

Enhancing Spontaneous Interaction in Opportunistic Mobile Social Networks

Bin Guo^{1*} Daqing Zhang^{1,2} Zhiwen Yu¹ Xingshe Zhou¹ Zhangbing Zhou^{2,3}

1. Northwestern Polytechnical University, China

2. Institut TELECOM SudParis, France 3. China University of Geosciences (Beijing), China

guob@nwpu.edu.cn

Abstract

With the development of advanced mobile devices and social network services, mobile social network (MSN) has become popular in recent years. This paper we present a new perspective of MSN, the opportunistic MSN, which aims to enhance spontaneous interaction/communication among people that opportunistically encounter in the physical world, without any infrastructure support. We present the motivation of opportunistic MSN, explore its underpinning and the key concepts. Further, we describe our ongoing practice regarding to this emerging research area.

Keywords: Smart phones, mobile social network, opportunistic community, spontaneous social interaction

1. Introduction

Mobile social networking (MSN) refers to social networking where individuals with similar interests connect with one another through their mobile devices [1]. Similar to Web-based social networking, existing MSN services (e.g., Foursquare) occur in the virtual world, relying on full mobile access of the Internet. In this paper, we want to present a different form of MSN – the Opportunistic MSN, which aims to enhance spontaneous interaction/communication among people that opportunistically encounter in the physical world, without leveraging any infrastructure support. In the following we describe the motivation of this work, using several use cases.

Forging social connections with others is the core of what makes us human. However, people co-present in the same places often miss opportunities to leverage social affinities for instant interaction or friendship due to the lack of awareness. The social affinities can have different forms, such as *shared interests/goals, with mutual friends, having similar backgrounds*, and so on. For example, Bob and Alice meet in chance in a coffee shop. Alice is a close-friend of Bob's sister, and they have the same interest on painting. Though sharing some commons, the two people are not aware of this, and may miss the opportunity for face-to-face conversation and friend making. The friendship network in existing MSNs is formed by user specification in online environments. Spontaneous prediction of potential "friends" co-present in

* Correspondence: Bin Guo, guob@nwpu.edu.cn

Department of Computer Science, Northwestern Polytechnical University, Xi'an, Shaanxi, China

offline/physical environments, however, is not incorporated in existing MSN services. Another motivation for opportunistic MSN is local information sharing, people often want to be aware of nearby events (e.g., sale in a nearby shop, local traffic information) or need to distribute location-dependent, spontaneously-triggered information to others in the proximity (e.g., selling an unused ticket near the train station due to an unplanned schedule change). Such information are better to be generated and disseminated within the local-area community, without leveraging the global network/Internet.

The issues mentioned above can be addressed by opportunistic MSN, which enables *information sharing and matchmaking among opportunistically encountered people, leveraging ad hoc networking (or opportunistic networking [2]) techniques*. With the development of Internet of Things in recent years, smart devices are being prevalent in our daily life [3]. Particularly, advanced mobile phones that are equipped with various sensors (e.g., Bluetooth, Wi-Fi, GPS), provide a technical basis for the building of opportunistic networks. In the following sections, we first extract and describe the characteristics of opportunistic MSN. Our ongoing efforts to opportunistic MSN will then be presented. Finally, we conclude the paper and present the future work.

2. Characterizing Opportunistic MSN

In this section, we explore the underpinning of MSN in opportunistic networks and present the key concepts in association with opportunistic MSN.

2.1. The Underpinning

As defined by Wikipedia, a community is a social group of organisms sharing an environment, normally with shared interests [4]. In *traditional human communities or online communities*, intent, resources, preferences, needs, and a number of other conditions may be present and common, affecting the identity of the participants and their degree of social cohesiveness. The opportunistic MSN/community presented in this paper is formed based on the movement and opportunistic, informal contact nature among people (e.g., people casually encounter in a coffee shop can form an opportunistic MSN). Does it still share the main features (e.g., similar interests, social cohesiveness) of existing forms of communities?

In recent years, numerous studies on “human mobility patterns” [5-7] have been conducted, and the following findings are obtained. First, humans follow fairly regular movement patterns in their daily life [5]. Second, human movements are highly influenced by the need for social interactions [6] or distribution of social capitals [7]. Like-minded people are thus more likely to be co-located, or in close spatial proximity, than those who share no interests. These findings provide a theoretical underpinning for opportunistic MSN, namely, *informal, short-lived co-presence of people in the physical world also shows a certain degree of social cohesiveness, which raises opportunities to mainstream social network services, such as friend making, information/resource sharing, as well as social interaction*.

