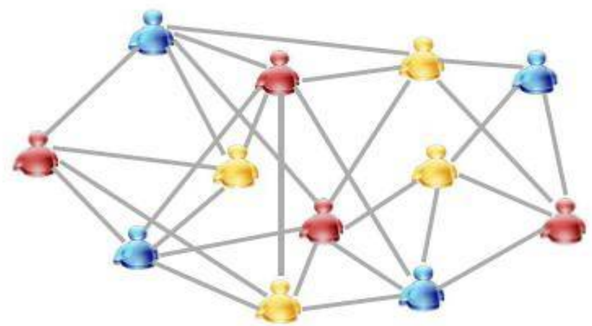

Figure 2. The social graph of mobile users.

Users connected by an edge are friends of each other. There are three communities depicted by different colors. Users in the same community form a clique. There are also connections between different communities. The work can exploit both types of communication to facilitate information dissemination in MoSoNets. On the one hand, friends can actively forward (push) information whenever they want. On the other hand, mobile users that are in contact can also pull information from each other locally.

3.2 Problem Statement

The Problem in existing study is how to choose the initial target set with only 'k' users, such that it can maximize the expected number of users receiving the information. This 'k' number of target users will help in decreasing of mobile data traffic. If there are totally 'n' subscribed users and 'm' users finally receive the information before the deadline, the amount of reduced mobile data traffic will be $n - (k + (n - m)) = m - k$. For a given mobile user, delivery delay is defined to be the time between when a service provider delivers the information to the 'k' users until a copy of it is received by that user. Service providers will send the information to a user directly through cellular networks, if he or she fails to receive the information before the delivery deadline. How the information is propagated is determined by the behavior of mobile users and how to exploit a probabilistic dissemination model is been discussed. .

The number of user disseminating the information may not be the same for different types of information and might change as time goes on, which reflects the dynamics of information. After mobile users receive the information from either the service providers or their peers, they may also (disseminate) forward it, through cellular networks (e.g., MMS, Multimedia Messaging Service), to their friends.

The modeling of information dissemination through opportunistic communications can be viewed as a combination of three sub-processes. First, to protect their privacy, mobile users have the control of whether or not to share a piece of information with their geographical neighbors and share it with probability p1.

Second, mobile users may want to explore the information in their proximity only when they are not busy and mobile phones may not always be able to discover each other during their short contacts. Thus, they can find the meta-data of a piece of information with probability p2.

Finally, based on these meta-data, mobile users will decide whether or not to fetch the information from their geographical neighbors and pull it with probability p3. As a result $\mathrm{p} = \mathrm{p1.\,p2.\,p3}$

4. PROPOSED SYSTEM

4.1 Target-Set Selection

Service providers may deliver the information to only a small fraction of selected users to reduce mobile data traffic and their operation cost, this selection process is known as Target-set selection. Target-set selection is the first step toward bootstrapping mobile data offloading for information delivery in MoSoNets.

The information dissemination function is the function that maps the target set to the expected number of infected users of the information dissemination process. Using this process presents the details of the greedy algorithm and the proposed heuristic algorithm.

4.1.1 Sub modularity of the Information Dissemination Function

The well-known greedy algorithm is applied to identify the target set and evaluate that the information dissemination function is sub modular, the greedy algorithm proposed to identify the target set. For any subset S of the users, the information dissemination function(S) gives the final number of infected users .when S is the initial target set. The function G {(.)} is sub modular if it satisfies the diminishing returns rule.

$$g(S \cup \{u\}) - g(s) \geq g(S^1 \cup \{u\}) - g(s^1)$$

For all users 'u' and all pairs of sets S⊆ S^1 it's been mentioned and compared in information diffusion in traditional social networks, the contact graph of MoSoNets changes dynamically and mobile users can pull information from their peers at every contact .Note that the delay-tolerance threshold (i.e., the delivery deadline) determines the information dissemination duration.

