Ambient Intelligence to Go

White Paper on mobile intelligent ambience

edited by

Andreas Björklind and Stefan Holmlid

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AmIGo

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Preface

Working in a vision and scenario oriented project, designing a cell-phone based in and out of the pocket application family promoting and supporting interaction and communication in ad-hoc and dynamic environments in everyday life for passive and active peers is an inspiring task.

In this White Paper we have collected the experiences from the participants of the AmIGo project and researchers attached to the knowledge development of the project. We hope that you will find inspiration from the paper, and that you will want to further the knowledge and horizons of what an intelligent ambience could be like.

There is still some way to go before we can realize the potentials of what intelligent ambience actually means for people living with mobile peer-to-peer technology. Trying to realize some of its potentials and reflecting over these is one important step to create better understanding of the issues and better designs for the future.

Acknowledgements

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We also wish to extend our warmest regards to all workshop participants, and other people involved in the project and process. If anyone is feeling left out this is mainly a matter of administrative slips while keeping track of all people involved in greater or lesser parts of this effort.

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Andreas Björklind	Stefan Holmlid
Project manager, editor	editor

Contents

INTRODUCTORY MATTER

Chapter 1 Project background

This white paper is one of the results of the pre-study AmIGo (Ambient Intelligence To Go).

The overarching goal for the AmIGo project was to evaluate various aspects of Ambient Intelligence and mobile devices. The objective was to identify possible (even disruptive) applications and enablers that can be turned into new opportunities for the Swedish IT-industry. One of the driving forces was the fact that peer-to-peer communication could be viewed either as a disruptive technology or a possibility for the large actors on the Swedish mobile telecommunications scene.

Goals

When composing this white paper, we focused on two main objectives:

1. To describe the background and content of some important state-of-the-art applications and projects in the Ambient Intelligence area, and
2. To show which position Sweden has in the area, and thus show which areas Sweden can work within to grow stronger in the Ambient Intelligence field

Scope

The scope of this white paper is to present such material (papers, conferences, project descriptions, etc) that has had influence on the work of AmIGo. Therefore, it is not the scope of this white paper to catalogue the complete history of the area or summarise every single project. The rule of thumb was to first and foremost describe the material that has actually stood out in one way or another.

Structure of the White Paper

This white paper consists of the following sections:

1. Introductory matter
2. Overview of fields of interest
3. Deep dive chapters
4. Conclusions and remarks

Chapter 2 Definition of AmIGo concepts

During the AmIGo project four concepts were used as groundwork in defining the area that we wished to explore.

Ambient Intelligence

Ambient Intelligence refers to an environment that is sensitive, adaptive, and responsive to the presence of people. Such an environment relies heavily on information from the numerous sensors monitoring the environment. The components of the ambient intelligence environment is pervasive, meaning all devices (and things) are connected to the personal, local, regional, national, and global network. The devices are also invisible, until they are needed.

Context Awareness

Context aware computing is the use of context to provide task-relevant information and/or services to a user, wherever they may be. Following on from this, three context awareness behaviours that an application might exhibit can be identified: (1) the presentation of situational information and services to a user, (2) the automatic execution of a situational service, and (3) tagging of context to information for later retrieval.

P2P

Peer computing replaces the asymmetric client-server relationship with a symmetric one, in which all peers are simultaneously client and server requesting service of, and providing service to, their network peers. If, from this network of peers, any single, arbitrary chosen peer can be removed from the network without having the network suffering any loss of network service, it is called a pure peer-to-peer network. If a central entity is necessary to provide parts of the offered network services, the network is called a *hybrid* peer-to-peer network (Schollmeier and Rüdiger, 2001).

In a near future we see the emergence of the area of Ambient Intelligence with Peer-to-Peer (P2P) Communications between Personal Area Networks as a central component. The current evolution path for wireless communication is towards multi-access. This means using several of access technologies such as WLAN, GSM, or WCDMA at the same time to ensure that the user is always best connected to the environment.

Network assistance

A peer-to-peer based service is network assisted if some part of its performance or service is using a central entity. In effect, a network assisted peer-to-peer based service is a hybrid peer-to-peer based service.

As more and more of the local communication will move towards using P2P as a way to exchange information at no cost we need to analyse the impact of this development. Our goal is to study this emerging area for new types of

applications, with a special interest on how we can use the cellular network (GSM/WCDMA) to enhance these new services. This offers added value to the end-users and also an opportunity for Ericsson current customer base, i.e. operators such as Telia and Vodafone), to charge for these services. Initial examples of this type of Network Assistance are:

- Secure information exchange using standard AAA services, Authentication, Authorisation and Accounting
- Security and instant updates of virus-scan
- Support for Context Awareness, Location, Situation, etc.
- Access discovery of possible P2P paths
- Interpretation and referencing of sensor data
- Mobility support that extend the coverage of a local P2P connection to work over longer distances using multi-hop or the public network

Network assistance is in our view one potentially viable way to establish and ensure this infrastructure and service network.

Basic human needs, definitions

In the AmIGo project we identified the need of establishing firm ground in human needs. Thus we have used a definition of basic human needs derived from an Ericsson Consumer Labs report.

From the Ericsson Consumer Labs document:

» The first and most important need within our business is social communication. This need is spread among more or less all individuals. Among old and young, pioneers and traditionalists, unemployed and managers, etc.
The need to feel safe is also very important and a lot of different services could be offered to more or less the total population.
There are some services that "empower" the user, like navigation services remote control of the home, banking, etc. These services attract different subgroups of the population and have a big potential.
Services that support "fun" like games, music, radio, gambling etc only attract a small part of the population, and are more niche-oriented. »

Figure 1. The AmIGo concepts, aka The Swirl

Chapter 3 The AmIGo Scenario

A scenario set in the year 2010

Legend

The story proper [Palatino, 11 pts]
Comments [Arial, 11 pts, Italic]
Things happening in the background [Palatino, 11 pts, bold]

The story

While putting on your jacket to go to work in the morning, you see on your device that your tenant-owner's association wants to know your opinion on an issue. A new small garden is planned in the central area of your neighbourhood. The board wants you to have a say in the matter. You decide a small garden is better than the boring lawn there now. After sending the poll answer you get a small credit to your account.

Since you came home last night, your personal device has been syncing itself with your family's home server. *The syncing takes place at various points in time, all through the day, and depending on things like availability of networks, proximity to people connected to your local, home network, and so forth.*

Sitting on the tube, Monday morning, you pick up a copy of the *businessBriefs* that's floating around in the carriage's scatter net. It is instantly displayed on your device, and your preference agent makes a few notes, since you never looked twice at the *businessBriefs* before. Before this, you started a *musicSync* with people sharing your taste in music in your scatter net. To ensure total syncing, and feeling slightly rich after a quiet weekend, you opted for a network supported complete sync. So, you leave that in the background, listening to the first few tunes already completed, while browsing the paper.

For the presentation this morning, you need to use the projector in the conference room. After getting access to it, you check that nothing is missing from your presentation folder in your file area. Of course, the music that you downloaded on the tube are not yet on your omnipresent system, it's still physically on your device in your pocket. But, since the room is now your immediate scatter net, all files and resources on your device is also available in your interactions with the projector.

While the projector is warming up, it notices that its lamp is starting to show wear. According to its internal housekeeping agent, it is time to order a new

lamp. Since your personal device is being the closest with far-reaching scatter net contact, it uses you as a stepping-stone to relay a message to the Support Division. Your account is credited a few credits, for allowing the stepping-stone relaying of that message.

While checking your preparations, you notice someone is approaching in the scatter net, someone with a mutual friend in his or her contacts list. The next second, a woman who will attend the presentation appears in the doorway. You ask if she also knows your friend. And yes, he happens to be one of her colleagues from at her former work! Which also is your former job. You have a brief chat before the rest of the participants arrive.

After your successful presentation, you open it for public access. The people in the room may now get it for themselves. As long as they start the fetching process before leaving the scatter net, your company will pay for the last (potentially) network supported downloading to their devices. The presentation is also available in full, report-length format. The participants so inclined may purchase a copy of this report. If they start the transaction within your company's scatter net, they receive a handsome discount. Some of the attendees take up this offer and start downloading the full report.

When the participants leave the room, their connection to that particular scatter net will be lost. Depending on their device and what other nets are available at that instance, they will switch over to another small ad hoc scatter net, or to a radio-based network. If a cost is incurred, the host company will pay for this.

Lunch is rapidly approaching. Therese just urges you to answer her poll: lunch at the usual place or try something new? You see that the usual suspects are on voting duty, and you make your choice. The result is to meet at the new place by the park. On your way there you glimpse who are coming with Therese, and you bump into Edward in the park. Of course both your devices start syncing your music since you have created a musical bond between you. This syncing only takes place when you actually meet though.

You pin Edward's icon. You two are going to chat about next weekend later in the afternoon, and rather than just calling him back later, you mark his icon as pinned. This means you'll be able to chat with him unhindered during the afternoon.

On your way home, you go to the cinema with Edward. Leaving the cinema, you see one of the polling stations by the exit. Its sign says it polls your view on the film that you just saw, and that you'll get a drink voucher valid in a nearby bar, should you answer the poll. Moving closer to the poll station, your device

displays the poll and you are asked to make your choice. You submit your answers, and is also encouraged to recommend this film to a friend; giving an additional reward. You decide to recommend the film to a friend, and the poll station gives you an extra voucher for the bar. Ed and you head there together.

Finally home after a long day. It's quite late, but the rest of the family is still elsewhere, so you have the home to yourself for now. This means that your device immediately, on low volume at first, starts playing today's catch of music (from the tube, meeting with friends, etc). You leisurely listen and weed out what you don't like.

Your wife is at an art gallery, and wants to show you a favourite from the show. She asks your TV-set to show you the picture she wants you to see. You feel a bit sorry you didn't come, but this way you can at least get an impression of the exhibit.

FIELD OVER VIEW

Chapter 4 Defining the field

It is of course a paramount task to exhaustively define a field that is in its infancy and is mutually depending on developments of the technological frontier, on the verge of emerging research areas, as well as the way we view the world. Still, we will here try to develop a view of the field within which we have been operating, doing design, research and development.

Ambient systems are often referred to as being IT systems intimately integrated with everyday environments and supporting people in their activities. In the visions of ubiquitous computing the integrative ideal is one of invisibility:

» Such a disappearance is a fundamental consequence not of technology, but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it. When you look at a street sign, for example, you absorb its information without consciously performing the act of reading. Computer scientist, economist, and Nobelist Herb Simon calls this phenomenon 'compiling'; philosopher Michael Polanyi calls it the 'tacit dimension'; psychologist TK Gibson calls it 'visual invariants'; philosophers Georg Gadamer and Martin Heidegger call it 'the horizon' and the 'ready-to-hand'; John Seely Brown at PARC calls it the 'periphery'. All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals. »

Mark Weiser, 1991

Later, in 1998, Weiser coined the term "Calm Technology" in order to honour the fact that what he wished for the future was to focus on designing technology that would act in the periphery for us. As he stated in a keynote speech

» Unlike ubiquitous computing, 'calm technology' does not name a method, but a goal. »

Mark Weiser, 1998

The transition from ubiquitous computing to calm technology mainly is a transition from technology-centred work to human-centred work. Even though ubiquitous computing definitions allude to post-modernity, it is hard to see that the perspective takes a stand against the modern; the increasing technologization of our life-world and the views of the human being as one being possible to model by means of computing technology analogies. Ubiquitous computing also posits itself as a contrast to Virtual Reality, as one not putting people into a computer-generated world, but instead forcing the computer to live where people live. Thus ubiquitous computing contributes to the increasing technologization of the life-world and assumes that it is desirable to increase the dependence of people on technology, even invisible technology.

Calm technology on the other hand wishes to honour humans, and the complexity of human life. The goal, though, is still technological development and dependence. The idea of invisible technology is strong within the calm technology perspective, as is the idea of fitting technology to the visible parts and the invisible parts of the iceberg that is used as a model of a human being within calm technology perspectives.

One common vision for ambient intelligence is that the user is provided with applications and services with which s/he interacts in an enjoyable and unobtrusive manner. All senses are supposed to be supported and utilized in this interaction, and applications and services should be consistent, easy to handle and easy to learn. This vision can be used for technology centred as well as user centred research and development.

Figure 2. The Multisphere level ⑥: CyberWorld (Book of visions, 2000)

One way of trying to define the field is to take the networks that will surround us as a starting point. The central idea of these networks is to create

environments in which people are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects. It is an environment that is capable of recognizing and responding to the presence and actions of different individuals in a seamless, unobtrusive and often, invisible way using several senses.

This gives us environments were most communication will take place locally between humans, humans and the surrounding objects but also between the objects themselves. The objects may be devices built to be "smart" such as PDAs or computers, but most of the objects will be single purpose objects that have been (retro-) fitted with a chip capable of logic and communication, in its simplest form a coffee cup with a RFID-tag. The volumes of traffic will increase massively, but almost all traffic will be using no-/low-cost short-range connections to a specific object or the closest access point, (using multi-hop all intelligent objects may act as access points).

In a ubiquitous environment where everything is networked and intelligent, the *services* become the center of everything. The way the user accesses the services should be transparent using any distributed multi-modal user interface that is available. Management of the services and the physical and virtual "home environment" will be an important business opportunity.

The battle between thick or thin clients will continue, but the option with a thick client storing a personal environment that you always bring with you seems to gain ground. This client can pro-actively update frequently accessed information based on earlier behavior when in reach of a no/low-cost access point. This will limit the need for real-time information access and wide-area coverage will be used as a bridge between smart environments.

We foresee the emergence of the area of Ambient Intelligence with Peer-to-Peer (P2P) Communications between Personal Area Networks as a central component. The current evolution path for wireless communication is towards multi-access. This means using several of access technologies such as WLAN, GSM, or WCDMA at the same time to ensure that the user is always best connected to the environment.

As more and more of the local communication will move towards using P2P as a way to exchange information at no cost we need to analyse the impact of this development. Our goal is to study this emerging area for new types of applications, with a special interest on how we can use the cellular network (GSM/WCDMA) to enhance these new services. This offers added value to the end-users and also an opportunity for Ericsson current customer base, i.e. operators such as Telia and Vodafone), to charge for these services. Initial examples of this type of Network Assistance are:

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Network assistance is in our view one potentially viable way to establish and ensure this infrastructure and service network.

One important conclusion is that our technical environment will grow increasingly gaudy. People will have so many devices from many different technology generations. There will be specific gadgets as well as general-purpose gadgets, people will cling onto unusable or incompatible or naïve things for their love and affection to them. Things will act or adapt by your being passive as well as acting on actions of yours, and sometimes behave profoundly (and with surprising precision) proactively. It will be rare to be alone (i.e., without someone or something registering you). We need an *Infrastructure* that allows us to interact with such a collection of things, and we need a *Service Network* that can distribute the computing power and establish policies that can adapt to peoples individual needs, preferences and behavior.

Chapter 5 Review of projects

Introduction

In the AmIGo project we have used a four-armed star to visualise the four main ideas during the pre-study.

Figure 3. The AmIGo concepts, aka The Swirl

- Ambient intelligence
- Peer-to-peer computing
- Network support
- Context awareness

The other dimensions of our study has been the three aspects:

- User needs
- Business viability
- Technology

The four main ideas are used in the structure of this section. We have roughly classified all projects, products, ideas and initiatives within one of the four main

categories. We wish electronic or print paper would allow for a smooth way of displaying the underlying web of categorization. We have chosen to present the projects under the heading that seem to have the strongest presence in our interpretation of the projects. The review of items does not claim to be a comprehensive list of all interesting items possible to include in a review of the area. Instead it should be read as a review of items that has been influential during the course of the AmIGo project.

