Social positioning: Designing the Seams between Social, Physical and Digital Space

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Abstract

Mobile settings are not only physically and digitally mediated; they are also inhabited by people – a social space. We argue that careful design exposing the connections, gaps, overlays and mismatches within and between physical, digital and social space allow for a better understanding and thereby mastering of the resulting combined space. Two concepts are explored in MobiTip, a social mobile service for exchanging opinions among peers: *intramedia* seams concerning network coverage and position technology, and *intermedia* seams between digitally transmitted tips and the physical, social context surrounding the user. We introduce *social positioning* as an alternative and a complement to the current strive for seamless connectedness and exact positioning in physical space.

1 Introduction

The use of mobile equipment – phones, PDAs, laptop computers – becomes more and more commonplace. Technology equipped with many different means for communication, with video and audio, featuring a number of sophisticated services, is carried around in people's pockets. Since mobile devices are carried everywhere, they provide access to the digital medium everywhere. In addition, as these devices are usually able to connect to global networks and are provided with technology that makes it possible to determine their location, many researchers and designers have seen opportunities for connecting information with the physical world. In such mobile services, a digital space is layered on top of the physical space and made accessible on demand or by using context cues such as geographical location or vicinity to some object.

But mobile settings are not only physically and digitally mediated; they are also inhabited by people. Social practices and procedures within both the physical and the digital must be taken into account. We move through both physical and digital places at the same time – and one affects the other. In a wireless world, people will meet others, experience places and situations, have opinions, and be more or less aware of what resources are available to them at different points in time and space. Socially related information can be explicitly or implicitly picked up and made available to others through the wireless devices that we carry with us. Thus, even though there might be no boundaries in digital space for making a phone call while enjoying a play at the theatre, social practices developed in this particular physical place makes such a phone call socially unacceptable. The inappropriateness of the phone call at the theatre is not only caused by the caller disturbing other people but also by the fact that the rules for physical places are broken by including a person at another location (Agre, 2001).

Architects have long experience in perfecting not only the functional qualities of buildings and urban space, but also their aesthetic qualities. The digital medium is a different and in many ways more powerful design material than concrete and steel and the design of digital spaces thriving on existing physical and social space is not yet well developed. In a mobile setting, precise positioning technology and never-faltering network connections are often put forward as if removing the need for understanding the connections between the digital and the physical. But if we want to help end-users understand the combination of digital, social and physical space it is not enough to create more refined positioning systems or support seamless access to networks everywhere.

We argue that careful and aesthetically pleasing design exposing the *seams* – connections, gaps, overlays and mismatches – within and between physical, digital and social space may allow for a better understanding of the resulting combined space. In addition, given such an understanding, we may add functionality that allows for active co-construction (by the end-users) of connections between spaces, or for playful use of the seams themselves. Such

functionality forms the basis of more relevant and dynamically changing mobile services, enabling a better dialogue between physical places, social practice, and digital information.

In this paper, we challenge two current trends in mobile research and industry: the striving for seamless, continuous connection and for perfect positioning. We discuss the drawbacks and limitations of these trends and propose an alternative way of handling the connection between digital and physical spaces, taking social space into account. As a touchstone for the discussion, we describe our system MobiTip, a mobile social service that explores *seamful* instead of seamless design and *social positioning* as an alternative to perfect positioning.

2 Background and Related Work

There are basically two classes of mobile services that are concerned with interweaving physical, digital and social space. The first class aims to make people aware of each other, and tend to focus on friends, family and other close relations. An early example is *Hummingbird*, alerting ski instructors when their peers were in close range. Studies showed that Hummingbird affected the social space by spawning new forms of communication (Holmquist, Falk & Wigström, 1999). One set of applications make family members aware of each others' locations and activities in different ways, e.g. *WatchMe* from MIT media lab (Marmasse, Schmandt & Spectre, 2004). Other services monitor the whereabouts of friends, such as *Dodgeball* (www.dodgeball.com) or *NearMe* (Krumm & Hinckley, 2004).