4.1.2 Greedy, Heuristic, and Random Algorithms

The three algorithms for the target-set selection problem called Greedy, Heuristic, and Random. The Greedy algorithm, initially the target set is empty so, this work evaluates the information dissemination function for every user, and selects the most active user (i.e., the one that can infect the largest number of uninfected users) into the target set. Then repeat this process, in each round selecting the next user from the rest with the maximum solution into the target set, until the 'k' Target-set user selected in a NP-hard problem for both the independent cascade model and the linear threshold model.

This will be the optimal target set, it shows the function is non-negative, monotone and sub modular and at each time target user is selected. The limitation of the Greedy algorithm is that it requires the knowledge of user mobility during the dissemination process, which may not be available at the very beginning.

Finally, for the Random algorithm, the service providers select 'K' target users randomly from all the subscribed users. Although this algorithm is simple, it is still effective in the offloading process. This verifies the feasibility mobile data offloading through opportunistic communications.

5. PERFORMANCE EVALUATION

The performance Evaluation is with respect to total number of requests the server has to process among the number of requests it has received. As shown in Figure 3 the plotted graph depicts the performance of three algorithms with respect to the "Number of Request Send to Server" and "Number of Request Processed by Server". According to this, it states, with respect to No algorithms, Random algorithm is reduced by 30%, Heuristic by 60% and Greedy by 80% in processing the requests received by server.

Figure 3 below shows the performance of the three algorithms with respect to the reduction of load on servers in 3 G Network.

Figure 4 shows the performance of all three algorithms with respect to "the number of user requesting for information in MoSoNets" to the "information disseminated to number of users in MoSoNets".

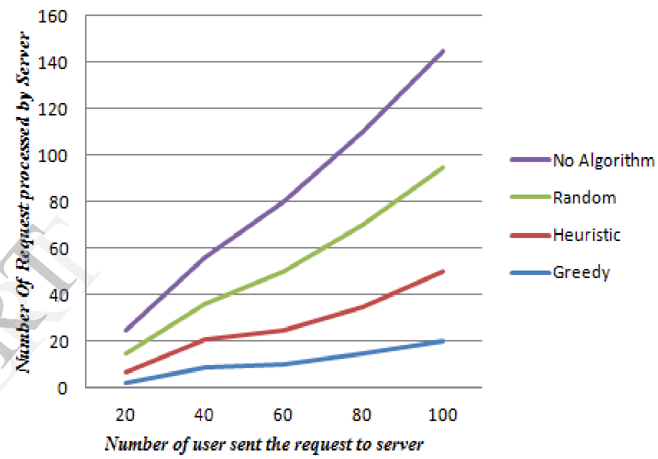

Figure 3. Graph which shows the performance of all three algorithm.

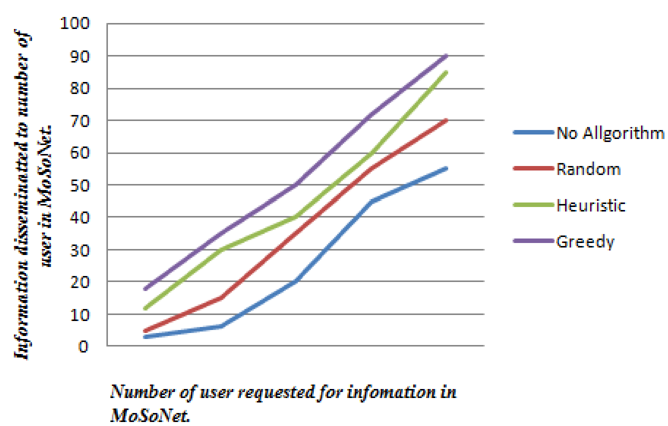

Figure 4 Information dissemination to user in MoSoNets

From the above graph it can observed that with the use of Greedy technique the information is been disseminated to more number of users than compared to Heuristic, Random and without using any of these (no algorithm).

CONCLUSION

Hence this work considers offloading mobile data traffic through opportunistic communication by investigating the target set selection for information dissemination in MoSoNets. This is achieved using three algorithms namely, Random, Heuristic and Greedy technique. Using the said approaches the number of requests to be processed at the server side is reduced so as to improve the performance and then reduce the load on 3G Network. With consideration of the proposed solution Greedy Algorithm performs the best followed by Heuristic and then the Random Algorithm.

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