Ambient Intelligence

Home care (Mobile e-business)

Source:

http://www-3.ibm.com/pvc/products/wes_embedded/internet.shtml

Description:

John has a heart condition and wears a smart watch that takes his blood pressure three times a day. His watch also reminds him to take his medications and the proper dosage for each medicine. If anything is unusual, his watch alerts both him and his doctor.

John also has a PDA that contains an interactive health control table where he can monitor his medications, schedule his exercises, manage his diet and log his vital statistics. His doctor and trainer have access to this table so they can keep up to date on his condition.

Currently, John's watch detects that his blood pressure is unusually high. His doctor receives a grade B alert through her portable phone and John's profile is sent to her PDA. Doctor Yamada calls him to check what might be causing his high blood pressure. At the same time John receives a checklist of possible causes to review. John compares this list to his own health control table in his PDA to see what might be wrong. Meanwhile, the computer network at the heart center has noted John's condition, checked with both John and Doctor Yamada's calendars and suggests an appointment for them next week. Both John and Doctor Yamada confirm the date as it appears in their PDAs.

Communication between wallscreen display and personal devices

Source:

http://swig.stanford.edu/pub/publications/ads/ubicomp01.pdf

Description:

Bob is attending a meeting with his colleagues. He starts the meeting by transferring a meeting outline from his PDA to the wall-screen display via an IR-dongle located under the display. Team members display documents in the same way from their PDAs, laptops, and handheld scanners. Some editing of the documents is made, and when the meeting ends, people transfer the documents they need back to their mobile devices.

UniNotes

Source:

SICS-document

Description:

GeoNotes but not positioned in geographical space, but in any kind of digital or analogue media. The possibility to place GeoNotes anywhere and on anything. Examples:

- While copying a book you get available UniNotes about the specific page as notes in the margin. The copying machine uses some kind of smart recognition procedure.
- While watching a film you may get UniNotes about each frame.
- While downloading PDF:s you get UniNotes from people who have downloaded the document before.
- While walking by a sepcific place you get the UniNotes for this specific place
- While reading an ordinary paper based book you get the UniNotes for it.

The virtual guide – museum

Source:

http://www.hpl.hp.com/techreports/2001/HPL-2001-215.pdf

Description:

Laura is visiting a museum and is very interested in particularly exhibits from 15th century. She maps out which exhibits she wants to see on her wirelessly networked mobile phone or PDA. As she visits each exhibit, her mobile device automatically displays the web page that is tied to each exhibit.

The Rover

Source:

http://www.marylandresearch.umd.edu/issues/fall2001/feature.html

Description:

Imagine a summer's day, sometime in the not-too-distant future, in the tourist-filled heart of Washington, D.C. There, amid the monuments and museums, visitors from all over the world are converging to explore the ambiance, culture and history of the nation's capital.

For first-time visitors, such a visit can be overwhelming; for Jennifer, a freshman art history major from the University of Maryland, it is downright frustrating. She has braved Washington's busy streets and crowded Metro subway to visit the National Gallery of Art, where she stands at the entrance to the museum wondering which direction to take.

Jennifer contemplates turning back onto Constitution Avenue, but an interesting kiosk catches her eye. Its sign says, “Let Rover Be Your Guide.” Jennifer assumes it to be a standard guide-led or audio tour, a staple of modern tourist attractions. But after closer inspection, she pulls out her credit card and signs up to use

"Rover," a new wireless communications device that will personally guide her through the art gallery or a variety of other museums lining the National Mall. The Rover technology will give Jennifer location-specific listings of events for the day, and no matter where she is, it will tell her what, based on her interests, there is to do.

A vendor hands Jennifer a hand-held "Rover" personal digital assistant, or PDA, and reviews the basics. It has audio and text capabilities; it will keep track of her visit and record it on CD-ROM; it can purchase tickets, meals and gifts from museum stores; it provides detailed information about every exhibit; and it has messaging and locating capabilities. "There's more, but it's easily learned as you go along," the salesperson says.

Automatic recharging at the grocery store

Source:

http://www.csd.uwo.ca/faculty/hanan/Perv/Scenario.doc

Description:

Sue cooks for relaxation. She feels like making a special dish for which she knows that she doesn't have the ingredients. She walks into a grocery store and picks up everything she needs. As she picks out an item, she has it scanned by the scanner on her shopping cart. She then walks out (and the security guard gives her the receipt she forgets). She didn't stop at a till or give anyone money - the store knows that she is removing items, and automatically charges her.

Home delivery from the grocery store

Source:

http://www.csd.uwo.ca/faculty/hanan/Perv/Scenario.doc

Description:

[At Home]

Sue and Mike have their home-computing environment configured so that 10 minutes before 4:00 their alarm clock rings in the morning, the coffee machine is automatically started. In making their breakfast of eggs and toast, Mike realizes that the egg supply is low. He instructs the home computing environment to add a dozen eggs to the shopping list. The refrigerator, scanning the barcode on the milk, realizes that it will soon expire; it adds a gallon of milk to the shopping list. This shopping list is sent electronically to the grocery store once a week for home delivery of the items on that list.

Home networking

Source:

http://www-3.ibm.com/pvc/tech/networking_appendix.shtml

Description:

Tom is a busy insurance salesperson. Although he uses a PC daily, he does not consider himself technically sophisticated. Tom likes technology to be invisible.

Like many other insurance agents, Tom uses a notebook computer in his work. When Tom returns to his small insurance office after visiting a client, his notebook computer uses UPnP to discover and communicate with other devices in the office, like the printer. Tom frequently brings his notebook computer home from work. The notebook computer dynamically joins the RF-based home network in Tom's home and uses UPnP to discover the printer attached to the PC in Tom's den. Tom can print documents from his notebook computer at home. The notebook computer also uses the home gateway connecting Tom's home to various service provider networks (including his ISP). Using the Internet sharing function provided by the home gateway, Tom can surf the Web at the same time as his daughter Laurie.

Tom and his wife Mary replaced their household appliances opting for the latest smart appliances that incorporate power line networking and Jini technology. These smart appliances can discover each other (and each others' capabilities) and exchange information, using the existing AC wiring in the house. One example of this system of smart appliances is that the Jini-enabled clothes dryer can discover the Family Information Center appliance in the kitchen and display a message that the clothes in the dryer are now dry. The Jini-enabled refrigerator also can discover the Family Information Center. It displays a warning message that it has detected increased energy usage. The message recommends cleaning the cooling coils to regain energy efficient operation.

Maria Road Warrior

Source:

ISTAG 2010

http://www.cordis.lu/ist/istag.htm

Description:

After a tiring long haul flight Maria passes through the arrivals hall of an airport in a Far Eastern country. She is travelling light, hand baggage only. When she comes to this particular country she knows that she can travel much lighter than less than a decade ago, when she had to carry a collection of different so-called personal computing devices (laptop PC, mobile phone, electronic organisers and sometimes beamers and printers). Her computing system for this trip is reduced to one highly personalised communications device, her ‘P–Com’ that she wears on her wrist. A particular feature of this trip is that the country that Maria is visiting has since the previous year embarked on an ambitious ambient intelligence infrastructure programme. Thus her visa for the trip was self-arranged and she is able to stroll through immigration without stopping because her P-Comm is dealing with the ID checks as she walks.

A rented car has been reserved for her and is waiting in an earmarked bay. The car opens as she approaches. It starts at the press of a button: she doesn’t need a key. She still has to drive the car but she is supported in her journey downtown to the conference centre-hotel by the traffic guidance system that had been launched by the city government as part of the ‘AmI-Nation’ initiative two years

earlier. Downtown traffic has been a legendary nightmare in this city for many years, and draconian steps were taken to limit access to the city centre. But Maria has priority access rights into the central cordon because she has a reservation in the car park of the hotel. Central access however comes at a premium price, in Maria's case it is embedded in a deal negotiated between her personal agent and the transaction agents of the car-rental and hotel chains. Her firm operates centralised billing for these expenses and uses its purchasing power to gain access at attractive rates. Such preferential treatment for affluent foreigners was highly contentious at the time of the introduction of the route pricing system and the government was forced to hypothecate funds from the tolling system to the public transport infrastructure in return. In the car Maria's teenage daughter comes through on the audio system. Amanda has detected from 'En Casa' system at home that her mother is in a place that supports direct voice contact. However, even with all the route guidance support Maria wants to concentrate on her driving and says that she will call back from the hotel.

Maria is directed to a parking slot in the underground garage of the newly constructed building of the Smar-tel Chain. She is met in the garage by the porter – the first contact with a real human in our story so far! He helps her with her luggage to her room. Her room adopts her 'personality' as she enters. The room temperature, default lighting and a range of video and music choices are displayed on the video wall. She needs to make some changes to her presentation – a sales pitch that will be used as the basis for a negotiation later in the day. Using voice commands she adjusts the light levels and commands a bath. Then she calls up her daughter on the video wall, while talking she uses a traditional remote control system to browse through a set of webcast local news bulletins from back home that her daughter tells her about. They watch them together.

Later on she 'localises' her presentation with the help of an agent that is specialised in advising on local preferences (colour schemes, the use of language). She stores the presentation on the secure server at headquarters back in Europe. In the hotel's seminar room where the sales pitch is take place, she will be able to call down an encrypted version of the presentation and give it a post presentation decrypt life of 1.5 minutes. She goes downstairs to make her presentation… this for her is a high stress event. Not only is she performing alone for the first time, the clients concerned are well known to be tough players. Still, she doesn't actually have to close the deal this time. As she enters the meeting she raises communications access thresholds to block out anything but red-level 'emergency' messages. The meeting is rough, but she feels it was a success. Coming out of the meeting she lowers the communication barriers again and picks up a number of amber level communications including one from her cardio-monitor warning her to take some rest now. The day has been long and stressing. She needs to chill out with a little meditation and medication. For Maria the meditation is a concert on the video wall and the medication….a large gin and tonic from her room's minibar.

Dimitrios and the digital me

Source:

ISTAG 2010 http://www.cordis.lu/ist/istag.htm

Description:

It is four o'clock in the afternoon. Dimitrios, a 32 year-old employee of a major food-multinational, is taking a coffee at his office's cafeteria, together with his boss and some colleagues. He doesn't want to be excessively bothered during this pause. Nevertheless, all the time he is receiving and dealing with incoming calls and mails.

He is proud of 'being in communication with mankind': as are many of his friends and some colleagues. Dimitrios is wearing, embedded in his clothes (or in his own body), a voice activated 'gateway' or digital avatar of himself, familiarly known as 'D-Me' or 'Digital Me'. A D-Me is both a learning device, learning about Dimitrios from his interactions with his environment, and an acting device offering communication, processing and decision-making functionality. Dimitrios has partly 'programmed' it himself, at a very initial stage. At the time, he thought he would 'upgrade' this initial data periodically. But he didn't. He feels quite confident with his D-Me and relies upon its 'intelligent ' reactions.

At 4:10 p.m., following many other calls of secondary importance – answered formally but smoothly in corresponding languages by Dimitrios' D-Me with a nice reproduction of Dimitrios' voice and typical accent, a call from his wife is further analysed by his D-Me. In a first attempt, Dimitrios' 'avatar-like' voice runs a brief conversation with his wife, with the intention of negotiating a delay while explaining his current environment. Simultaneously, Dimitrios' D-Me has caught a message from an older person's D-Me, located in the nearby metro station. This senior has left his home without his medicine and would feel at ease knowing where and how to access similar drugs in an easy way. He has addressed his query in natural speech to his D-Me. Dimitrios happens to suffer from similar heart problems and uses the same drugs. Dimitrios' D-Me processes the available data as to offer information to the senior. It 'decides' neither to reveal Dimitrios' identity (privacy level), nor to offer Dimitrios' direct help (lack of availability), but to list the closest drug shops, the alternative drugs, offer a potential contact with the self-help group. This information is shared with the senior's D-Me, not with the senior himself as to avoid useless information overload.

Meanwhile, his wife's call is now interpreted by his D-Me as sufficiently pressing to mobilise Dimitrios. It 'rings' him using a pre-arranged call tone. Dimitrios takes up the call with one of the available Displayphones of the cafeteria. Since the growing penetration of D-Me, few people still bother to run around with mobile terminals: these functions are sufficiently available in most public and private spaces and your D-Me can always point at the closest…functioning one! The 'emergency' is about their child's homework.

While doing his homework their 9 year-old son is meant to offer some insights on everyday life in Egypt. In a brief 3-way telephone conference, Dimitrios offers to pass over the query to the D-Me to search for an available direct contact with a child in Egypt. Ten minutes later, his son is videoconferencing at home with a girl of his own age, and recording this real-time translated conversation as part of his homework. All communicating facilities have been managed by Dimitrios' D-Me, even while it is still registering new data and managing other queries. The Egyptian correspondent is the daughter of a local businessman, well off and quite keen on technologies. Some luck (and income…) had to participate in what might become a longer lasting new relation.

Carmen: traffic, sustainability and commerce

Source:

ISTAG 2010 http://www.cordis.lu/ist/istag.htm

Description:

It is a normal weekday morning. Carmen wakes and plans her travel for the day. She wants to leave for work in half an hour and asks AmI, by means of a voice command, to find a vehicle to share with somebody on her route to work. AmI starts searching the trip database and, after checking the willingness of the driver, finds someone that will pass by in 40 minutes. The in-vehicle biosensor has recognised that this driver is a non-smoker – one of Carmen requirements for trip sharing. From that moment on, Carmen and her driver are in permanent contact if wanted (e.g. to allow the driver to alert Carmen if he/she will be late). Both wear their personal area networks (PAN) allowing seamless and intuitive contacts.

While taking her breakfast coffee Carmen lists her shopping since she will have guests for dinner tonight. She would like also to cook a cake and the e-fridge flashes the recipe. It highlights the ingredients that are missing milk and eggs. She completes the shopping on the e-fridge screen and asks for it to be delivered to the closest distribution point in her neighbourhood. This can be a shop, the postal office or a franchised nodal point for the neighbourhood where Carmen lives. All goods are smart tagged, so that Carmen can check the progress of her virtual shopping expedition, from any enabled device at home, the office or from a kiosk in the street. She can be informed during the day on her shopping, agree with what has been found, ask for alternatives, and find out where they are and when they will be delivered.

Forty minutes later Carmen goes downstairs onto the street, as her driver arrives. When Carmen gets into the car, the VAN system (Vehicle Area Network) registers her and by doing that she sanctions the payment systems to start counting. A micro-payment system will automatically transfer the amount into the e-purse of the driver when she gets out of the car.

In the car, the dynamic route guidance system warns the driver of long traffic jams up ahead due to an accident. The system dynamically calculates alternatives together with trip times. One suggestion is to leave the car at a

nearby 'park and ride' metro stop. Carmen and her driver park the car and continue the journey by metro. On leaving the car, Carmen's payment is deducted according to duration and distance.

Out of the metro station and whilst walking a few minutes to her job, Carmen is alerted by her PAN that a Chardonnay wine that she has previously identified as a preferred choice is on promotion. She adds it to her shopping order and also sets up her homeward journey with her wearable. Carmen arrives at her job on time.

On the way home the shared car system senses a bike on a dedicated lane approaching an intersection on their route. The driver is alerted and the system anyway gives preference to bikes, so a potential accident is avoided. A persistent high-pressure belt above the city for the last ten days has given fine weather but rising atmospheric pollutants. It is rush hour and the traffic density has caused pollution levels to rise above a control threshold. The city-wide engine control systems automatically lower the maximum speeds (for all motorised vehicles) and when the car enters a specific urban ring toll will be deducted via the Automatic Debiting System (ADS).