These services are all concerned with close relations. Unknown people may also be a key component for a service. *Jabberwocky* (www.urban-atmospheres.net/Jabberwocky) goes into depth with the concept of the familiar stranger, i.e. the people you often come across but have no relation to (Paulos & Goodman, 2004). *Social net* (www.cc.gatech.edu/~everyday-computing/projects/socialNet) matches strangers based on interest and explores people's webs of mutual friends (Terry, Mynatt, Ryall & Leigh, 2002). *HocMan* (Esbjörnsson, Juhlin & Östergren, 2003) explores brief encounters between motorcyclists on the road.

A second class of services focus on the information people leave behind rather than on people themselves. Communication between users is mediated through the information they leave behind in services built on user provided information content. *GeoNotes* (Persson, Espinoza, Fagerberg, Sandin & Cöster, 2003) discussed further below, and *Campus Aware* (Burrel & Gay, 2001) and are two examples that use WLAN technology to place digital annotations in physical space. Urban Tapestries (urbantapestries.net) explores several connection technologies and allows for richer annotations (Lane, 2003). *InfoRadar* (Rantanen, Oulasvirta, Blom, Tiitta & Mäntylä, 2004) utilizes location as one resource in a service focused on communication between people. The commercial *Tag&Scan* service (www.tagscan.com) runs on mobile phones and manages annotations at operator level. Recent applications also use Internet repositories to store user-provided annotations on physical objects and locations, two notable examples being Microsoft's *Aura* (Smith, Davenport & Hwa, 2003), based on bar codes, and *Cellspotting* (www.cellspotting.com), using the cell information provided by mobile phone operators.

Many services that have their focus in one of the classes above also contain characteristics of the other class. Services may also be taken into use in unexpected ways. The users of GeoNotes, a service designed to leave information behind, found ways to use the service as a discussion forum, for message sending and even for chatting. In MobiTip, described below, the presence of other users in the interface triggers a need for direct communication. The services listed here and many other new and innovative mobile services are part of an ongoing exploration of the digital medium and its relation to the physical, geographical and social environment.

3 Social Positioning of Information in Seamful Designs

The telecom industry envisions users to be seamlessly connected anywhere anytime[1]. They want end-users to always be connected to the telephony network or internet without having to worry about what network technology is enabling the connection. For the most part, this is a perfectly respectable and highly relevant goal that will make life for end-users much easier. But there are some problematic issues with such a vision, mainly related to whether and how this seamless connectivity is presented to the end-user. Is it always true that we do not need to worry about how

[1] E.g. the "Optimally Connected Anywhere, Anytime" vision from the International Telecommunications Union http://www.itu.int/ITU-R/study-groups/was/documents/optimally_connected.html (accessed February 16, 2005).

and when we are connected? Do we really need or even want to be connected at all times? Can we trust positioning to be perfect and thereby form the basis for decisions everywhere, always?

The concept of seamfulness was introduced by Weiser (1991) and has been further developed by Chalmers and Galani (2004) and by Chalmers, Dieberger, Höök & Rudström (2004). In this paper we define seams to be:

1. The connections, gaps, overlays and mismatches occurring *within* the digital medium (often related to technology) – *intermedia seams*; and
2. The connections, gaps, overlays and mismatches occurring *between* digital and physical media, when constructing hybrid spaces combining digital, physical and social space – *intramedia seams.*

Our claim is that some of these seams should be made visible to the users so that they can appropriate them, make sense of network glitches, and understand what is offered, when and why. A well designed seam between a digital mobile service and the physical and social space it relates to can help users make sense of the service.

3.1 Always Seamlessly Connected

Most developers and researchers of mobile services make the assumption that users should never have to worry about when and how they are connected to the digital space – they should always be seamlessly connected. To strive for such perfection is probably a powerful vehicle for the mobile industry. But reality is and will continue to be less than perfect. Pursuing seamlessness at any cost might not only be an impossible goal to reach but possibly even be harmful. If led to believe in continuous connectedness, users will be annoyed, frustrated or confused when faced with anomalies. A notable example of such an anomaly is given by Dourish, Grinter, Delgado de la Flor and Joseph (2004), where a networked printer suddenly became unavailable, since the computer had silently switched to another wireless access point and thus to a different network.

