

# An Indoor Location-based Social Network for Managing Office Resource and Connecting People

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**Abstract**—With growing popularity of social networks, people’s locations are being used for providing rich mobile social services, mostly with outdoor positioning using GPS. We present a mobile social service deployed in an indoor office environment called “Nokia Find & Connect” (NF&C). In NF&C, employees’ locations are tracked using Wi-Fi to efficiently find, reserve and manage office resources like meeting rooms and desks and to easily connect other colleagues through scheduled interactions like having a meeting together and/or unscheduled yet implicit interactions like ephemeral encounters between two people. We present the user interface and functional architecture of NF&C and discuss a user study that we conducted in our office.

**Keywords**—Location social service, ephemeral social network, office resource management, mobile social network

## I. INTRODUCTION

Location-based social networks are getting more popular due to the relative ease that people can share their location with friends, but also can interact with the objects (e.g. checking in and posting a tip for a nearby restaurant) and connect with other people (e.g. adding people with similar lifestyle, interest and food taste as friends) that relate to a specific location. Current location-based social networking applications such as Geolife [1], Brightkite [2], Foursquare and Google Buzz, mainly focus on outdoor environments, using GPS for positioning [3]. However, in indoor environments where GPS is typically unavailable or weak [4], many indoor positioning systems use infrared sensing, ultrasonic sensing or RFID to track people’s location. These technologies are dependent on specific device and are limited in sensing range [5].

Little work exists on indoor location-based social networks. Inspired by Jyri Engstrom’s comment that “social networks consist of people who are connected by a shared object”, we present an indoor location-based social network called Nokia Find & Connect (NF&C) for use in office environments. NF&C utilizes people’s location and office resources such as meeting rooms where employees share, meet and connect with each other, to facilitate social networking. In NF&C, employees’ locations are tracked using Wi-Fi to efficiently find, reserve and manage office resources like meeting rooms and desks and to easily connect other colleagues through scheduled interactions like having a meeting together and/or unscheduled yet implicit interactions like ephemeral encounters between two people.

## II. NOKIA FIND &CONNECT (NF&C)

There are two main functions in NF&C: managing office resources and connecting people. We will explain the common use cases here, the reader is referred to [6] for the detailed system description. Fig. 1(a) below shows the functional architecture of NF&C. The function of how to make a new reservation is demonstrated in Fig. 1(b). In Fig. 1(c) we can view friends, similar people, everyone and rooms nearby.

When a user wants to reserve a meeting room, first she needs to create a new meeting with the starting and ending time of the meeting (and optionally floor as in Fig. 1(b)), select “Find Available Room”, reserve one of the available rooms and then use the “Create Meeting” feature. If a user knows the name of a meeting room and wants to reserve it or get there, she can achieve these tasks using “Find Room”. When the reserved meeting is about to start in 5 minutes, NF&C will check the meeting organizer’s location and if the organizer is not in the meeting room or nearby, NF&C will push a notification message to the organizer to ask if the meeting room is still required, otherwise, it will be cancelled and the room resource will be released (“Cancel Meeting”). For the second function, if A wants to know how she knows B who is nearby, A can use “View Everyone (Nearby)” in Fig. 1(c), then use “Meeting History” to obtain the information of meetings both A and B have attended or meetings both B and one of A’s friends have attended. This allows users to add new friends based on other information such as encounter history, similar interests and instant messages which greatly help users become friends and forms the ephemeral social network.

## III. USER STUDY

Nokia Find & Connect was tested and officially deployed in the Beijing office in late May 2010. To understand how NF&C uses the indoor location social network to help people efficiently manage office resources and easily connect with each other, we collect and analyze NF&C usage data logged for approximately 2 months from May 24 to July 25, 2010. During the nine weeks, 113 active registered users are involved in the service and Fig. 2 presents their behavior data over the past nine weeks for room and meeting reservation management.