Carmen arrives at the local distribution node (actually her neighbourhood corner shop) where she picks up her goods. The shop has already closed but the goods await Carmen in a smart delivery box. By getting them out, the system registers payment, and deletes the items from her shopping list. The list is complete. At home, her smart fridge screen will be blank.

Coming home, AmI welcomes Carmen and suggests to telework the next day: a big demonstration is announced downtown.

Annette and Solomon in the ambient for social learning

Source:

ISTAG 2010 http://www.cordis.lu/ist/istag.htm

Description:

It is the plenary meeting of an environmental studies group in a local 'Ambient for Social Learning'. The group ranges from 10 to 75 years old. They share a common desire to understand the environment and environmental management. It is led by a mentor whose role it is to guide and facilitate the group's operation, but who is not necessarily very knowledgeable about environmental management. The plenary takes place in a room looking much like a hotel foyer with comfortable furniture pleasantly arranged. The meeting is open from 7.00-23.00 hours. Most participants are there for 4-6 hours. A large group arrives around 9.30 a.m. Some are scheduled to work together in real time and space and thus were requested to be present together (the ambient accesses their agendas to do the scheduling).

A member is arriving: as she enters the room and finds herself a place to work, she hears a familiar voice asking "Hello Annette, I got the assignment you did last night from home: are you satisfied with the results?" Annette answers that

she was happy with her strategy for managing forests provided that she had got the climatic model right: she was less sure of this. Annette is an active and advanced student so the ambient says it might be useful if Annette spends some time today trying to pin down the problem with the model using enhanced interactive simulation and projection facilities. It then asks if Annette would give a brief presentation to the group. The ambient goes briefly through its understanding of Annette's availability and preferences for the day's work. Finally, Annette agrees on her work programme for the day.

One particularly long conversation takes place with Solomon who has just moved to the area and joined the group. The ambient establishes Solomon's identity; asks Solomon for the name of an ambient that 'knows' Solomon; gets permission from Solomon to acquire information about Solomon's background and experience in Environmental Studies. The ambient then suggests Solomon to join the meeting and to introduce himself to the group.

In these private conversations the mental states of the group are synchronised with the ambient, individual and collective work plans are agreed and in most cases checked with the mentor through the ambient. In some cases the assistance of the mentor is requested. A scheduled plenary meeting begins with those who are present. Solomon introduces himself. Annette gives a 3-D presentation of her assignment. A group member asks questions about one of Annette's decisions and alternative visualisations are projected. During the presentation the mentor is feeding observations and questions to the ambient, together with William, an expert who was asked to join the meeting. William, although several thousand miles away, joins to make a comment and answer some questions. The session ends with a discussion of how Annette's work contributes to that of the others and the proposal of schedules for the remainder of the day. The ambient suggests a schedule involving both shared and individual sessions.

During the day individuals and sub-groups locate in appropriate spaces in the ambient to pursue appropriate learning experiences at a pace that suits them. The ambient negotiates its degree of participation in these experiences with the aid of the mentor. During the day the mentor and ambient converse frequently, establishing where the mentor might most usefully spend his time, and in some cases altering the schedule. The ambient and the mentor will spend some time negotiating shared experiences with other ambients – for example mounting a single musical concert with players from two or more distant sites. They will also deal with requests for references / profiles of individuals. Time spent in the ambient ends by negotiating a homework assignment with each individual, but only after they have been informed about what the ambient expects to happen for the rest of the day and making appointments for next day or next time.

Driving data

Source:

http://design.stanford.edu/spdl/ME218d/ME218D%20BMW%20Tech%20Office%20revA.pdf

Description:

Albert enjoys taking his 5-series BMW out for drives on remote routes that require extended periods of skilled driving. After returning home, Albert moves the raw data recorded by his Ultimate Embedded Vehicle-Performance Monitor over to his home PC, via a wireless or wireline connection, or by a removable media device. After especially interesting drives, Albert combines the recorded performance data with recorded GPS coordinates and uses software running on his PC to plot the drive data onto a map. Albert also keeps a record of the statistics for repeated trips over the same route, and uses this information to monitor both his driving skill and the performance of his BMW.

A visionary Smart Space scenario:

Source:

http://www.nist.gov/smartspace/smartSpaces/#scenario

Description:

George, a group leader with the FEMA (Federal Emergency Management Agency Headquarters) is currently sleeping peacefully at home; dreaming of his upcoming vacation. However, hurricane Sandy unexpectedly changed course during the night and is just then impacting the Florida coast south of West Palm Beach with one hundred and forty mile per hour winds. Power and civilian communication systems are failing under the lashing winds and rain.

George's smart office PC, Grover, receives a Priority Emergency Advisory and routes it to his pager, downloads a header paragraph and actuates its emergency management tones. George sends an acknowledgment and stumbles out of bed. “Gonna be an interesting day,” he says to himself. All other members of Team Charley are alerted in the same way.

At work, George enters the SA room that contains many sensors fused to provide capabilities that none could do alone. The wall screen is divided into video communication areas as well as working command and data areas owned by the various personnel. The wall screen can thus be used collaboratively for both input and output without the use of pointing devices.

Each team member is a specialist who has a working session connecting him to various disaster management functions, such as supply chains for food, potable water, power, medical facilities, local police, and National Guard.

As the storm passes, the SA room provides George with a log and summary of the dialog and activities of his personnel, at the SA rooms and in the field, for analysis and reporting.

Policeman Bob

Source:

http://www.cs.washington.edu/sewpc/papers/houck.pdf

Description:

Policeman Bob was on his routine patrol in his car, when the monitor near the front seat alerted him about a possible home invasion nearby. While the car navigator automatically displayed the route to the location, Bob asked for more information about the neighbourhood (residents information). Upon Bob's request, the system found the neighbourhood information and summarized it using a geographical format (information overlaid on a map).

When approaching the destination, Bob noticed a suspicious vehicle parked in the driveway. To read the car license plate, Bob got out of his car with his radio-PDA. Nobody was in the car, and Bob used his radio to request a license plate check and indicated that the result should be sent to his wristwatch. Bob input the plate number and also silenced his radio so as not to alert the suspect. By sending only visual alarms to his wristwatch, the system alerted Bob that the war was reported as stolen by an extremely dangerous suspect. Since the system also knew that Bob sent the request to his radio, it notifies Bob that the suspect's picture can now be seen on his radio PDA. In addition, the system also knew that Bob has a desktop computer in his office, so it then prepared a detailed multimedia information summary about the suspect and sent it to his office computer.

In the mean time, Bob examined the suspect's picture on his radio-PDA and used his wrist watch to request backups silently. Since Bob and his backups could not find the suspect nearby, he went back to the police station. To finish his paper work, Bob reviewed the multimedia summaries about the suspect sent earlier by the system.

Selective availability

Source:

SICS document

Description:

Possibilities to be undisturbed in everyday life. The balance between availability and integrity. Work-related voicemails will not be notified until the day after when at work. The possibility for truck drivers to disappear from the tracking system for a while, without having to cheat away out of sight.

Instead of building more and more controlling systems for availability we need to build on a larger freedom for being unavailable, at least for some kinds of communication.

Peer-to-peer computing

Communication between artifacts

Source:

http://www.newcastle.research.ec.org/cabernet/workshops/radicals/2002/Papers/Karypidis.pdf

Description:

Mary strolls around the winding roads of Heraklion. She takes pictures of the beautiful surroundings using her digital camera. Reviewing her shots, she notices that they have been tagged with the time and location they were taken at. This information was retrieved from her GPS-enabled wristwatch. She keeps on shooting and at some point notices the message "Camera memory full - using MP3 storage" in the viewfinder. Surprised, she reaches into her left pocket and discovers her forgotten since yesterday MP3 player. She continues shooting photos, without further action.

A businesswoman on a train

Source:

http://www.usa.philips.com/InformationCenter/NO/FArticleDetail.asp?lArticleId=1197&lNodeId=234&channel=234&channelId=N234A1197

Description:

A businesswoman on a train is working with her laptop computer. The phone in her briefcase plays a tune and an incoming e-mail is displayed on her computer screen. The phone sounds again. This time it is an incoming voice call, which she takes on her headset with attached microphone. In both instances, she answers the phone without having to open her briefcase.

Peer-to-Peer file sharing to obtain clinical data

Source:

http://www.ama-assn.org/sci-pubs/amnews/pick_01/tesa0312.htm

http://www.ai.mit.edu/projects/iroom/publications/hanssens-aba-02.pdf

Description:

Dana is a physician that is in need of the results of all tests and a list of all medications other physicians have prescribed during the past six months for a patient of her.

She logs on to a computer, and learns that a group practice, a laboratory, two hospitals and two pharmacies around town have eight records matching her criteria. She clicks on a hypertext link for each record, and she immediately becomes connected and able to download the data she needs directly from the computers of those entities. Dana is now ready to treat her patient in her office.

Digital ugly news

Source:

SICS document

Description:

Assume there is a database with information on sanitary problems at restaurants in a city; the Restaurantkiller application (could be an add-on for UniNotes). Links to reviews in the press and reviews from people that have been to the restaurants. Even reports from health institutes and protocols from inspections.

MP3 File Sharing

Source:

http://www.cs.uoregon.edu/research/wearables/Papers/p2p2001.pdf

Description:

The Music Trading Organization, an industry business group, has recognized both the need for copyright protection and a business opportunity in collecting royalties from digitally exchanged music. They have developed a technology that makes it possible for a small royalty to automatically be paid to the copyright owner when two individuals exchange copyright music. Further, both individuals involved in a trade will get a small payment every time they generate royalty for the copyright owner.

Eric and Jennie, both owners of copyright-enhanced wearable MP3 players, meet at a party. After listening to a song they both like, they begin discussing music and find they have a similar interest in Latin Calypso music. At Eric and Jennie's request their wearable computers start comparing music profiles and identify songs that Eric and Jennie might want to exchange. As result, their wearable computers wirelessly send selected songs to each other and record the transaction in a tamper-resistant database module.

When returning home from a long day, both Eric and Jennie synchronize the database on their wearable personal assistants with their desktop computer. As a side effect, MP3 transactions that happened throughout the day are automatically uploaded to the server of the central Music Trading Organization that in turns arranges payments to and from Eric and Jennie's bank accounts.

Ad hoc communities

Source:

SICS document

Description:

In this context we define a community as "a group of people that share a common interest either implicitly or explicitly". Thus, the community members do not have to be aware of each other. An ad-hoc community, as the name implies, is a short-term community that typically exists around a situation in a specific context. For example, when people meet at the pub they form a community around that setting. Another example of an ad-hoc community could be people that are buying or just bought a new Volvo.

The problem then is how we can move from implicit communities (as in the Volvo example) to more explicit ones (as in the first example). Traditionally, communities (or discussion forums) have been initialised by a person who then invites other people to join (or people have searched for communities). Such a process is too slow for the type of short-term communities that we are interest in.

By using a recommender system to recommend and create communities for the user we gain two things: (a) since setting up the community and finding the

members is done automatically, the probability of doing that increases and (b) we help people find people and communities that they did not know they where interested in.

How and where do we envision ad-hoc communities to thrive? Firstly, communities are already present on the Internet. Here we see our recommender mostly being used as a tool for finding communities (i.e. these are communities that have a longer life span). Secondly, and more importantly, the mobile context offers a great setting for short-term communities. At a technical level (using small devices, such as mobile phones) the ability to have communities created for you is a tremendous gain. Also, the mobile setting is very dynamic: as we move in space our task and situation constantly changes, and thus also the community that we are presently in.

In order for the above scenario to work we need information about people. We need to gather as much data about them as possible: what their current task is, where they are, where they have been, what their interests are. Also, the type of data used to "match" people will probably vary depending on what type of community that is to be formed or recommended. That is, a work related situation is probably different from the types of activities that we engage in on our leisure time. Another aspect of the "match making" process is of course the people themselves. It is probable the case that young people are different from their parents in terms of what the important properties are. Finally, when we move from recommending items to recommending people (which is in fact essentially the same process), privacy issues will become more important. The fact that people are recommended could feel a lot more intrusive.

Network support

Communication between artefacts

Source:

http://www.usa.philips.com/InformationCenter/NO/FArticleDetail.asp?lArticleId=1197&lNodeId=234&channel=234&channelId=N234A1197

Description:

A tourist on the ski slopes is snapping away at the spectacular winter scenery with his digital camera, while the mobile phone safely tucked away in his carrier bag is sending his snapshots to his computer hard-drive back at home, where the photos are stored. The computer at home has a greater storage capacity than what his digital camera can offer.

Communities-related keywords/search-engines

Source:

http://www.stanford.edu/~javiers/cs241/DraftProposal.html

Description:

Suppose Drew is interested in ubiquitous computing related articles on the web, but she does not know the right keywords/search-engines nor she has the time

to do an extensive search and hence cannot get the most relevant results using a traditional approach. But the proxy (say the CS dept proxy) that Drew is using has information about the pages visited by other users. Among these users are people who are also interested in ubiquitous computing and the proxy has information about the pages they visited in this regard. What the proxy can do now is to suggest Drew these pages that are more likely to be relevant to what she needs. Note that the server need not explicitly "know" what Drew is looking for and then match it. The power of this approach comes from the fact that users in a community would often look for the same resources and this information can be easily aggregated and de-personalized. Another motivation is that Drew is not only interested in what she can find now about ubiquitous computing but she would also like to know about new sites that are related to that topic that she didn't find today (and were not known to the proxy either). In the traditional approach, this will involve a new search or someone sending her a link. But if the proxy, that monitors traffic of the CS community, "knows" that Drew is interested in that topic, it can notify her about new links that were not reported to her previously.

In the previous scenario, there was very little active participation by Drew to contribute to the information that the proxy accumulates. The information accumulated by the proxy is totally automated. But we can do better. Suppose Drew ranks the pages she visits on the basis of their usefulness or relevance vis-à-vis her search. Then others, say Cameron, can take advantage of this ranking. This ranking is especially useful because it has been produced by Cameron's peers and so it is much more likely to be relevant to her. Of course, this will require the users to proactively rank pages they visit (or otherwise review them)

Finding of personal devices

Source:

http://www.ccsr.cse.dmu.ac.uk/conferences/ccsrconf/abstracts/araya.html

Description:

John has misplaced his pair of glasses somewhere. He does not know where, and he is in need of them. John access his device-location finding website at home, enters some description about the pair of glasses he has lost, and immediately he receives information about the glasses location; they are located in the glove compartment of the car. John can with help of the device-location finding website locate people and things of all kinds that have an embedded signal emitter device attached to it.

Follow Me

Source:

http://www.research.philips.com/Assets/Downloadablefile/passw3_10-1124.pdf

Brainstorm-activity about Usability: For Whom and Why? – 2002-06-24

Description:

Dad is browsing the Internet on the PC in his study room and has found a web Site with information that is interesting for the whole family. He then loads that information on the television in the living room for his family to see. Upon the displayed information the family decides to make updates and/or modifications on the families web site, and some design are made together at the television in the living room. After a while the children programs start at the television and Dad decide to move back to the study room to do the final changes on the web site. His son Bob, who is working on a paper for school, now occupies the PC in the study room, so Dad decides to continue the work on his laptop computer. The information that was available at the television is therefore "pushed" to his laptop.