Mobile devices come with an assortment of wireless connection technology. While GSM is often used to communicate information over long distances, many applications rely on Bluetooth or infrared communication as a means to transfer information over short distances – sending pictures from one device to another or connecting a wireless headset with a mobile phone. But different technologies have different characteristics. Infrared connections only work if devices are properly aligned. Bluetooth connections have a 10 meter range. From an end-user perspective, some level of understanding of the differences is needed in order to make things work properly. In particular, this understanding is crucial for peer-to-peer applications that use Bluetooth as a means to create ad-hoc networks between devices, or between devices and servers or global networks. MobiTip, discussed below, explores such mixed situations.

Seamless design aims to hide what is perceived as unnecessary technical details from users. However, if these technicalities affect the functionality of a service, an alternative would be to carefully design features that enable users to visualise, understand and possibly take advantage of differences and variations in functionality or accessibility: seamful designs (Chalmers, MacColl & Bell 2003; Chalmers, Dieberger, Höök & Rudström, 2004). An example of a successful, unobtrusive design of a "seam" is the visualisation of signal strength available on mobile phones. This visualisation is not strictly necessary – the user will be aware of signal strength anyway, since it affects the quality of the connection. However, without much explanation it becomes a tool that allows users to search for locations with better signal strength in areas with low coverage. It may also educate users in understanding of where connections could be expected to be stronger (close to a window) or weaker (in a tunnel).

An example of playing with functionality that would normally be hidden to the user is *The Seamful Game* (Chalmers et al., 2003). This game is played on mobile devices equipped with GPS and WLAN technology. A centrally placed game server places "coins" at random locations on a map over an area that is only partly covered by the wireless network. Players use WLAN connectivity to connect to the server where they can find out about the location of coins and upload collected coins. GPS is used for determining where players are and if they are close enough to a coin to be able to pick it up. However, when within range of a WLAN node, players' geographical positions are also reported to the server, allowing for others to steal their coins.

The Seamful Game highlights seams instead of hiding them. Successful players explore the seams even further. Chalmers et al report on some users utilizing GPS positioning errors as if they were "hyper jumps" and others lurking in the shadows of low WLAN coverage to jump out and pick other players' pockets for their coins.

3.2 The Quest for Perfect Positioning

Positioning is another area where the mobile industry – and much research – strives for perfection. Many solutions other than GPS are used to pinpoint the exact coordinates in physical space of a user, or more correctly, of a user's device. Regardless of precision, however, any position needs to be given a mapping to some concept. In other words, the meaning of "here" needs to be defined.

This mapping was explored in the GeoNotes service (Persson et al., 2003), one of the first services allowing users to attach digital "Post-it" notes to physical locations. GeoNotes used a WLAN network that technically speaking offered notes to be posted at each WLAN hotspot. However, hotspot coverage corresponds very poorly with the buildings, rooms and other places where users move about. Instead of providing lists of places where notes could be attached, GeoNotes users were allowed to themselves name the places where they wanted to attach their notes. Each such place label belonged to the hotspot where it was entered, but could denote both smaller and larger places than covered by the hotspot (Figure 1).

In a one-month field test with 78 users, seams between the underlying hotspot model and the user perceived model of how places should be named were elegantly handled by the users (Fagerberg, Espinoza & Persson, 2003). Place labels were created by the end-users to post notes at places that covered smaller areas than the positioning system could handle, such as "the sofa" or somewhat more esoteric "the lecturer's forehead". Large places were created by re-entering identical place label names at several hotspots. One group of users also created a virtual place, their own "VIP-room", through adding this place label to all the hotspots they encountered.

Figure 1: Positioning offered by technology often does not correspond to the positions people want to refer to

The placement of digital post-it notes under different place labels did not follow the rules for paper Post-It notes. In particular, the place labels invented by users did not map virtual places in a one-to-one relationship to the geographical or physical world. The digital medium is both bigger and smaller and more plastic than the physical medium. By not forcing any official labelling system upon GeoNotes users, they were set free to explore the relation between hotspot coverage and perceived places – thus dynamically creating the ties between information and place, i.e., the intermedia seam between the digital and the physical.

3.3 Physical, Social and Digital Space

The physical medium builds a space that is filled with nature, roads, buildings, walls, doors, and objects. The design and characteristics of this space allows for and fosters different social practices. In his work studying New York parks and plazas, ethnographer Whyte (1980) found relationships between sitting space, trees, fountains, and openness of a park and the ways it would be used socially, by people. Social practices develop in dialogue with the properties of the physical space.