In Fig. 2 (a), the number of related requests about reserving meeting rooms is shown and in Fig. 2 (b) the percentage of the



Figure 1. (a) Functional architecture of Nokia Find & Connect which is currently split into three main functions: Contacts, Map, and Reservation. (b) Make a new reservation in NF&C. (c) View different kinds of people or resource nearby (Friends, Similar people, Everyone and Rooms)

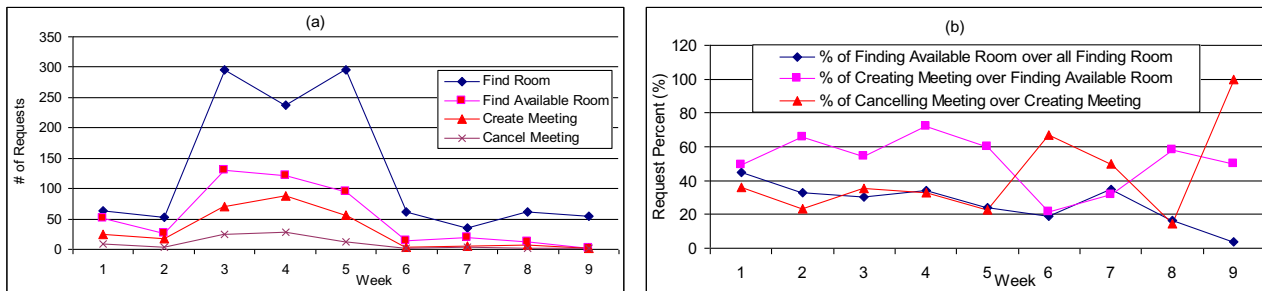


Figure 2. NF&C in the 9 weeks with (a) the number of requests for “Find Room”, “Find Available Room”, “Create Meeting” and “Cancel Meeting”, (b) the percentage of the related requests in (a).

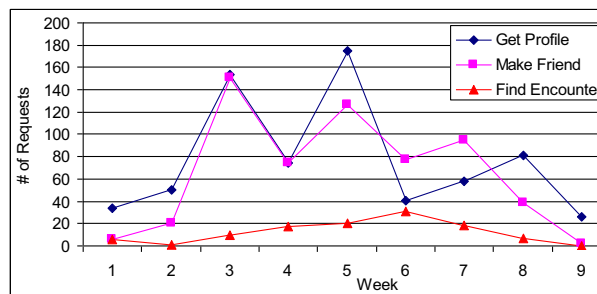


Figure 3. The number of requests related to connecting.

related requests in Fig. 2 (a) is calculated. It shows that about 20-40% of the requests for finding a room are for finding an available room to reserve a meeting, and afterwards 50-70% of the requests from finding an available room result in creating a meeting. We discover that meeting reminders result in the cancellation of at least 20-40% of reserved meeting rooms, making the rooms available to others.

In Fig. 3, the number of related requests for connecting people is shown. We find that NF&C users are interested in viewing other people’s profiles and then make friends with them as can be seen from the figure. (Note: “Make Friend” requests here include adding new friend, accepting the friend request or rejecting the friend request). NF&C also helps

people to remember the person they met before through the “Find Encounter” request. Therefore, NF&C makes connecting people easily and users will never forget who they have met in meetings or encounters.

A total of 41 users are involved in a total of 181 requests for making friends, from which 53% of friend requests are accepted. We also look at the reason attached in the friend request as shown in Table 1. We can see that with indoor location tracking, friend requests to nearby people are more likely to be accepted. If the friend requests from nearby people with similar interests are included, about 48.6% of the total friend requests are accepted and come from nearby people. From Table 1, 65.5% of friend requests from nearby people are

TABLE I. THE PERCENT OF FRIEND REQUESTS ASSOCIATED WITH EACH REASON

	Accepted (%)	Not Responded or Not Accepted (%)
Nearby	31.5%	16.6%
Similar Interests and Nearby	17.1%	15.5%
Same Meeting	0.6%	6.1%
Found Online	3.9%	3.3%
Others	0	5.5%

accepted and 52.5% of friend requests from nearby people with similar interests are accepted. Very few people use the find encounters function to discover if they have encountered others. Therefore NF&C helps to easily connect nearby people in the office.

#### IV. CONCLUSION

In this paper, we present Nokia Find & Connect, a mobile social application for efficiently finding, reserving and managing office resources like meeting rooms and desks and to easily connect with other colleagues through those resources. Our work addresses how social networks can be used and created in the office environment, something that is rarely captured, in order to improve work efficiency and efficiency of office resources. We presented the user interface, functional architecture and conducted a user study of Nokia Find & Connect to demonstrate its usage and benefits. Future work will involve a more comprehensive study and pilot of Nokia Find & Connect to other environments, and how ephemeral encounters can be used for friend recommendations.

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