E-mail transmission at airport

Source:

http://www.andrew.cmu.edu/~cfchen/readings/pvc/pervasive-computing-vision-and.pdf

http://www.ngi-supernet.org/lsn2000/CMU-Smailagic.pdf

Description:

Jane is at Gate 23 in the Pittsburgh airport, waiting for her connecting flight. She has edited many large documents, and would like to user her wireless connection to e-mail them. Unfortunately, bandwidth is miserable because many passengers at Gates 22 and 23 are surfing the web.

Jane's handheld device observes that at the current bandwidth Jane will not be able to finish sending her documents before her flight departs. Consulting the airport's network weather service and flight schedule service, Jane's handheld device discovers that wireless bandwidth is excellent at Gate 15, and that there are no departing or arriving flights at nearby gates for half an hour. A dialog box pops up on Jane's screen suggesting that she go to Gate 15, which is only three minutes walk away. It also asks her to prioritise her e-mail, so that the most critical messages are transmitted first. Jane accepts the advice and walks to Gate 15. She watches CNN on the TV there until her handheld device informs her that it is close to being done with her messages, and that she can start walking back. The last message is transmitted during her walk, and she is back at Gate 23 in time for her boarding call.

Location-based Application

Source:

http://www.cs.brown.edu/courses/cs227/2002/pervasive/Bisdikian.pdf

Description:

Jennifer needs to make two customer visits today. As she drives to the first customer's site, she receives driving directions from Watson (a system) through the speakers of the car. When Watson learns of a major accident on the normal route, it promptly informs her of the accident and offers her an alternative route that will avoid the expected delay. After she arrives to the customer's site,

Watson continues to give her the directions to the meeting room, via her cell phone.

During the meeting, a contract is discussed and Jennifer wants to get the opinion of Joe, her legal counsel. Hence, Jennifer asks Watson to print a copy of the contract for Joe. Watson automatically selects the nearest printer to Joe that is not busy or down and prints the contract for him. It does so without revealing Joe's exact location to Jennifer. A notification informs Joe of exactly which printer to seek out the printout.

After the meeting, Jennifer has time for a very short lunch. Watson finds her a nearby deli with no waiting time. As Jennifer is walking to the deli, Watson learns that her next scheduled visit has been postponed 2 hours. Watson uses Jennifer's cell phone to inform her about the change. She browses her new schedule on her phone display and requests by voice to cancel a conflicting meeting. Given the additional time and Jennifer's food preferences, Watson asks Jennifer whether she would go to a nearby Creole restaurant instead which serves highly touted gumbo. To help Jennifer make a decision, Watson shows the menu of the restaurant on the public terminal in front of which Jennifer happens to stand.

After lunch, Jennifer is on her way to meet with the second customer. Since her gas tank is almost empty, Watson suggests that she make a stop at a gas station on the route, which offers an excellent price on her preferred gasoline grade.

Context awareness

Personalized newspaper at handheld device -"Push"

Source:

http://portolano.cs.washington.edu/scenario/

Description:

Alice begins the day with a cup of coffee and her personalized newspaper, which is gathered information from different sources according to Alice's interests (web pages that she usually visits every morning). When her carpool arrives, she switches ("push") to reading the news on her handheld display, where she notices an advertisement for a new 3-D digital camera. The advertisement is new for the day, cause it is only up-to-date and news/advertisements she has not yet read, that is available at her personalized newspaper. It looks like something that would interest her shutterbug-friend Bob, so Alice asks her address book to place the call. Bob's home entertainment system softens the volume of his custom music file as his phone rings. Alice begins telling Bob about the camera, and forwards him a copy of the advertisement that pops up on his home display.

When the camera arrives, Bob snaps some photos of his neighbour's collection of antique Portuguese navigation instruments. After reviewing the photo album generated automatically by a web-based service, Bob directs a copy of his favourite image to the art display in his foyer.

Trust-based security rather than user authentication and access control

Source:

http://www.cs.umbc.edu/~finin//papers/vigil/vigil.pdf

Description:

John is an employee of one of the office's partners, but the security agent in the office doesn't understand his role in the organization, so it denies him access to the Smart Room services. John requests permission from Susan, one of the managers, to use the services. According to the office's security policy, Susan can delegate access rights to anyone she trusts. Therefore, she delegates to John the right to use the lights, coffee maker, and printer – but not the fax machine – for a short period of time.

Susan's laptop sends a short-lived signed delegation to John's handheld device. When John enters the Smart Room, the client on his handheld device sends his identity certificate and the delegation to the service manager. Because Susan is trusted and can delegate access rights, the delegation conforms to the policy and John now has access to the lights, coffee maker, and printer. Once the delegation expires, John must ask Susan for another delegation to access services in the room.

Working at different locations and at different work spaces

Source:

http://one.cs.washington.edu/papers/sigops00.pdf

Description:

As part of Alyssa's job she visits different organizations around the Silicon Valley almost daily and frequently travels across the world.

For managing her complex schedule and her numerous contacts as well as for communicating with clients she relies on a number of devices. At her office, Alyssa uses a conventional PC. At home, her PlayStation 3 not only functions as a digital VCR and music jukebox, but also provides her with access to her contacts, schedule, and electronic mail. On the road, Alyssa prefers smaller, more portable devices. Her 4-band cell phone is the most important; in addition to global voice communications, it lets her access her personal information manager and provides her with a music player to entertain her during those long international flights. At a client's location, she typically uses the client's computing facilities to make presentations, and, when staying at a hotel, she uses the in-room information appliance to access her office workspace. But, for travel to less technologically developed parts of the world, she also relies on a pad with an optional keyboard.

Across all these devices, Alyssa can access basically the same information and functionality. Her schedule and contacts are automatically synchronized between them. And, when accessing her workspace from a client's computer or a hotel's information appliance, she is presented with her desktop, featuring the same applications, data, and customisations as those on her office PC.

Furthermore, many of the tasks centred around personal information management are performed automatically and often without human interaction. For example, after agreeing on a meeting, the actual time for the meeting are automatically scheduled by her and her client's personal information managers. And, her manager reacts to a successfully scheduled out-of-town meeting by making the necessary travel arrangements, booking appropriate flights and hotels, all based on Alyssa's preferences, but without directly involving her (besides notifying her on the results).

Repair worker

Source:

http://web.media.mit.edu/~rhodes/Papers/bt-journal-wearables.html
http://more.btexact.com/projects/agents/publish/papers/bttj98-wearable.pdf

Description:

I am a new field engineer issued with the latest support equipment: a wearable computer that I clip to my belt with throat microphone, earpiece and head-up display that looks like a pair of normal glasses. My first job is to a repair at a large building complex, which is unfamiliar to me. As I approach the complex my wearable whispers in my ear reminding me I have to report to a certain building first and gives appropriate directions from my current position. As I check in, my head-up-display reminds me about a recent fault that was fixed by another engineer, so I enquire if the fix has been suitable. As I get to the equipment for repair, a virtual reminder has been left by the installation engineer, which I read on my display before starting. As I start to work notes about similar faults are brought to my attention, which makes it easier to track down the problem. In this case I know I will need to liase with one of my colleagues at some point who is a specialist in this area. There are a number who I could talk to and from the background 'noise' from the wearable I know who and when they are available. I have finished the repair work, and it is interesting that the wearable is showing me that there were a number of faults that happened at about the same time of day indicating some other, common cause that needs to be tracked.

The Highway Helper

Source:

http://www-3.ibm.com/pvc/tech/bluetoothpvc.shtml

Description:

Peter is going to visit some friends in Germany during his vacation. The car that he is driving has a vehicle navigational system. Information about the cars current location (perhaps through a Global Positioning System or cellular triangulation) is combined with map information that suggests Peter to different driving routes that help him to reach his final destination. After some time Peter is starting to get really hungry and wants to find the nearest fast food restaurant. He enters a question to the vehicle navigational system to locate the nearest

McDonalds. The navigational system then locates the nearest McDonalds restaurant and gives Peter directions to find it.

Peter then continues his drive, and after some time the car's sensors have detected a problem and notifies Peter about the problem via the Bluetooth in-vehicle network. It seems like the car is in need of service within the nearest 20 miles. Peter decides that a service might be appropriate to conduct during his stay at Stockholm, so he gives the navigational system instructions to locate and notify a service center nearby his final destination. If a major problem would have aroused the navigational system could have initiated a call for roadside help or located and given Peter instructions so he would have been able to get to the nearest service center.

Peter did not plan for a stay over at a motel during his trip, but when the evening comes Peter starts to feel very tired, and decides to spend the night at a motel. He instructs the navigational system to locate the nearest motel and make reservations for him for the night. When the reservation has been done, Peter is given directions to find the motel that the navigational system made reservations for him at.

Recent purchasing history → acknowledgement about special offers

Source:

http://swig.stanford.edu/public/projects/papers/mobicom99.pdf

http://www.dmreview.com/master.cfm?NavID=68&EdID=5201

Description:

Opening your refrigerator to take out a soda, you notice that there is only one can left. You can scan its UPC with the scanner attached to your refrigerator. This action adds soda to your shopping list. You plan to have guests over this weekend, and make a note on your ScreenFridge that you need to replenish your supply of drinks by Friday.

The next day, on your drive home from work, you happen to approach a local supermarket. Your GPS-enabled AutoPC, previously informed by your refrigerator that purchases need to be made, signals that you are near a grocery store, and if it is convenient, that you should stop by the supermarket on the way home. Suppose you do not act on the opportunity, and Friday rolls around and you still have not visited the supermarket; in this case, a message to buy drinks is sent to your pager, or an alarm is triggered in your PDA, or both.

Mary is the mother of two boys (ages 9 and 12) and she is married to an avid reader, Tom. She has been shopping at a particular mall for several years and has purchased numerous items.

Mary walks into the mall with her wireless PDA one Saturday and logs into the mall's server. Retrieving Mary's recent purchasing history as recorded on her preferred customer cards, she is presented with specials on the following:

- Baseball cleats and bats to go with the baseball glove that she purchased last week for her older son.

- A two-for-one special on the Sony video games that her 9-year-old plays all too often.
- A discount coupon for the new John Grisham book. (She has purchased the last three for her husband.)

For ease of review, the offers are categorized on her PDA similar to the mall directory (men's apparel, sporting goods, etc.) and once she expresses interest in a special, the store is highlighted on a displayed floor plan. Mary is better served because she is able to pick some of these items up at discounted prices. The stores benefit from sales that probably wouldn't have occurred under other circumstances.

A spontaneous button "Give me a fun …"

Source:

SICS document

Description:

The possibility to get tips on relaxing or fun activities nearby. Answers the question "If I get 40 minutes free time, what could I do, here and now?". Tips on music, free spa slots, cafes etc. There is need for contextual information, but it does not have to be user adapted. It is more important to be relevant with respect to location.

The virtual guide – booking of meeting room

Source:

http://www.hpl.hp.com/techreports/2001/HPL-2001-215.pdf

Description:

Ben needs to address some major issues to his colleagues and need to book a last minute conference room since the meeting was not planned in advance. He uses his virtual guide that senses what building Ben is located in and automatically displays a listing of available meeting rooms at the specified meeting time.

Printer Localization

Source:

http://www.csd.uwo.ca/faculty/hanan/Perv/Scenario.doc

Description:

Just before 10 AM Mike heads to Conference Room A to meet with his lead developers. On the way, his badge beeps and he sees that he has a message from Tom, one of his lead developers, who is away at a conference. Mike opens his PDA and selects PRINTERS. He enters "Conference Room A" and three rooms near Room A appear along with brief descriptions of the printers. He selects one of the printers. The message from Tom is printed and Mike picks it up on his way to conference room A.

DEEP DIVE

Chapter 6 Sharing digital goods: The potential importance of giving

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Introduction

Many people like to share and participate in communities of sharing. Technologies and mechanisms for supporting models of sharing are also of potential benefit to service providers. An important part, in order to help both groups, is to identify the sharing needs, interests and motivations of end-users – and viable design features of technologies that can support them. Computer networks, the facilitation of computer-mediated communication and the digitization of anything possible have created a new arena for sharing. Systems like Napster, have created a lot of debate and further strengthens the idea that people want to share digital goods (in this case music). But, this is just the most visible sign of many other forms of computationally-mediated sharing. Systems like Napster, Usenet news, eBay, SETI@home et c work partly to the fact that people are willing to share or donate to the public good.

People want to share for a variety of reasons. These reasons/motivations are often part of a social process and resulting in social actions. The general approach has been that people are primarily acting in self-interest. The act of giving in sharing contexts has, to some sense, been overlooked. Motivations become interesting in the aspect of understanding whether giving is in fact related to, or perhaps even driving, popularity of sharing technologies and services. In other words, what particular motivations drive people's decisions to contribute in a specific sharing context? The motivations for sharing could be of fundamental interest, both as a scientific research area and as a platform for developing services and tools to support them. In work situations several attempts has been made to facilitate sharing and formal/informal communication. For everyday recreational use, few studies have emerged. As mentioned earlier, there are existing tools being used to support sharing, as well as tools to support socializing/communicating. However there are few that effectively combine these, and appropriately consider the social and motivational aspects of everyday recreational sharing (the giving aspects in particular). The question is then: could giving in itself be one of the central aspects that determines the popularity and success of "sharing" activities, communities, tools, and services?

Background

What evidence is there that giving might be a significant aspect of the success of sharing technologies and services? Other work relevant to studies of recreational

sharing is mainly on gifts and gift-giving, technology-mediated sharing and virtual communities. The studies of gifts are often of anthropological or ethnographic nature. A controversy in the field is whether a gift can be free or altruistic. Several authors find it compelling and show that there are not always simply selfish motives behind gifts and giving (Berking, 1999; Godbout & Caillé, 1992). " The gift involves a comparable tangling of levels: an immediate return in the pleasure of giving, the counter-gift, chain reactions, an amplification of the donor's consciousness, reinforcement of the bond – everything that comes to pass with a gift occurs at many interacting levels, in a tangled hierarchy, forming strange loops that the model of the market can view only as a paradox…" (Godbout & Caillé, 1992). When it comes to virtual communities of sharing and sharing from a technology-mediated perspective, the viewpoint has for long been one of instrumental issues and work-related activities (Constant, Kiesler, & Sproull, 1994; Constant, Sproull, & Kiesler, 1996; Staples & Jarvenpaa, 2000). More recently a few studies on more recreational types of sharing has been conducted (B. Brown, Sellen, & Geelhoed, 2001; B. A. T. Brown, Geelhoed, & Sellen, 2001; Giesler, Mennicken, & Pohlmann, 2001; Golle, Leyton-Brown, & Mironov, 2001; Kollock, 1999; Lee, 2003; Levine, 2001). The findings of these studies all have bearing on the understanding of motivations for giving and the design features to support them. Many suggest that sharing and giving are important, but most of them concentrate on purely selfish motives and free-rider problems. Research both into gifts, computer-mediated sharing and communities (virtual and geographic) indicate that people often act out of, at least what seems as, altrustic behavior. The need to examine altrustic behavior more thoroughly is pointed out (Levine, 2001).

Incentive structures for sharing

Structural conditions of technology in combination with group norms and incentive structures (and the individual motivations) for sharing create the specific context in which computer-mediated sharing takes place. Incentive structures that could be present in such a context are for example: extensions of identity, anticipated reciprocity (generalized or individual), generation of personal ties, feelings of fariness, improving reputation/status/fame/respect, sense of efficacy (feeling useful, trusted and valued by others), expanding taste and learning, filling a need, filling a gap in distribution chain, contributing to community archive, likeliness of equal quality reciprocity, low cost, gain from externalities, warm glow, identity persistance, group cohesion (loyalty, boundaries, attractiveness, barriers et c), ongoing interaction, sharing history, community size, topic range, subgroups, social embededness and ideological reasons.