Digital space is often viewed as a model of physical space, where every piece of digital information can and should be tied to a specific physical location. Such a view is unnecessarily restricted. The digital medium allows for the

construction of parallel digital spaces, for time travel and personal views. In addition, there are other aspects of the physical that can be considered for positioning. Instead of positioning a user in relation to her geographical coordinates we opt for a position that relates her to other inhabitants of the space. We use the term *social space* to denote the people populating a space (currently or over some time period) and the practices and procedures that these people use. The fact that "I met you" may affect reasoning and also provide input to geographical positioning.

Considering the social life and practices of the people inhabiting physical space requires that a new layer is added to the digital space. The digital model of the social space may change faster or slower than the actual social activities in the space. Messages may be left at certain locations for others to read much later as in GeoNotes. Physical and digital encounters may also be mismatched. In the HocMan biker service mentioned above (Esbjörnsson et al., 2003), personal web pages are swapped between bikers as they pass each other on the road. On one occasion, a biker happened to be hidden from view. A passing biker became very confused when he heard the sound alert indicating that he had just passed another biker: there seemed to be no one there. This pinpoints the problematic nature of understanding the seam between the digitally mediated social meeting and the physical encounter.

3.4 Making Sense of Seams

In general, simply offering a representation of a seam, such as the signal strength indicator, will make it possible for users to start making sense of a service. Once there is a glitch in the network coverage or imperfect positioning the user can make sense of the problem and find ways to overcome it. When it comes to making sense of how digital space is related to on-going social activities in the physical space, the visibility of seams between the two in the interface as such, may help users to understand the relationship between the two. The representation of the seams may be some design choice in the interface, or a choice of functionality allowing the users to participate in the construction of the seam, such as naming places in GeoNotes. The latter representation is interesting as it allows for more dynamicity and co-construction of the digital space by end-users. This may better capture the dynamic nature of how the combined space changes over time, with changes in physical architecture, social practice and with the change of meaning of the system as it develops over time. This might seem utopian but in effect there is already a range of information systems that work this way: Wikis, blogging systems, or the web itself. Nobody has an overall control of the structure or naming conventions in these systems – it is in the hands of the end-users.

The place labelling in GeoNotes and in the Tag & Scan system exemplifies how end-users can be involved in naming positions, small or large, thereby compensating for the lack of meaning in positioning systems. As users dynamically add names of places the meaning of the combined space is changed over time. Alternative solutions would have been to only allow for pre-named places, or to use generic place size and only allow posting and reading of notes at those particular places. In the world of people, places are named for many reasons – and should a place not have a name appropriate to the current context or need, a name is invented. Old names may be forgotten and new names added.

4 MobiTip: Using Social Positioning

MobiTip[2] (Rudström, Svensson, Cöster & Höök, 2004) is a social mobile service and a research vehicle for exploring the interconnection between digital, social and physical space. Our aim was to create a service that supports and thrives on the social environment, without reducing it to messages that can be posted at geographic locations. The underlying principle for the service takes advantage of the fact that many social contexts are repeated at the same physical locations. Most of us work at the same place, with the same people, every day. We travel to and from the same places daily, and have lunch with our colleagues at the same lunch places populated by the same crowd. MobiTip places information, or tips, within the social context using Bluetooth technology and collaborative filtering techniques. The connection to the physical location is implicit.

4.1 The MobiTip System

MobiTip allows its users to express their opinions and comment on anything of interest. Users may enter their own opinions, as well as inspect and react to tips from others, presented as aggregated opinions or recommendations.

[2] We refer to www.mobile-life.org/mobitip for further details on MobiTip.

What tip the system proposes in a given situation is based on similarities between users, on context as defined by Bluetooth-closeness of users, and on tip popularity. The system uses collaborative filtering algorithms suited for mobile devices that are not always connected to a central server.