2.2. Key Concepts

There are several concepts that are essential to the success of opportunistic MSN, including IoT devices, opportunistic communities, opportunistic data dissemination, and mobile sensing.

The development of *IoT devices* is one of the enabling techniques of opportunistic MSN. The devices used here should have several features: 1) they should be equipped with short-range communication (e.g., Bluetooth, Wi-Fi) and sensing modules (e.g., GPS, accelerometer); 2) they have tight-coupled relationship with human (e.g., the so-called “personal companions”[8]). Existing IoT devices, such as mobile phones, wearable devices, smart vehicles, can meet these requirements and provide pervasive support to opportunistic MSN formation..

It is well-known that *online communities* enable people to foster interaction with their friends irrespective of physical distance in the virtual world. The *opportunistic community*, however, refer to a group of people (known or unknown) connected using infrastructure-less networking techniques in the physical world. It pertains to traditional way of interaction to people within physical proximity.

Opportunistic data dissemination exploits opportunistic contacting between pairs of devices (e.g., mobile phones, vehicles) to disseminate information (e.g., local traffic information, user profile). It mimics the way people seek information via social networking through direct, face-to-face contacts (e.g., mouth-based information dissemination in villages). Data can be initially shared within an opportunistic community. When a node/human moves, the data can be opportunistically floated to newly formed o-communities. An example of opportunistic data dissemination is shown in Fig. 1, which illustrates the data floating within opportunistic community *i*, and from *i* to *j*, resulting from the movement of human nodes.

Mobile sensing is a significant data source for opportunistic MSN, where user location (e.g., in a park), activity (running, walking), ambient context (traffic condition, noise level) can be sensed and disseminated among opportunistic community members.

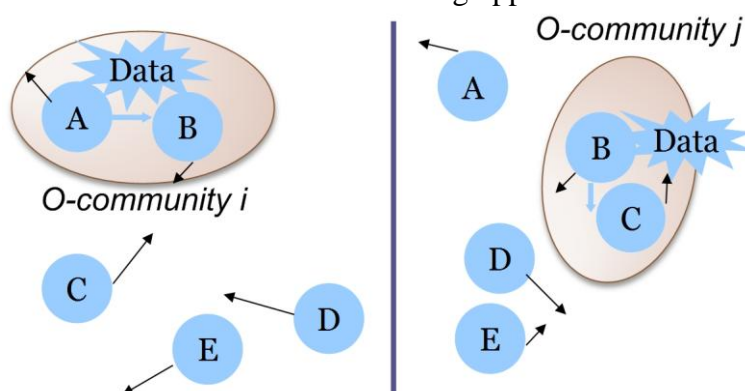


Figure 1. Dissemination of data within/among opportunistic communities

3. Our Practice on Opportunistic MSN

Opportunistic MSN brings new potentials to spontaneous social interaction and direct contact-based data sharing. We make a summary of our ongoing work in the following.

3.1. Community Building

One major purpose of opportunistic MSN is to improve social connectivity in physical communities by leveraging the information detected by mobile devices that contact. The SOCKER application we developed is such an example, which can build ad-hoc communities of like-minded people [9]. For instance, if Bob wants to organize a

basketball game at weekend in the university campus, he can post a request to SOCKER and recruit participants who are basketball-lovers and who live nearby. A broker-based mechanism is used by SOCKER to facilitate the dissemination of community-formation requests in the campus-wide environment. Finally, people who are socially- and physically-close to each other are opportunistically recruited to participate this activity.

3.2. Content Sharing

Data sharing is another major application area of social networks. Traditionally, data are shared among peers through Internet connection. However, in many cases, the data to be shared is only of interest to the local community (e.g., local traffic information to the in-region vehicles). That's to say, locally relevant data may be of little concern to the rest of the world. We have implemented BlueShare, which is a media sharing application among mobile phones based on opportunistic connection (based on Bluetooth techniques) [10]. With BlueShare, users can share files with other members in the opportunistic community, without relying on infrastructure-based connection. We have used it in our university campus, where courseware from the teacher can be spontaneously shared with the students in the classroom. Another usage of BlueShare is opportunistic advertising [11], a place-dependent viral marketing solution that supports advertisement distribution (e.g., forwarding promotional messages like coupons) among the customers of a store (e.g., user A in a coffee shop in Fig. 2) and their encounters (e.g., user A and B encounter at the metro in Fig. 2) in the local area (e.g., the *Ile de la Cite* area of Paris in Fig. 2). The advertisement message are thus disseminated opportunistically among the people who are nearby and who may have interest to visit that store (e.g., the coffee shop in Fig. 2).