Implementations and Communities that indicate the importance of Giving

Communities and implementations of sharing that exist today are of many kinds. Several have been very successful. As will be seen, several does also indicate the importance of giving. Usenet newsgroups, one of the elderly "inhabitants" of the Internet, often doesn't require users to contribute. In fact, lurking is encouraged in many newsgroup FAQ:s. Still, there's a vast amount of sharing taking place in newsgroups. Further, the structures and rules of contribution and reciprocating are constantly discussed and hence, evolving. So, to post something in the correct fashion (both socially **and** technically) in a newsgroup is not trivial. Other online communication forums (weblogs, wikis, chats, bbs's) also show that people are willing to contribute. Some forums have grown extremely popular. This in combination with whether the contribution is substantial and has made many online forums implement features for addressing reproachable conduct and size issues.

Also, the open-source community is, of course, one of sharing. Linux, as exampled in (Kollock, 1999) carry a lot of support for the claim that giving is important. Kollock suggest two major reasons that people would not contribute (and instead free-ride): first, the system is open-source, hence it would be provided to anyone who wants it, even if I don't lift a finger; second, it is a **large** project and if there's not enough people contributing, the project is likely to fail – so my efforts (if any) could be wasted. Still, a lot of people contributed time, effort, code et c.

Seti@home is devoted to the search for radio signals possibly indicating extra-terrestrial civilizations. The SETI project obviously relies on people's willingness to give (in this case processing power). It can be seen as a many-few type of ratio between givers and takers (although it can be argued that the result might be beneficiary to all humankind, and hence a many-to-many situation). Whether SETI@home users can be seen as part a community (virtual or not) is questionable. There are newsgroups, mailing lists and web pages devoted to SETI, and in that way there are communities surrounding the use of the sharing application.

Hotline is a client-server based protocol/application. It has established itself as a tool for accessing copyrighted material (although it is designed as a general file-sharing tool). Hotline has communication capabilities both in the form of BBS and IM. Since it is a client-server system, it relies on server admins. Server admin is usually the person running the server application on his/her machine, but it could also be some other person(s). The admin(s) have exclusive power to control the frame of the community. They decide on ratios, rules, accounts, co-admins etc. Therefore the motivations for sharing could differ with the particular communities on Hotline. In general, though, one could say that HL is very rich on servers "trying to be" communities. That is, *present* server objectives and rules clearly aimed at trying to establish loyalty, reciprocity and endurance. Most community-servers on HL keep ratios as a way of keeping the balance of

givers and takers. Hotline is interesting for several reasons. One of the reasons is that it has moved from being viewed as a free and giving technology to being an account and ratio restricted technology. In the larger HL community it is often referred to "the good old days of HL, where information was free". Perhaps a bit romantically exaggerated, the spirit of then is often remembered as still keeping a good ratio between givers and takers. HL is also interesting because it seems to support identity persistence. Several servers keep (some of) the same members (server admin account exchange is not rare), or at least what seems as the same persons with the same nicknames (stealing a nick in the HL community is often seen as reproachable conduct). On a whole scale HL can be seen as many-to-many file-sharing, while the individual servers are often few-to-few.

Future Research

The incentive structures and individual motivations of giving is embedded in communities (both computer-supported and non computer-supported). However, it seems unclear how they should be empowered in the structural conditions of technology. Said another way, there's a strong connection between end-user communities and the social structures of giving, but it is not clear whether or how strong is the connection between the embedded structures of giving and the technology used for giving. It seems that the social activity of giving has been overlooked when it comes to support in computer-mediated communities or software used by groups. Important questions to answer are:

- could the ability (or not) to give be one of the important reasons for the popularity of sharing communities/services?
- what existing giving needs are (or could be) supported, and how?
- are there any new classes of giving acts that seem to be arising in the context of new technology?

These questions have received little academic attention. However, answering these questions would bring benefits to both end-users and service providers. By meeting important sharing needs and motivations in end-users, new services can bring an added value to the use of these services (that may be worth paying for) and thereby be successful. By not creating any added value (especially in the form of supporting sharing motivations) and charging fees, however, new services are likely to fail. The answers to the questions above would then be of interest to (cultural) content providers, because it enhances possibilities for product exposure, different formats, recommendations, customer ethics, market research and quick market information updates.

References:

Berking, H. (1999). *Sociology of giving*. Thousand Oaks, Calif. ; London: SAGE.

Brown, B., Sellen, A. J., & Geelhoed, E. (2001). *Music Sharing as a Computer Supported Collaborative Application.* Paper presented at the ECSCW 2001, Bonn, Germany.

Brown, B. A. T., Geelhoed, E., & Sellen, A. J. (2001). *The Use of Conventional and New Music Media: Implications for Future Technologies.* Paper presented at the Interact '2001, Tokyo, Japan.

Constant, D., Kiesler, S., & Sproull, L. (1994). What's Mine is Ours, or is it? A Study of Attitudes about Information Sharing. *Information Systems Research, 5*(4), 400-421.

Constant, D., Sproull, L., & Kiesler, S. (1996). The Kindness of Strangers: The Usefulness of Electronic Weak Ties for Technical Advice. *Organization Science, 7*(2), 119-135.

Giesler, M., Mennicken, C., & Pohlmann, M. (2001). *The Song Behind the Screen: Musical Cyberconsumption in a Global World.* Paper presented at the Eighth Cross-Cultural Research Conference, Oahu, Hawaii.

Godbout, J., & Caillé, A. (1992). *The World of the Gift* (D. Winkler, Trans.). Quebéc: McGill-Queen's University Press.

Golle, P., Leyton-Brown, K., & Mironov, I. (2001). *Incentives for Sharing in Peer-to-Peer Networks.* Paper presented at the EC'01, Tampa, Florida, USA.

Kollock, P. (1999). The Economies of Online Cooperation: Gifts and Public Goods in Cyberspace. In M. A. Smith & P. Kollock (Eds.), *Communities in Cyberspace*. London: Routledge.

Lee, J. (2003). An End-User Perspective on File-Sharing Systems. *Communications of the ACM, 46*(2), 49-53.

Levine, S. S. (2001). *Kindness in Cyberspace? The Sharing of Valuable Goods On-line.* Paper presented at the EICAR 2001.

Staples, D. S., & Jarvenpaa, S. L. (2000). *Using Electronic Media for Information Sharing Activities: A Replication and Extension.* Paper presented at the ICIS 2000, Brisbane, Australia.

Chapter 7 Distributed user interfaces

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We often perceive an application as a program running on a single computer, which shows its result on a single screen. Although it is possible to run applications remotely (such as in the VNC and X-Windows client–server models), the application is still associated to a single workstation, or screen, from an interaction perspective. This approach has been the standard model for user interactions since the introduction of CRT terminals in the late-1970s and early-1980s. Basically, you interact with a mouse, a keyboard, and a screen.

Researchers started experimenting with devices for ubiquitous computing in the 1980s. These early devices represented a departure from the traditional view of computing and information processing, and a move towards distributed computing devices in the human habitat. During the 1990s, ubiquitous computing has gained momentum slowly and we are now at the point where (1) the proliferation of traditional computing has begun to saturate current information-technology demand and where (2) suitable hardware for small networked devices is becoming available.

Distributed user interfaces

An application with a distributed user interface can interact with users through many devices in different locations. The application is not restricted to the terminal—it is available throughout your living and working spaces. You use one system with many user interfaces to accomplish your task.

Imagine you are making a presentation. Today you might be running MS PowerPoint on a laptop computer connected to a projector. Here, your connected system consists of two screens (a laptop and a projector), but yet you have difficulties managing your presentation because the presenter's screen (the laptop) only shows the current slide and does not provide the speaker's view of the presentation. For example, you cannot see annotations and the upcoming slide on the laptop. A presentation application with multiple user interfaces could provide separate screens with different information for the presenter and the audience.

Tear-off applications

You can package the current state of your application in a small object (e.g., a smart card), carry it to a new location, and resume the application in its current state.

Knowledge and document management

Despite the 1980's vision of the paperless office, paper is still a major medium for information storage and processing. We must acknowledge that paper will not disappear as a medium and that we will continue using paper for a long time. Smart document can be containers and we can do research on their relationship to knowledge management.

Chapter 8 Interaction models

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Peripheral interaction

The Senstrip represents a type of application that will not, and should not, attract the user's primary attention except in rare cases. It is considered as an enhancement of the device itself; the idea being that the user should be able to use the device's main functionality (e.g., making phone calls, managing a calendar, taking pictures with the on-board camera) just as well as without the Senstrip. The user only interacts with the Senstrip when someone or something enters into the user's proximity sphere and nicely calls for attention. This kind of interaction differs significantly for most design situations, where it is taken for granted that the primary focus is on the application, and there is a delicate balance between making the user aware of changes in the environment and intruding on the user's attention.

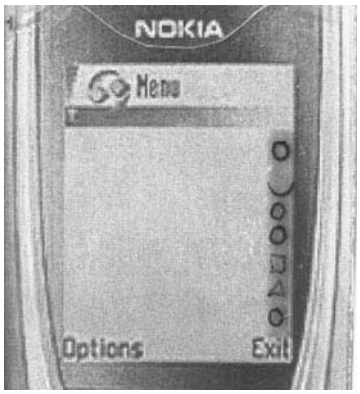

Figure 4. Sketch of the P2P browser Senstrip

Design Issues

The main problems related to this type of peripheral interaction could be summarized, "How should the Senstrip demand attention?" Since the screen real estate is usually extremely limited on handheld devices, almost everything outside the Senstrip will be considered as a theft of space, for example. Therefore, the traditional alternatives of modal or non-modal dialogs disappear, since any dialog that pops up on the screen will intrude on the application that the user is currently focussing on.

In some cases the user will probably not want to be disturbed at all, for instance when s/he is taking a picture of something, or is dialling a number (trying to keep the number in working memory). Thus, there is also an issue of in what task contexts the user will accept being notified of an event. Could different signals be used in different contexts, without completely loosing consistency?

A fast-changing environment presents another major issue. When the user is in a dense environment objects and other people may come and go too fast, so that the user has no chance to perceive all the changes, or even the important ones. What are some of the possible ways to filter, select and limit the flow of objects in the Senstrip? (e.g. by rigidly limiting the number of objects so that only the most recent objects are shown, by allowing only objects of a certain type or with a certain match pattern).

A third issue is that of proximity of other objects/people. Proximity is an important aspect in personal communication. Our perception of proximity to another person governs the way we speak; what we say, how we say it and how loud we say it. Proximity is also an extremely fine discriminator between objects and people, and as such it could be used to navigate among representations of objects on the Senstrip.

Unfortunately, communication protocols do not allow for this type of discrimination, i.e., if something is within Bluetooth range, it's "in", otherwise it's "out". However, there may be ways around this problem. Could, for example, the order of the objects in the Senstrip, combined with a focus policy help to provide a sense of closeness?

Finally, there is a balance between in-focus and not. In some cases the user will have full focus on the Senstrip, for example when he or she wants to communicate with an approaching peer. At such occasions it may be necessary or at least desirable that the Senstrip can attract more perceptual space.

Research issues

What is a feasible way of finding out whether the user has focus on the Senstrip or not?

How can the split attention of being both in a social situation and engaging with technology be supported?

Exchanging data with someone

One of the primary applications of peer-to-peer communication is the ability to exchange data of any format. With all such data exchange there is the inherent trade-off between simplicity and integrity. As a principle, it should be easy to share data with the right peers, and at the same time impossible for (unwanted) peers to unwantedly access data.

Design issues

In an ordinary networked environment this is usually solved by setting up different access privileges for different (groups of) users. However, in an ad-hoc network context, this planned and administrated access control is in conflict with the underlying concept. We have considered three different ways of avoiding the user having to administrate access rights.

1. The device may have a shared area with open read/write access for any other peer in the network - a “give-and-take” (GAT) area. The surrounding system of the device (e.g., other files and executables on board) would be secured from this area, so that, for example, no executable could be invoked from the shared area. This model would be easy to understand for most users and a use pattern would probably develop, where the user doesn't put anything in the shared area that he or she doesn't want to share with everyone. One of the problems, however, would be that the device is open for information push (including ads and spam), which could easily flood the GAT area.
2. As a remedy to the aforementioned problem, it has been suggested that the area should only have a “give” functionality, so that information could not be pushed. The metaphor is that of a tray, on which the user places objects that he/she wants to share. In terms of human communication patterns, the question “Could you give me the X object?” would then translate to “Could you place X on your tray so I can take it?”, since “giving” would be impossible. At a first glance, this may not be too much of a problem, but there are situations where this limitation could be annoying, such as when two youngsters are exchanging hockey-cards and are involved in an intense interaction with the device communication closely associated with the verbal communication. A second problem is that this non-push policy would also hinder, or at least be inconsistent with, the situation where a user wants to push information to e.g. a printer or overhead projector.
3. A third solution would be to have an open area and a restricted one, where the restricted part of the area would be accessible only by explicit consent. On the other hand, this would probably be a source of confusion and mistakes.

A different issue related to the GAT area is that of copyrights. From a business perspective, it is important that copyrighted material cannot be moved from one person to another without notifying the copyright owner. On the other hand it is equally important that copyrighted material is easy to transfer, given that the receiver has properly acquired the right to use it. A business model for this scenario has been outlined, but several issues remain to be solved, including the fact that in a ubiquitous computing environment, copyrights cannot be attached to devices without causing severe vexation. They should instead be associated with the consumer in some way.

A third issue is that of multi-peer communication. The screen real estate of a typical handheld device is very limited, and to present multiple shared spaces with potentially many objects in each is a difficult design issue. On the other hand, multi-peer communication is very natural and common from a communication patterns perspective, and thus it is important to find usable design solutions.

Research issues

How large is the importance of something being here or there to users?

If the importance is large what is meant by seamlessness and how can it be created?

What is the conceptual model and the practical consequences of a shared and distributed information space?

Matchwatching

Matchwatching emanates from the common situation where people want to find similarities between each other, as a trigger for conversation, or "ice-breaker". A typical example might be the host who welcomes a guest for a meeting and takes her to the coffee machine on the way to the meeting room. What they would typically talk about is something that is "safe" and inoffensive, like the weather or how the trip was. The match watcher supports this situation by suggesting other topics of conversation based on similarities or matches between two personal profiles.

Design issues

Matchwatching will necessarily depend on some sort of personal profiles, and there are at least two inherent difficulties with such profiles. One problem is that of creating and maintaining such a profile, and another problem is related to what we as individuals want to reveal and display about or personal life or preferences.

People may be quite cautious about what they choose to display and reveal about themselves. Two individuals that know each other only remotely or on a professional basis may not want to reveal even fairly "harmless" personal information, such as "I like Rioja wine" or "I take vocalist lessons", whereas more general information such as "I'm interested in gastronomy" or "I'm interested in music" may be acceptable. However, the level of detail that we want to reveal about ourselves is highly context-sensitive. Consider a situation when the vocalist is at a conference. Then the statement "I'm interested in music" would seem rather toothless, and in fact "I take vocalist lessons" may be more adequate, however the fact that she likes Rioja wine may still not be appropriate to advertise. Thus, the level of detail that a person wants to reveal about him- or herself is strongly dependent upon the context. In our social interplay, we as humans know and feel these subtle borders, but they are extremely difficult to formalize and transfer to a device, and for the match watcher feature to function well and be accepted it is important that these borderlines are not crossed.

An example solution to this problem could be to keep a set of trusted friends, so that the device would know what level of detail to reveal. The set could be specified by the user explicitly, or created dynamically derived from what individuals the user seems to communicate with on a frequent basis. But in the former case there will be a heavy administrative burden on the user, and in the latter case there is an obvious risk that (embarrassing) mistakes will be made by the simple device.