The service is implemented for the Sony Ericsson P900/910 combined PDA and mobile phone (Figure 2a). Tips are entered into the MobiTip system through a template as shown in Fig. 2b. The user must provide a name and a loose categorization for what the tip is about and rate the opinion on a five-point scale. New scales may be introduced to provide a richer language for expressing opinions. Tips from others are presented in aggregated form, as depicted in Figure 2c where two users give opposing opinions about the movie Matrix. The same five-point scale is used to capture the user's reaction to a tip, again offering the possibility to introduce new scales. The system also offers functionality for searching for tips, and for managing the user appearance by entering personal information and selecting one of nine different icons.

a) 

b) 

c) 

Figure 2: (a) MobiTip on the Sony Ericsson P900; screens for (b) entering and (c) receiving tips

As part of the service, a small number of Bluetooth servers (hotspots) may be placed at carefully selected locations. Hotspots are not necessary, but useful to the service, since they provide access to updated information and historical user presence at important physical locations (e.g. a cross road or information desk). Most of the time users will be in "floating" mode: out of range of hotspots, but possibly connected to surrounding users via Bluetooth.

Tips are propagated between user through peer-to-peer and network connections. User encounters also cause user profile information, i.e. rating behaviour, to be exchanged. At any given time, all or almost all of the tips entered into the system will be available on each user device, together with user ratings of these tips. However, encounters – the social space – determine the importance of each tip, and thus the order in which tips are presented. An encounter with a user with similar ratings will have a stronger effect than one with a less similar user. To achieve this functionality MobiTip employs collaborative filtering algorithms developed for mobile devices that are not always connected to a central server (Cöster & Svensson, 2005).

The test domain for MobiTip is the Kista Galleria shopping mall. Kista Galleria is a large (by Swedish standards) indoor shopping mall separating a suburban residence area from a large office area in the outskirts of Stockholm. According to a website promoting the region, this is the "epicentre of the Swedish IT industry", with 375 high-tech companies employing about 18.000 people (www.kista.com). As indicated by an ethnographically inspired study (Rudström, 2003), at lunchtime on workdays the mall and its Food Court becomes a canteen for office workers. On weekends, families take over. Many of the visitors thus are frequent visitors with recurring habits.

It should be noted that although MobiTip was designed and developed with the "shopping in Kista Galleria" scenario in mind, the only real connection between the system and the mall is that most user tips concern activities, things and places in the mall. A few Bluetooth servers, hotspots, have been placed in the mall during end-user studies, but are not used for positioning.

4.2 Social Positioning in MobiTip

The fact that two or more people are at the same place at the same time tells something about that place: "Your past is my future" (Martin Rantzer, personal communication). For a collaborative filter that groups users with similar taste, social space offers an additional source of input for determining the similarity between users. When MobiTip produces tips it will consequently use two sources of information: the user's ratings on previous tips and the proximity to other users. This information is continuously updated at user encounters. Tips are transferred if the first user carries some tips that the second user does not have yet. These new tips may have been entered by the first user or have been transferred from a third user. User profiles, i.e. information other user's ratings of tips are also transferred and updated. Finally, the encounter causes the set of tips on the user device to be sorted in a way reflecting mutual interest of the two users involved.

This design actually allows MobiTip to adapt to new settings. If the user is in a shopping mall, tips will be influenced by others in the mall. In a different setting – such as a conference – MobiTip will produce a different set of tips, based on another group of people. For a user moving from one environment to another, old tips will gradually sink down while new tips move towards the surface influenced by the new encounters.

MobiTip stresses the importance of social space by visualizing it to the user. The interface design is a deliberate effort to illustrate seams between the actual social space surrounding the user, and the representation of this space in the digital medium. In the presence display shown in Figure 3, fellow MobiTip users and other discoverable Bluetooth devices are depicted on the screen as animated icons. As the user moves among other people, icons will appear and disappear in the interface as the people carrying the devices move in and out of Bluetooth range. By clicking on an icon, the name of the Bluetooth device or the MobiTip user name is displayed. In evaluating early designs of MobiTip (Rudström, Cöster, Höök & Svensson, 2003) it became clear that the shopping scenario triggered users to assume that tips were initiated by commercial interests, i.e. by mall and shop owners. The presence map therefore also plays an important role in emphasizing that tips in deed emanate from peers: fellow mall visitors.