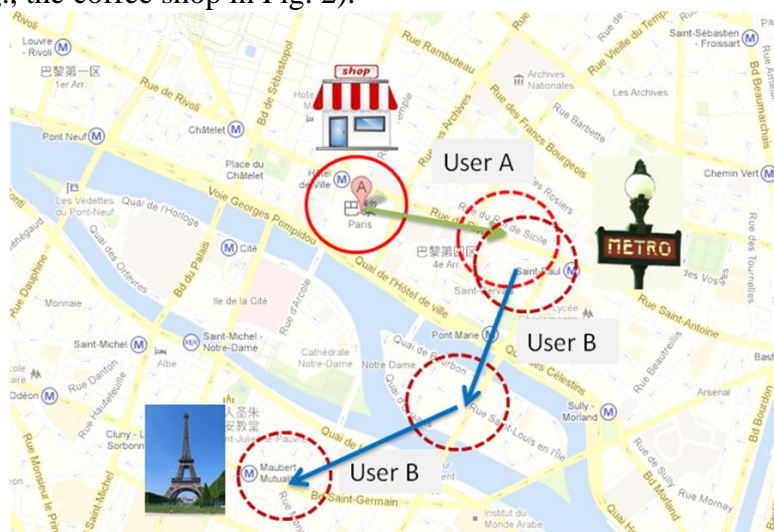


Figure 2. Opportunistic advertising: an example

4. Conclusion

The opportunistic MSN discussed in this paper aims to enhance spontaneous interaction among people that opportunistically encounter in the physical world, without leveraging any infrastructure support. It presents a complementary view of MSN, regarding that traditional MSN services mainly work in online/virtual environments. Recent studies on human mobility patterns reveals the existence of social cohesiveness in informal, short-

lived opportunistic communities, which provides a theoretical basis for opportunistic MSN. The novel features of opportunistic MSN is demonstrated through our ongoing projects. In the future we will explore other potential applications of opportunistic MSN and study the combination of opportunistic MSN and traditional online SNs, as well as the features and merits of hybrid social networking.

Acknowledgement

This work was partially supported by the National Basic Research Program of China (No. 2012CB316402), the National Natural Science Foundation of China (No. 61103063, 60903125), Natural Science Foundation of Shaanxi Province (No. 2012JQ8028).

References

- [1] Pietiläinen A, et al. (2009) MobiClique: middleware for mobile social networking. Proc. of the 2nd ACM workshop on Online social networks, Barcelona, Spain.
- [2] Conti M, Giordano S, May M, Passarella A (2010) From opportunistic networks to opportunistic computing. IEEE Communications Magazine, 48(9): 126-139.
- [3] Guo B, Zhang D, Wang Z (2011) Living with Internet of Things: The Emergence of Embedded Intelligence. Proc. of the 2011 IEEE International Conference on Cyber, Physical, and Social Computing, pp. 297-304.
- [4] Community definition in Wikipedia, <http://en.wikipedia.org/wiki/Community>.
- [5] Gonzalez M C, Hidalgo C A, Barabasi A (2008) Understanding individual human mobility patterns. Nature, 453:779–782.
- [6] Karamshuk D, Boldrini C, Conti M, Passarella A (2011) Human mobility models for opportunistic networks. IEEE Communications Magazine, 49(12): 157-165.
- [7] Urry J (2002) Mobility and Proximity. Sociology, 36: 255–274.
- [8] Zhang D, Guo B, Yu Z (2011) The Emergence of Social and Community Intelligence. IEEE Computer, 44(7): 21-28.
- [9] Zhang D, Wang Z, Guo B, Raychoudhury V, Zhou X (2011) A Dynamic Community Creation Mechanism in Opportunistic Mobile Social Networks. The Third IEEE International Conference on Social Computing (SocialCom'11), pp. 509-514.
- [10] Yu Z, Liang Y, Xu B, Yang Y, Guo B (2011) Towards a Smart Campus with Mobile Social Networking. Proc. of the 2011 IEEE International Conference on Internet of Things (iThings'11), Dalian, China.
- [11] Guo B, Zhang D, Yu Z, Zhou X (2012) Hybrid SN: Interlinking Opportunistic and Online Communities to Augment Information Dissemination. Proc. of the 9th IEEE International Conference on Ubiquitous Intelligence and Computing (UIC'12), Fukuoka, Japan.