Furthermore, for the match watcher feature to be successful, it has to be able to provide interesting matches, i.e., matches that are not too general. The fact that another person likes music may not be enough to trigger a conversation. So there is this balance between revealing details and still not cause embarrassment. One proposed solution to this problem may be to have a fairly detailed profile, but not reveal all the details. The match watcher could do the matching at the detailed level ("you both take vocalist lessons at the Music Academy"), but only reveal the fact that "you are both interested in music", and then leave the analysis work to the users, allowing them to decide what level of detail they want to reveal depending on the situation. This would probably also stimulate to conversation to a greater extent than if the users were only presented with an established fact.

Research issues

Given various contexts, what are some significant (as in "makes people want to start a conversation") matching aspects, and how could these be formalized?

Network assistance

One of the major reasons for Ericsson to closely follow the development of P2P communication is the potential it provides for network-assisted services. As P2P services spread and grow in popularity, new communication patterns will develop, and it is reasonable to believe that users will want to maintain connections even beyond close proximity (e.g., bluetooth-range). This is where network assistance comes in. The guiding principle should be to provide a seamless communication link, so that the user does not have to worry about setting up different protocols for different situations or distances. Indeed, this presents several technical problems, but it also involves some difficult design issues.

Design issues

Within AmIGo, we came up with the concept of "stickiness", i.e., making an object on the Senstrip stick, even when the object moves out of close proximity. The basic idea is that if the user decides that he may want to communicate with someone or something (e.g., a printer), he puts a frame on the object and thus prevents it from disappearing from the Senstrip. As long as he is close to the object, a short-range protocol will be used, but as soon as he moves away, the device will switch to another communication protocol (e.g., GPRS).

However, there are two main logical design issues involved with this stickiness. First, If user A makes user B's device sticky, does that also imply that user B sees A as sticky? In some situations this may be convenient, but it also breaks the general rule of user control. And it may be a problem if several users decide to make user B's device sticky. Then user B's Senstrip would soon fill up with sticky devices, obstructing and wasting screen space. This problem is also

related to the second one, namely how to make charging a natural part of network assistance.

In the above example, should only the initiator (user A) be charged for the network assistance (the GPRS traffic)? Or should both A and B be charged? If both are charged, then user B must be given the choice to accept or decline an invitation from A. This would add an extra step and thus make the entire connection a little less smooth.

Furthermore, it could be argued that the act of making another object sticky implies that the user accepts the extra cost for network assistance. But if the general principle of seamlessness is obeyed, there is no way for a user to know when the communication is actually switched from e.g., bluetooth to GPRS, and thus the user has no real control over the total cost. The user may believe that as long as he is in the same room as the object he is interacting with, the communication is free, but for several reasons this may not be the case.

A remedy to this problem would be to give a more or less subtle indication that the ongoing communication is charged. But there is a fine balance between giving a clear and unambiguous indication and intimidating the user from using network assistance.

This problem is not only related to the stickiness concept, but arises each time a user moves out of bluetooth range during a communication session.

Research issues

What constitutes the feeling of being on-line?

How do people experience proximity of different kinds; physical, logical, conceptual, task-driven etc.?

Dynamic information spaces

An ad-hoc environment, just as any natural environment, is dynamic in its nature. Things, services, people and concerns come and go. Within traditional HCI and interaction design a lot of the dynamics is hidden in sequences of dialogues, and is even avoided by design. Dynamics in today's interfaces is introduced as animations e.g. to show progress or to give life to anthropomorphic characters in the interface or with the argument that it supports the user in finding and understanding the mechanics of the interface and the effects of their actions. But the actual dynamics of the underlying structures or information spaces rarely is designed for, at the micro- as well as the macro-level.

Design issues

In Senstrip we decided to have a static space where all objects appeared, and that you should be able to scroll the list. In effect the list of objects became a history list, the oldest was situated at the bottom of the list. While being passive, having the terminal in one's pocket, this would support the user when deciding

to use it. While being active we needed to add a means for providing focus. We solved this by moving an accessed object to the top of the list. We also discussed whether the list of objects would be moving or not, as a ticker of available objects.

The dynamic information space of an ad-hoc network with peer-to-peer services has many dimensions. The easiest to grasp is the dimension of available objects or peers. The second is the services provided by a specific peer. As long as they are only singular peer-dependant it is a fairly easy design task given a specific interaction model. But services might be depending on software or technology from two or more peers, or is contextually or place dependant. Service attention-making and discovery become more difficult under such circumstances. Add then a layer of privacy onto this, where you share services only with a specific group, defined in some more or less complex way. The dynamic information space of services thus become a complex compound, consisting of matching service possibilities of peers with service sharing of peers with contextual and place dependencies with privacy policies.

Research issues

What are the provisions for designing with animation on a small screen?

How do people perceive and construe the available possibilities in a given situation, where services depend on a composite of different users preferences, the possibilities of a device and the offers provided through a network?

How do users perceive a space of continuously updating information, where the pace and rhythm of update is beyond the user's control?

How may we design for interaction with moving objects and concepts?

Other issues

A set of other issues, pertaining to design as well as research on interaction models was documented during the project. These will be reviewed shortly here. With possibilities for having polls and poll stations where you can submit how you liked the movie you just saw, what kinds of detergent is best etc. the design space for recommenders and consumer power grows larger. Using a poll within a group of people it is possible to create micro-democracies, and can of course be used for macro democratic polls and decisions too.

The kind of ad-hoc environments that we have envisioned in the project sometimes evokes the idea that there should be policies guiding access rights and other issues. In certain situations it is important for a presenter to have full control over what is shown on the projector screen, while in some situations it is important for people to bring their own views and be able to express them without moderation. Administration of such rights and setting up equipment to handle a set of different layouts puts more requirements on both technology and the organisation around the handling of the equipment.

A lot of P2P or instant messaging applications thrive on possibilities for synchronous communication, e.g. push-to-talk. In the case of Senstrip, with a chess game which is played by two peers (maybe without knowing or seeing each other) at a library or a café, has a synchronous as well as an asynchronous character. When designing such applications it is a delicate balance to decide whether the user should be notified when the other player is accessing the game, or when s/he is actually making a move. That is, do I as a user wish to go from a passive relationship to my device and the game to an active relationship every time my opponent accesses the game or when the move is made?

All in all designing a cell-phone based in and out of the pocket application family promoting and supporting interaction and communication in ad-hoc and dynamic environments in everyday life for passive and active peers is an inspiring task. There is still some way to go before we can realize the potentials of what this actually means for people living with this kind of technology. Trying to realize some of it is one important step to create better understanding of the issues and better designs for the future.

Chapter 9 Peer-to-Peer Technology in Nomadic Networks

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For Personal Devices and Ubiquitous Interfaces: The problem to solve is how to provide a wide scope of networking functions in a completely decentralized and unmanaged network (an ad hoc mobile nomadic network).

There are two available network technology modes that address this problem; wireless Internet access (WAP, Bluetooth, wireless data, etc.) and wireless broadband access (LMDS, MMDS) [7].

Peer-to-Peer implementations are based on having every node treated as an access point (AP). The Internet access mode is typically based on an IP network. The broadband access mode is based on mobile radio networks. Both systems have similar structures in their routing algorithms.

The routing architecture is a central module within the unmanaged networks. The routing algorithms find paths on a dynamic topology. These routing architectures open new vulnerabilities to security [§ 5.2.3.1].

Both networks show similarities in their routing principles. These algorithms adapt to the dynamic self-organization characteristics that these networks exhibit [7].

5.2.1 Short History of Peered Networks

Looking at TCP/IP from an historical point of view facilitates understanding the inherent advantages in Peer-to-Peer networks.

If we follow the history of the origins of TCP/IP, it was specified for the American Department of Defense (DOD). Their first concern was security of the information. The security of premises (grounds, buildings, rooms) had already been worked out and maintained by well-defined policies and training [8].

Concern 1: Security of the information.

Their second concern was sharing information between different makes and models of computers.

Concern 2: Interoperability, machines of different types and kinds could be interconnected.

They also wanted a decentralized system so that if part of the system were destroyed, the remainder could remain functional. Critical services must not be concentrated in a few vulnerable failure points.

Concern 3: Security of the hardware components must be decentralized.

In effect, what they wanted was a network with no failure points at all. If a bomb hit any part of the network infrastructure, the network still functions.

These were the requirements that led to the development of TCP/IP. The original decentralized vision of ARPAnet still survives in TCP/IP. There are two important features of TCP/IP that provide for this decentralization:

1. End node verification
2. Dynamic routing

Number 1; all the network nodes operate with equal rights (like peers). It is the end nodes that verify the transmissions. There is no central control for overseeing the communications.

Number 2; note that dynamic routing is addressing concern 3 as well, because connections can follow multiple paths.

With no central control and the ability to follow multiple paths, if a sector is bombed or otherwise non-functional TCP/IP can follow whatever other routes that survive.

In effect, this is why congestion in large degree is handled by TCP/IP. Congestion at routing nodes puts the nodes into a non-operational state for incoming packets, etc., therefore, another route is chosen for the packet. If a server is congested, this is not a feature that TCP/IP was originally designed to handle.

Today there are new types of congestion because of the client/server domination in the Internet. In other words, the original notion of decentralization has given way to interconnected centralized servers (a topology that Bluetooth mimics in miniature). This offers challenges to TCP/IP that it was not originally designed for.

Peer-to-Peer in some respects is a step back in time, where decentralization reaches its ultimate end at the edges of the Internet. A peer represents a leaf-node. In the old days the terminals were not regarded as leaf-nodes. It was the mainframes that the terminals were connected to that were regarded as the leaf-nodes. Leaf-nodes in Peer-to-Peer connectivity require computational power.

Peer-to-Peer is in part a return to the original design specifications of TCP/IP. However, there are some differences today that require consideration.

We have taken this point of view to show that Peer-to-Peer and the original specifications of TCP/IP have much in common. This helps explain why the Internet carries Peer-to-Peer connectivity so well.

Finally, with respect to TCP/IP, Peer-to-Peer can establish virtual addressing methods that allow Peer-to-Peer networks to ride on any network configuration that uses IP addressing. In effect, this allows the formation of ad hoc networks that are functionally independent of the hardware they ride on [8].

5.2.2 Ad Hoc Networks

5.2.2.1 Distributed Computing

Peer-to-Peer offers a platform for distributed computing that has yet to be fully exploited. Let us review the features of general-purpose distributed computer systems from the user point of view.

General-purpose distributed systems are designed to enable the individual computers of which they are composed to use shared resources in the network. Users are given the impression that they are using a single, integrated computing facility, although the facility is actually provided by more than one computer and the computers may be in different locations.

In this context, this impression is denoted by the word transparency.

Transparency is defined as the concealment of separation, such that the system is perceived as a whole rather than as a collection of independent parts.

'Distributed' has gone through an evolution in distributed systems. There are three well-defined stages in this evolution that set the stage for a fourth generation of hard-wired distributed systems.

1. Distributed in the sense of various nodes, some autonomous, some not, in the network, some having different functions, but no necessary transparency in their functioning or location, or means of implementing. The user perceives the network as a collection of entities.

EXAMPLE: A computer may connect to another computer, a computer may connect to a printer, etc.. For each call, the user (caller) has to decide where to call and have a means to make the connection interoperable.

2. Distributed in the sense of various nodes, some autonomous, some not, some having different functions, but working together as one entity. Individual nodes and functions are transparent to the user.

EXAMPLE: With respect to the system database, one node may be a database for a bank, another a database for a realtor, etc.. This collection of databases collectively may be referred to as the database of the distributed system. 'Transparency' is the feature that distinguishes this form of distributed database. If the transparency is not sustained, then it is not a distributed system in this sense.

3. Distributed in the sense that all computing resources in the network are shared, the network is the computer, and transparency is everywhere sustained.

EXAMPLE: With respect to a database, the difference with respect to this form of distributed database is: instead of the bank having one central database (with backup duplicate), the database itself is distributed among the network nodes of individual autonomous computers. For simplifying security, this distribution may be only in the bank network. However, it is feasible that this database can be distributed anywhere in a global network.

It is the third form of distribution that has the largest capacity for scaling. Each computer has equal rights in terms of functions; the network therefore accommodates the addition or removal of a computer without any special changes to the operating system.

Closer to current feasibility we have a fourth form of distributed systems. It is a hybrid of 2 and 3.

1. Distributed in a hybrid sense, there is a mixture of Peer-to-Peer platforms (general as well as special interest groups) and individual autonomous special purpose systems (medical, legal, banking, GIS, etc.) with transparent linkage.

Concomitant with this fourth form of distributed systems is the development of wireless connectivity. One of the remarkable features of wireless connectivity is its simplification of interoperability. Furthermore, it facilitates dynamic network topologies and accommodates the physical mobility of its nodes. However, this adds new modes of security requirements. Security concerns are addressed in § 4.2.3 below.

This opens the door for ad hoc nomadic mobile applications. It is this last and perhaps fifth form of distributed systems that is likely best suited to Project AmIGo. With respect to the personal devices, the wireless connectivity can be ad hoc and nomadic, and their use for Project AmIGo requirements can be matched with Peer-to-Peer specifications.

5.2.2.2 Bluetooth

Bluetooth operations are based on proximity RF. It allows transparent wireless communications in static or dynamic network topologies. This is not a new technology; it is a new use of existing technologies. The Bluetooth chip can operate on both circuit and packet switching modes. It provides both synchronous and asynchronous data services.

Bluetooth uses piconets in scatternets. In a **piconet** a device is picked as *master* and the rest serve as *slave*s. Some of these slaves can function as masters in other piconets, etc. In a **scatternet**, multiple masters must establish links to each other. The scatternet concept is used as a clustering of piconets and piconets are used as a clustering of individual devices. From this arrangement we can see that we have the masters as the bottlenecks in a Bluetooth network [9].

In a pure Peer-to-Peer network the client/server, master/slave, concepts do not apply. In pure Peer-to-Peer, there is no master, there is no slave. Therefore, Bluetooth may not be seen as P2P at the transmission level due to the master-slave architecture. However, the master-slave paradigm only addresses the physical exchange of information and may not relate to applications that run on top of Bluetooth-enabled devices. These applications may therefore employ P2P functionality. This is similar to the way that P2P rides on the Internet using virtual addressing.

P2P implementations are based on having every node treated as an access point (AP). In the AmIGo Project, the use of BlueTooth may qualify as P2P connectivity because of the limitations imposed by the constraints of the individual communication devices (currently Nokia 7650), which limit communications to a one-to-one basis. In the BlueTooth architecture every master can function as a slave to another master. Theoretically, this suggests that BlueTooth network connectivity could itself be trimmed to a P2P architecture if every slave can also function as a master. The piconets then become overlays on a network of nodes that are reversible according to their direction of connectivity (master -> slave). This eliminates leaf slaves when every node is embedded in a distributed network, which can be represented as a directed graph structure without a leaf. This model needs investigation for its theoretical and practical limits.

5.2.2.3 Other Wireless Platforms

Wireless IP-based connectivity without cells opens the way for Peer-to-Peer implementations, both as virtual networks as well as the hardware (physical network) they ride on. Both the virtual and the physical wireless networks have topologies that may be static or dynamic. In wireless topologies both the virtual network and the physical network can be made congruent in their topologies and this can be done ad hoc.