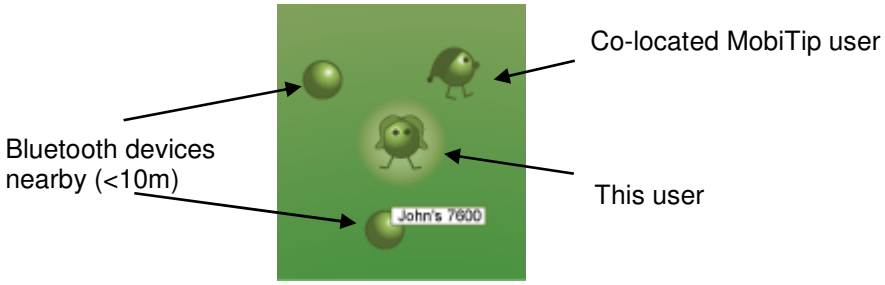


Figure 3: Detail of MobiTip's presence display. Icons are animated using a small, sideways movement.

In contrast to GeoNotes and other systems relating digital information to physical places, MobiTip's information storage is distributed and duplicated over users' devices. Hotspots provide functionality for downloading the latest tips but do not tie information to their geographical location. A hotspot's prime task is instead to act as a collector of user trails within a particular environment. Whenever a user passes a hotspot, the social trails (tips and ratings) gathered on that user's device are collected and saved at the hotspot. Thus, in the vicinity of a hotspot, the collaborative filter can use historical user presence in the same way as for actual encounters, triggering tips and exchanging collaborative filtering information.

4.3 Seamful Network Connections in MobiTip

MobiTip is not dependent on being always and seamlessly connected to a server. Instead, it is designed to function in floating mode, when in vicinity and possibly connected to other users, and when in range of a hotspot. In addition, users may explicitly synchronize with a central server over the Internet, wirelessly over the phone's GPRS connection or by docking to a PC with an Internet connection. Events such as encounters with others or entering in range of a hotspot will allow for slightly different functionality, and trigger service actions. Instead of hiding the different connection modes, we chose to emphasize and visualize them in MobiTip's user interface.

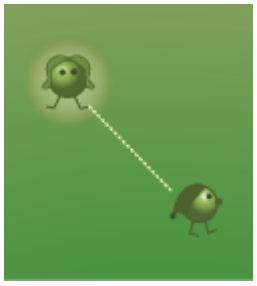
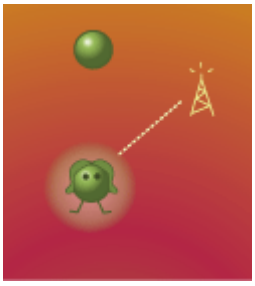
a)  b) 

Figure 4: Information exchange with (a) another MobiTip user (green); and (b) a hotspot (red)

Alongside the visualization of peers, being in range with a hotspot is visualized by displaying an antenna icon on the screen. In addition, the background of the screen changes from a cool green to a hotter red, indicating a change in functionality. As depicted in Figure 4, the fact that a connection is made between two devices or to a hotspot is visualized, by drawing a line between the icons involved in the communication.

The presence display is designed to make users aware that the service is based on short-range connections. As users move, they can see MobiTip users as well as other Bluetooth devices appearing and disappearing on the screen. The inclusions of others not using MobiTip indicates that the technology used is not service specific, but generally available. MobiTip users also need to be aware of Bluetooth being used, since they need to make appropriate Bluetooth settings. In a way, MobiTip is designed to educate users in Bluetooth functionality, e.g. by making them experience the range and quality of Bluetooth connections.

4.4 Experience with MobiTip

MobiTip has been demonstrated at several occasions, and was made publicly available from our web site in November 2004. During November and December, about 50 users downloaded the system to their SonyEricsson P900/910 mobile phones. Most of these are technologically savvy users working in the Kista region. Our own and others' experience with the system and preliminary results from end user studies indicate some interesting issues, mostly related to Bluetooth technology.

An early observation that surprised us was that many users seem to keep Bluetooth on and in discoverable mode. Most of these terminals are un-named, or appear on MobiTip's presence display with the phone model name provided by the manufacturer. Some users had changed that to a name, most often a first name. Other types of naming observed were using community rather than name ("Bajen 2003", where "Bajen" is a major Swedish football/ice hockey team), and sending a message rather than conveying identity ("Keep out" or "This machine kills computers"). At demonstrations, we have also noticed people changing the name of their device when watching it become visible on MobiTip's presence display.

In late 2004, we placed two MobiTip hotspots (i.e. Bluetooth servers) at different locations the Kista Galleria shopping mall. One of these was equipped with a public display, showing Bluetooth activity within a ~10 m radius. This public display also triggered observations of people renaming their Bluetooth device as they became aware of their own (or rather their device's) visibility to others. One user reported on playing with the display, ending up with the device name "I am naked". We have also observed indications of recurring behavioural patterns on our own MobiTip devices. When passing through Kista Galleria we would notice the same (un-known) Bluetooth devices re-appearing on our MobiTip presence displays.

The recommender system behind MobiTip requires tips to share a common structure. At the same time, an important goal was to have an open format, allowing for users to co-construct the nature of tips, i.e. what tips should be about. These two conflicting design goals were merged by using a template both for entering and for presenting tips, but allowing for free naming of the parts of this template (Figures 2b and c). More or less all tips provided so far are specific to Kista galleria and nearby places, i.e. they do have a relation to some location in the mall. However, the tips are quite different. They may concern a restaurant, a specific dish, the number of ATM machines in the mall, or

be a comment about "The tree in front of Complé [coffee shop]". The decision not to frame the service by bootstrapping it with tips and categories seems to have been successful in terms of enabling users to actively construct the meaning of the digital space of tips.

In the presence display, the current user is placed in the centre with other users and Bluetooth devices randomly scattered around. This design was successful in that users did understand that there were other Bluetooth-devices around and which of those were in fact MobiTip-users. The presence display also triggered people to make their own Bluetooth devices discoverable just to see them turn up on the screen, and spawned some curiosity as to who else was around. The design was thus able to reveal the intermedia seams related to Bluetooth technology and coverage. People and their devices were treated as one, and most users believed that they were positioned correctly on the screen in relation to their position in physical space: "I am in the middle"; "oh, there you are, but now you are on the other side?"; and from someone carrying two MobiTip devices, "now I am walking in front of myself". While the positioning actually was random, these examples show that users tried to map the well-known physical and social space directly onto the new and unknown digital space.

Finally, we also found indications of success for the design of intermedia seams in MobiTip's presence display. Preliminary results of an on-going end-user study provide an example: A user who had first tested the service on his own later participated in a live test with other MobiTip users. During the test, he suddenly realized that MobiTip was essentially peer-to-peer and not server based. This understanding occurred at the very moment that he saw the visualisation of two MobiTip devices communicating on the presence display.

5 Summary and Concluding Remarks

In MobiTip we visualise Bluetooth presence for two reasons:

1. The visualisation makes the Bluetooth wireless coverage visible to the end-users. Thereby the seams between the ad-hoc Bluetooth connections are exposed, making them available for appropriation. The early experiences with users renaming their device in order to appear on other's devices with a more interesting name, indicates that users may make use of this visualisation to convey the meaning of the Bluetooth device visualisations.

2. It also helps in positioning tips relative to the surrounding social space – the tips become *socially positioned* relative to the group of people we happen to pass by. Information is exchanged as users pass by each other, visualised through the connecting line between their user representations in the Bluetooth presence display.

These two reasons correspond to the two kinds of seams that we wanted to expose to the end-users: the *intramedia* seams concerning network coverage and position technology, and the *intermedia* seams between digitally transmitted tips and the physical, social context surrounding the user.

Positioning tips relative to their social context means that we avoid the problem of positioning systems altogether. Tips will be triggered whenever we meet other MobiTip-users. As we tend to inhabit the same physical spaces regularly – going to work, spending time at work, having lunch, going back from work – the recommender system will distil the tips most relevant to our re-occurring physical and social contexts. Again, in our preliminary experiences with MobiTip, we have seen that the same Bluetooth-resources tend to pop up regularly.

In summary, we argue that exposing seams to users allows for better functionality and provides the basis for making sense of the digital spaces that is layered on top of physical and social space. Through allowing users to name the seams or add information of various kinds to the digital space – positioned geographically as in GeoNotes, or socially as in MobiTip – we form the basis for better sense-making of the combined digital, physical and social space.

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