Today there are many choices for wireless networks [7]:

- Big or Little LEOs (Low Earth Orbit) [10][11]
- CSMA/AMPS Cellular [12]
- GSM-PCS [13]
- Metricom [14]
- SkyTel 2-Way [15]
- TDMA-PCS [16]
- Wireless LANs [17]

5.2.2.4 Ad Hoc Nomadic Mobile Applications

Mobile ad hoc devices can recognize the presence of other wireless devices through sensing the presence of *neighborhood* beacons. Here neighborhood is defined as those devices within the RF range of the sensor. From this we derive the concept of *ad hoc nomadic mobile applications*.

Examples:

In the **home**: exiting or entering; set security alarm on or off, set temperature control, set lights control, set entertainment centers control, set computer telephone answering service, etc…

In the **car**: receive email, telephone calls, roadside-shopping information, receive directions to various services or places, make reservations, etc. It can also cover speed control, toll collection, and synchronization of traffic lights.

In the **office**: download emails, update schedules, track working hours…

While **shopping**: RF tags (they are cheap) can be used for price, sale, and stock information, as well as automatic shopping searches by location (distance) and prices.

While **travelling**: information, schedules, reservations, payment, and automatic check-in all available in real time, no waiting in line except for luggage check-in/check-out or transport entry/exit.

5.2.3 P2P Security Issues (Trust Management)

P2P applications introduce a whole new class of security issues, security within the virtual P2P networks themselves and security with respect to the environments they ride on.

Leaf nodes in mobile ad hoc networks communicate in a self-organizing dynamic topology. The properties of these networks generate new vulnerabilities that are unknown in the hard-wired infrastructures. This section identifies vulnerabilities.

In the case of P2P connections that form virtual networks, security must first be based on the infrastructure. The deeper we can run P2P on the TCP/IP stack the less vulnerable the system is to attack. However, we are faced with a trade-off between vulnerability and interoperability. The deeper in the stack that we run P2P the larger the interoperability problem when we have a many-standard system.

It is well documented that the wireless environment is prone to failures and disconnection and this makes the exchange of data less reliable. When this applies to security, the problems may be more critical with regard to the key management since situations such as lost keys or impossibility to communicate with the owner/distributor of keys may appear. Aside from the specific requirements on the security mechanisms, the use of security in wireless transmission also puts requirements on the communication characteristics. The overload of the communication channel, the need for high data rates, the efficient management of the connection and communication time, are that have to be addressed.

We have chosen the threat modeling and risk assessment approach to security systems, "…you first need to define the threat model, then create a security policy, and only then choose security technologies that suit." [6]

5.2.3.1 Vulnerabilities in Wireless Routing Protocols

The wireless routing protocols have common features that we exemplify here by the specific consideration of the Dynamic Source Routing (DSR) protocol. DSR is for routing mobile ad hoc networks.

DSR can be attacked by any combination of targeting:

a. availability
b. integrity

c. confidentiality
d. non-repudiation
e. authentication
f. access control

Buchegger and Le Boudec [20] found that these may obtain

a. Incorrect forwarding (works until upper layers find out).
b. Bogus routing information or traffic control
c. Salvage a route that is not broken (if the salvage bit is not set, it will look like the source is still the original one).
d. Choose a very short reply time, so the route will be prioritized and stay in the cache longer.
e. Set good metrics of bogus routes for priority and remaining time in the cache
f. Manipulate flow metrics for the same reason
g. Do not send error messages in order to prevent other nodes from looking for alternatives routes
h. Use bogus routes to attract traffic to intercept packets and gather information
i. Denial-of-service attack caused by overload by sending route updates at short intervals.
j. Use promiscuous mode to listen in on traffic destined for another node

With the exception of the last threat, promiscuous listening, all of the threats listed correspond to attacks the monitor component in each node can detect either at once or at least when they happen repeatedly [20].

5.2.3.2 Free-riders and Accountability [22]

a. Non-cooperation

Forwarding: There is a trade-off between cooperation and resource consumption. For example, in an IP based ad hoc network, forwarding packets consumes resources. Since ad hoc networks are generally not constrained by an organization that can enforce cooperation, this generates a need to develop incentives to cooperate in the forwarding of messages (packets).

Security Risk: Nodes may boycott communications. This is equivalent to a denial of service.

b. Malicious Intent

Routing: Routes should be advertised and set up adhering to a protocol that can reflect the structure of the network topology.

Security Risk: Nodes may forward messages to collusion partners for analysis, disclosure, money. This is not only a denial of the expected service; it is an invasion of privacy with malicious intent.

Non-cooperation and malicious intent should be sanctioned. They must be held accountable in a manner that is to their disadvantage.

c. Prevention, detection and reaction: If we could make a perfect prevention mechanism we would have a utopic level of security. All threats to a system are in terms of vulnerabilities and this includes the possibility of bypassing the in place prevention mechanisms. Given this reality, developing methods for detection and response is essential [6].

5.2.3.3 Security Issues Against P2P (the environments they ride on)

1. **Steganography:** Using a freeware utility called Wrapster, a P2P wrapping tool, a user can disguise a .zip file containing source code as an MP3. An accomplice could then download the 'music' file from the user's PC. Millions of dollars worth of proprietary information can be stolen with appearance of a relatively common abuse of company resources.
2. **Encryption Cracking:** Using P2P architecture and over 100,000 participants (using only idle CPU time), Distributed.net was able to test 245 billion keys per second to break the 56.bit DES encryption algorithm in less than 24 hours (22 hours and 15 minutes). The 56-bit DES encryption algorithm is the strongest that the US government allows for export.
3. **Bandwidth Clogging:** The most visible problem with P2P file sharing programs concerns file sharing. This traffic clogs institution networks to the detriment of ordinary business related traffic. This affects response times for internal users as well as e-business customers. Many organizations have taken to using Internet links to create virtual private networks (VPNs) between their disparate offices or on the road users. If legitimate traffic has to compete with non-business file-sharing traffic, VPN performance will suffer.
4. **Bugs:** P2P file-sharing applications require leaf client software to be installed on each node, exposing the network to a number of risks. A badly written application may cause the system to crash or conflict with business applications. Security flaws in the P2P application may provide attackers with ways to crash computers or access confidential information.
5. **Trojans, Viruses, Sabotage, Theft:** An attacker could also convince a naïve user to download and install a booby-trapped P2P application that does damage or allows obtaining more information than they should have (backdoor access). A user of P2P software can misconfigure to

expose confidential information for gain or revenge. P2P file-sharing applications can also cause a loss of control over what data is shared outside of the organization. (Note that these risks concern P2P applications that admit these problems to the network it rides on.)

6. **Backdoor Access:** Combine your P2P applications with a VPN and security problems compound. If a user starts Gnutella and then clicks into the corporate VPN to check email, a determined attacker could use this backdoor to gain access to the corporate LAN. Many companies delay rollouts of VPNs in spite of the potential cost savings.
7. **Non-encrypted IM:** Instant message leaf clients also pose an information leakage threat to the organization. All the messages sent back and forth in plain text across the network or Internet can be captured and read using a simple network-monitoring program.

Developers of P2P applications and security software need to meet on common ground to develop ways to use these products safely in a public environment.

5.2.3.4 Security Issues within P2P (The Large Scale Issues)

INTEROPERABILITY: A central security issue-set in P2P networks is associated with the introduction of different platforms, different systems, different applications, working together in a given infrastructure. These differences open the set of security issues we associate with interoperability. The more differences we have to cope with, the more compounded are the security problems. Though wireless connectivity can lower interoperability problems, we as yet have no way of eliminating promiscuous listening.

PRIVATE BUSINESS ON A PUBLIC NETWORK: Using P2P to conduct private business on a public network is clearly an exposure to security risks. The risks entailed by use of a public network must be addressed in order to avoid the liability this use entails.

VARIABLE MEMBERSHIP: People 'permanently' leaving the network, joining the network, there must be a feasible method to add or delete users without increasing vulnerability. The system is most vulnerable to users and former users who know the ins and outs of the system.

GENERAL SECURITY: P2P shares many security problems and solutions with networks and distributed systems. There are also security problems peculiar to P2P systems.

5.2.3.5 Policy Modes of Security

a. Two general modes that underpin organization policy--

1. That which is not expressly prohibited is permitted.
2. That which is not expressly permitted is prohibited.

These rules are dual to each other. The second rule is the most common rule-based policy put on firewalls. The first has more flexibility, but it admits greater

security risk. The principles of Information Risk Management (IRM) can help define policy.

b. Information Risk Management (IRM): The processes of; identifying, analyzing, and assessing, mitigating, or transferring risk, is generally characterized as Risk Management. We want to secure information effectively from

1. threats
2. vulnerabilities

The sheer complexity of modern software and networks means that many vulnerabilities are inevitable. They are in every major software package. (Crypto-gram. 15 NOV 01)

3. breaches

These efforts are in a never-ending catch-up mode.

The following four questions are at the core of IRM:

1. What could happen (threat event)?
2. If it happened, how bad could it be (threat impact)?
3. How often could it happen (threat frequency)?
4. How certain are the answers to the first three questions (uncertainty)?

When these questions are answered we can ask:

1. What can be done (risk mitigation)?
2. How much will it cost (annualized)?
3. Is it cost effective (cost/benefit analysis)?

c. Uncertainty is the central issue of risk. Does the gain warrant the risk? These determinations of risk aid in defining and prioritizing security levels. These in turn help define policy and help the security professional develop layers of security [6].

d. Routing Policy: Permits the use of different paths to minimize impact of attacks on data. New requirements have made the representation of routing policies more difficult [18].

1. There is a need to represent the routing policies of many organizations.
2. CIDR (Classless Inter-Domain Routing, RFC 1519) and overlapping prefixes and the increasing complexity of routing policies and the needs of aggregation have introduced new requirements.
3. There is a need to assure integrity of the data and delegate authority for the data representing specifically allocated resources to multiple persons or organizations.
4. There is a need to assure integrity of the data and distribute the storage of data subsets to multiple repositories.

e. Firewalls: A firewall can block all traffic to and from a network. For outside communication it is necessary to poke holes in the firewall. The firewall can

direct incoming traffic to a DMZ, which in turn sorts out for delivery *according to security policy.* Peer-to-Peer can penetrate firewalls [19].

To date, with respect to enterprises, to protect the networks that P2P rides on, the controls that can be put in place are vigilant monitoring with clearly defined security policies.

5.2.3.5 Environmental Security

Many technology people that work on security issues tend to neglect security issues that lie outside the technology domain. In this sense they treat security issues as if the users were functioning in a military installation that already has a physical security system in place.

When technology people only focus on the technology security without concern for the system environment, this could deliver an unspoken message to users that the system is secure. In the overall security scheme for a system, this is a false message. Furthermore, it reveals that security was not treated in a holistic way. It shows that the technology security was developed independently of the environment security and the gains that might come from a coordinated effort are lost [6].

For mobile ad hoc networks as utilized in Project AmIGo these security issues take a new turn. They must include both the permanent position stations and the mobile stations. Thus the security issues expand in their scope.

Bibliography

Books

[1] Barkai, David. 2001. Peer-to-Peer Computing: Technologies for Sharing and Collaborating on the Net, Intel Press.

[2] Gollmann, Dieter. 1999. *Computer Security*, Wiley & Sons.

[3] Li, Sing. 2001. JXTA: Peer-to-Peer Computing with Java, Wrox Press.

[4] Moore, Dana, John Hebeler. 2002. Peer-to-Peer: Building Secure, Scalable, and Manageable Networks, Osborne

[5] Oram, Andy. 2001. Peer-to-Peer: Harnessing the Benefits of a Disruptive Technology, O'Reilly.

[6] Schneier, Bruce. 2000. Secrets and Lies: Digital Security in a Networked World, Wiley & Sons.

[7] Toh, C-K. 2002. *Ad Hoc Mobile Wireless Networks*, Prentice Hall, Inc.

Internet

[8] History: <http://www.isoc.org/internet/history/brief.shtml#JCRL62>

[9] BlueTooth: <http://www.bluetooth.com>

[10] Big LEO:
<http://www.ee.surrey.ac.uk/Personal/L.Wood/constellations/tables/tables.html>
[11] Little LEO: < http://www.itu.int/newsarchive/press/WRC97/little-leo.html>
[12] CSMA/AMPS Cellular:
<http://www.computer.org/proceedings/hicss/1435/volume9/14350299abs.htm
[13] GSM-PCS: < http://www.cellular.co.za/gsm-overviewpage.htm>
[14] Metricom: < http://www.metricom-corp.com/>
[15] SkyTel 2-Way: < http://www.skytel.com/>
< http://www.esselshyam.net/essel/wwwroot/SKYTEL.htm>
[16] TDMA-PCS: <http://www.iec.org/online/tutorials/pcs/topic01.html>
[17] Wireless LANs: <http://www.computer.org/students/looking/summer97/
ieee802.htm
[18] Security: <http://www.fictitious.org/internet-drafts/rps-auth/rps-auth.pdf>
[19] Security: <http://www.interhack.net/pubs/fwfaq/>

Articles

[20] Sonja Buchegger, Jean-Yves Le Boudec 2002. *Nodes Bearing Grudges: Towards Routing Security, Fairness, and Robustness in Mobile Ad Hoc Network.* Proceedings of the Tenth Euromicro Workshop on Parallel, Distributed and Network-based Processing.
[21] Schneier, Bruce. 2001. Crypto-gram (an email newsletter). 15 NOV 01.
[22] Turcan, Eduard, Ross Lee Graham. 2001. *Getting the Most from Accountability in Peer-to-Peer*, IEEE Proceedings First International
Conference on Peer-to-Peer Computing.

Proceedings (for general reference)

[23] First International Conference on Peer-to-Peer Computing, P2P2001
Ross Lee Graham, Nahid Shahmehri, editors.
IEEE Computer Society Order Number PR01503
ISBN 0-7695-1503-7
ISBN 0-7695-1504-5 (case)
ISBN 0-7695-1505-3 (microfiche)
Library of Congress Control Number 2001099745
[24] Second International Conference on Peer-to-Peer Computing, P2P2002
Ross Lee Graham, Nahid Shahmehri, editors.
IEEE Computer Society Order Number PR01810
ISBN 0-7695-1810-9
ISBN 0-7695-1811-7 (bookbroker)
ISBN 0-7695-1812-5 (microfiche)
Library of Congress Control Number 200210980

Chapter 10 Network survivability

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The economy and security of Europe is increasingly dependent on a spectrum of critical infrastructures such as energy distribution and telecommunication networks. Protecting these infrastructures requires an understanding of the multiplicity of vulnerabilities that exist in every layer of the network, from the physical layer up to the network and service layers as well as the organisational layer that supports the complex operation of these networks. While physical and organisational vulnerabilities have existed in some form since the inception of these networks, there are a growing proportion of vulnerabilities in the network and service layers due to their merger with global information systems (IP-based networks). This has lead to recent interest in the notion of survivability as a means of specifically addressing the attribute of dependability in critical infrastructures. Survivability is defined the capability of a system to fulfil its *mission*, in a timely manner, in presence of attacks, failures and accidents. While basic work on security aims at preventing or protecting attacks and intrusions, work on survivability assumes that attacks will be successful at times and points, and thus, concentrates on metrics that indicate whether the critical (distributed) services of a network can be delivered despite some security breaches. Increasing the level of survivability, thus complements the preventative and defensive mechanisms for implementing security that are considered as a means of resistance. The key notions for achievement of increased survivability are thus distributed recognition, reaction and recovery, as well as adaptation to unknown and emerging attack scenarios.

Sensor networks

Sensor networks are considered a way for future realisation of large-scale data processing, in changeable environments, with massive distribution and little dependence on individual units. So, the question that is of interest here is how can one rely on delivery of critical information by sensor networks, if they are realised by ad hoc networked devices, connected to some network operator? Obviously, the utility of such an overlay network is highly dependent on the dependability of the base infrastructure. In this paper, we argue that in addition, the advent of sensor networks brings it own promises and pitfalls. Among the promises one may hope for more efficient disaster management. Also, one may envisage sensor networks in themselves as tool for monitoring of critical infrastructures, information gathering and exchange in defence applications. As current weaknesses of sensor networks one must however consider their vulnerability to many disruption strategies by adversaries, and small footprint

(bandwidth, power resources, memory). The latter limitation implies difficulty in deploying heavy-duty solutions to solve security and performance issues.

Challenges

Recent studies of the basic security problems of sensor networks indicate that security as an add-on does not work. For example there are surveys that show the vulnerability of protocols and mechanisms that were designed with efficiency or flexibility in mind, and later found to be highly receptive to DoS attacks. As examples of security vulnerabilities one may mention:

- authorisation problems: for example the trust model for 802.11b has turned out to be not so trivial.
- Distinction of probing messages from data messages: this may lead to an attempt by adversaries to route the probe message correctly but tamper with data messages
- Flooding: an attack that builds on memory exhaustion and works against protocols that require nodes at some end to maintain state information
- Combinations of resource allocation and differentiation mechanisms that are intended for power conservation and efficiency, can backfire by prioritising packets that have lasted many hops, thus not only bearing a malicious packet but also prioritising it.

The above list can be made much longer. While an extensive presentation of sensor network vulnerabilities are beyond the scope of this paper, the above examples should be seen as representative cases. Without considerable research in building security into sensor networks already in the design stage, the presence of these serious weaknesses currently make such networks unfeasible for critical applications.

Chapter 11 Ambient Intelligence at home

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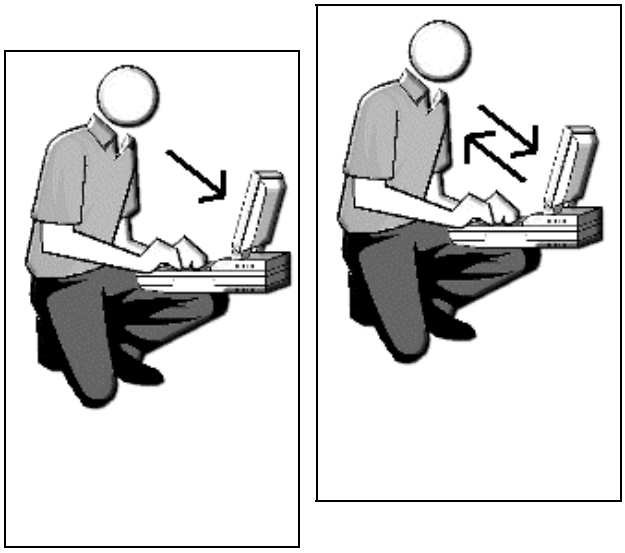
Figure 5. Proposed new UI considerations
Figure 6. Traditional UI considerations



Definitions

The area around Ambient intelligence has much in common with the history of Artificial Intelligence. In this chapter our view of intelligence is also shaped by the traditional views of intelligence from that field, however when talking about ambient intelligence the view will be kind of different. Our definition of Intelligence in this paper is very pragmatic: Intelligence is what the user experiences as intelligent. The reason to have this definition is not to easily get away with a complicated word, instead the reason lies in that the thing that is interesting in our point of view is not how to create intelligent machinery per se, but instead to find out how a user interacts with an application that s/he experiences as intelligent, no matter of the specific applications potential intelligence. Another aspect is that what is perceived as intelligent changes over time. This implies that the concept is under constant development in itself. This could be exemplified with the use of mobile phones and the technique T9 [10]. When T9 was introduced it was perceived as intelligent by many people, nowadays when a mobile does not have this technology it is perceived as a drawback for the mobile. Today the technology (T9) is so accepted that the absence of it could be perceived as a negative thing.

One way of shaping the users interaction is to employ an agent as a bridge between the AmI and the end user. Our definition of Agents is inspired by Pattie Maes' definition of Interface Agents from 1992:

> "Interface agents are computer programs that employ Artificial Intelligence techniques to provide active assistance to a user with computer based tasks."[1]

Our definition differs in that we include manmade entities and all types of tasks:

> Agents are computer programs or man made entities that employ AI techniques to provide active assistance to a user with different tasks.

The impact on design

Using what appear to be intelligent appliances in a home environment can interfere with traditional schemas of established use situations. The problem is not only in the unfamiliarity with new concepts, but also the interaction. As Höök [3] points out, intelligent interfaces do not follow traditional interface guidelines in aspects as user control, 'predictability and system behavior' and transparency in the system.

The role of the interface designer also changes, and the reason, to put it simply, is that the usage situation involves two intelligences, instead of traditional interface situations where there is only one. In other words the interface designer not only has to design usable interface from the user to the computer (**Error! Reference source not found.**1), but also a usable interface for the agent towards the user. (Figure 2)

Making the UI-design process a process involving two intelligences is not that common. There has been some work that has been touching these ideas, for example the work by Rich and Sidner [9]. They see the interaction between an agent and a user as a process where both are equally important for the process. The computer has for too long been seen as a largely passive entity that more or less merely reacts to what the user inputs. With the advent of more advanced AI in the computer, it is desirable to also contemplate the other way. We choose to call this reciprocal UI (RUI) or a two way UI. To illustrate, a linguistic theory about conversations that only incorporates one part as having a mind and being capable of adding to the conversation would be derisory. This is on top of other interface design problems such as to understand the user context, which kind of work the user is trying to accomplish and of course different users and use situations.[4]

In the opportunity with agents lie also the drawbacks. A general user only needs to know the agents capabilities, not the work that the agent needs to do or in witch order the agent performs that work. But since someone else than the user programs the agent, the user gets problems in knowing the agents limitations [1]. Höök [3] argues for an agent that does not give the impression of knowing too much or too little, just to not give the false impression to the user. We would like to emphasize that there are several good reasons to keep the agents appearance under the expected level or at least in the lower regions. The most obvious reason for this is, in our opinion, that it is much easier to make a false impression of being to smart when an agent is less smart than the user thinks it is. But it is also easier to build up a confidence in an application than to rebuild it. The reason to make the agent appear less intelligent than it is, is in our view, that if the agent can "surprise" the user with a more intelligent behavior, the likelihood for the user to accept the agent is higher. The result is that the user is encouraged to keep the agent active and not switch it off.

Aspects of ambient intelligence in the home

One problem that the agent technology and the discussion about AmI faces, is sometimes the ones that do not believe in the technology says that it can never take the place of human activities. The discussion mistake here is that the technology, in the way that we see it, should not replace neither the humans nor all traditional technology. This is because of, as Wexelblat and Maes [4] put it: "…this is an assistive technology, not a replacement." They say this in the context of replacing humans, where we see it in the context of replacing human and "old technology". However the goal for using this technology is the same, to replace or facilitate repetitive, boring or complex tasks.

In essence this is nothing new. Replacing/supporting a boring or complex task, with new technology is at least as old as when humans started to throw spears to kill a dangerous animal instead of attacking it at close range.

Trust

Without trust an AmI working in the home will probably be useless. Why is that? Most likely we have all experienced the need at some point in time to check on a program to make sure that it is doing its job properly. If there is no trust between the AmI/program and its user, the user will not use the program, or maybe worse, use it and end up double checking everything that the program does, thus rendering the program useless.

There are a number of differences between the contexts for the AmI in the home environment as compared to a work situation or lab environment.

The biggest difference is the type of activity that the user performs. At work the goal is usually defined by the work situation and not by the user, whereas at home the user is more often than not the master of the situation and can subsequently also set the goals.

When putting an intelligent appliance in the home, one is giving away some control, previously exclusive to the user and that demands quite a bit of trust. If the user does not feel comfortable enough to let go of some of the control and give away the trust, then AmI in the home is a mute point.

The potential for significant negative impact is much higher in the home environment than in a work situation, since it affects the users whole life. The tasks at work involving AmI are in most cases only a small part of the users life, and a part which have ample, direct support in case of mishaps, whereas at home the tasks that involve AmI has a potential to affect a bigger part of the users life as well as having a slower, less complete support cushion if any. The reason behind this could be in that the user has a feeling that the complication caused by the AmI in the home has a potential to affect the private integrity. As Maes [1] points out, even the programmers have problem trusting the system. This is probably because they know the limitations of their own skills and the limitations of the system.

Even if the AmI does its job properly and thus should create a great deal of trust it might still be a problem for the user, since in the words of Pattie Maes:

> "Users requested that they be able to instruct the agent to forget or disregard some of their behavior!"[1]

The Ricki Lake Phenomenon

One important thing in this can be exemplified by a situation that we refer to as "The Ricki Lake phenomenon" (TRiLaP). TRiLaP occurs when a user for instance watches a TV-program that normally would not correspond to his/her preferences. For example would rather be caught dead than watching Ricki Lake, still the same user does not mind using Ricki Lake as a mind-resetter after a long day at work, before watching the news. As a concrete example, the user starts watching the Ricki Lake show at 17:50, waiting for the News at 18:00. However the user would not admit to himself or to anyone else that s/he watches Ricki Lake on a regular basis. If the system, in this particular case changes the users preferences according to this activity, then an erroneous profile will be created that wont correspond to the users self image or the users image of his/her actions.

This behavior has also the purpose of "mind resetter". The user might need some kind of resetter after a long day at work and just need some time to relax. Doing this with Ricki Lake is just a relation of time/work/news. The actual show could be replaced with any other show that not demands deeper concentration. If one wants to create a system that can handle the mind resetter issue as a spurious item or a fluke it will be much harder than just making a system that just records the users behavior. However, the need for having this kind of approach when designing systems will probably be necessary if one wants to create a system that reaches higher level of acceptance in the home and the private sphere. So to make a complete and effective system, it is our belief that one has to take both of these aspects in mind. The system would benefit substantially if it can make a judgment of both what the user does not want to add to the profile and if it could draw conclusions of what is general criteria for a specific situation as well as make a generalization that corresponds to the users view of her/his performance the probability for acceptance would also have a higher potential.

Dwelling on this subject for a moment, it is fairly clear that this is a nondeterministic world with the possibility for highly irregular behavior. One way of approaching this problem is to do as Bohnenberger & Jameson [11] do, and that is to try and steer the user towards sequences of actions that are easy to recover from as well as highly predictable in their nature. Combining this with local plan recognition (a temporal window) on top of traditional plan recognition as Wærn [15] suggests would most likely yield good results.

TRiLaP touches upon the issue of what could/should be 'AmI-fied" (or turned over to AmI). This question in itself is probably not any different from what should be electrified in the home and what should not. Some people have

automatic front doors, but most people prefer manual ones. As discussed below in Stages & Timeframe, it is our belief that the key to AmI and agents in the home is modularity and functionality.

Types of Ambient Intelligence

The types of AmI that could be used in the home does not differ that much from traditional AmI usages situation. However, the focus will shift. There are three major types of AmI, Assistive, Decision-support and Control-Support. In traditional use, decision and control-support are the dominating ones. The use of AmI in a home environment will involve the assistive techniques at a much higher level.

With assistive we mean technologies that assist the user in performing various tasks such as providing a shopping list at an appropriate time and with an appropriate content. With control-support we mean for instance temperature control devices that might be autonomous or linked to the users calendar. An example of decision-support could be recipe suggestions based on what groceries that is available.

Since both assistive and control-support AmI are/will be used a lot in the home, it will be even more important to follow the advice of Wexelblat et. al. in [4] where they claim that:

> "Users of an agent system should be able to describe their desired end result without needing to specify precise methods for achieving these results."

User differences & Cultural aspects

Not one user is alike, and moreover different users have different preferences as to what they are fond of. One user might want to rely heavily on automation, and another might want to rely more on doing everything by him/her-self. Yet it is possible to cluster users by using diverse techniques such as sex/age/location/income etc. This leads to the bleak but realistic outlook that it might be impossible to accommodate all users out of the box. Possibility for profiling and user controlled customization is vital. For example knowing if it is a male or female user is important since it is likely to influence the way the user (wants to) interact(s)

The desktop metaphor is well known within the western world, but it was not such a long time ago that part of it, namely the clipboard metaphor was virtually unknown in Sweden for instance. American students have for a long time used clipboards that look almost identical to the ones that are depicted in computer interfaces, for holding their loose sheets of paper to take notes on, whereas Swedish students have bought booklets of blank paper instead. Of great importance is therefore to find out the cultural conception of intelligence, so that the home AI can be adapted accordingly.

Interfaces

This is closely related to trust. A transparency of the interface is a basis for trust. With transparency, we mean the ability for the user to get a subjective conceptual image of the inner workings of the program. If there can be this successful connection between the user and the program, then not only will we have a good interface, but also a good basis for trust. Koda et. al. [2] states that a face is despite its drawbacks a good interface for several reasons. Among them such things as "engaging, attention grabbing" and so on. We would like to argue for a slightly different approach: The "embodied pet metaphor". By this we mean that the AmI in a home could take the shape of a pet, preferably embodied since virtual pets depend on other things such as availability of screens and so on. This creates numerous advantages. Firstly, the users conception of the intelligence of a dog, cat, parrot or similar pet is most likely that the pet in question has less intelligence than a human, thus reducing the users expectations of the system and creating pleasant surprises when the system performs better than expected. Furthermore the interaction can be much better directed from the systems point of view since the user has a conception of how to handle for example a dog, which commands to use, and what tasks it can perform, thus (as mentioned in **Error! Reference source not found.**), creating a better defined interface from the AmI towards the user. Koda [2] also states that using a face could be advantageous in situations where it is important to convey the agents' behavior. Again, we feel that this can most likely be conveyed more efficiently with the embodied pet metaphor than a dismembered human face on a screen. Supporting our claim is Parise et al. [14] that shows that people find a computer agent that looks like a dog to be more trustworthy and loyal than an agent with a real or animated human face. Parise also found that the subjects found the dog-looking agent to be more gullible. In the experiment, some participants tried to take advantage of this perceived gullibility, while others choose not to. This would suggest that the participants regardless of if they tried to take advantage of the agent or not, felt that they were superior to the agent. Furthermore the study also showed that the subjects liked the dog-looking-agent over the human-looking-agent.

Another problem that faces the UI for an AmI or agent is when the UI should manifest itself or to quote the paperclip from word; "It looks like you are writing a letter". The problem with the traditional technique for deciding when to interrupt is twofold. First, there is a problem that there is even a need to interrupt. This suggests that something is wrong in the design of the agent and/or the application/system in that it is not conveying its full potential. Second, the problem of deciding when to interrupt is just that. When should the system interrupt the user? Analyzing what the user is doing is of course one way. Timed suggestions are another and scripted behavior is a third. The result is a system that sometimes will interrupt when not wanted and sometimes ignore the user when s/he needs helps or suggestions since all bases cannot be covered. A step on the way to rectify this could well be to use the AmI in the

shape of an embodied pet metaphor, since embodiment brings with it synergetic effects from the pets interaction with its surroundings. A more concrete example is that having an embodied artificial pet interface gives, in the example of user interaction with a traditional computer or AmI, another channel between it and the user instead of only the traditional keyboard, mouse, screen, speaker, mike. It enables the computer to convey information through true 4D movement (social interaction) as well as the traditional ways. It also enables the user to do this as well as demonstrated by Blumberg. [17] A true intelligent interface if you so will. The point being that it is as important how things are presented as what is behind the behavior, but as Höök says:

> "understanding how adaptivity works (transparency) does not necessarily mean that the system has to explain exactly what it is doing." [3]

Looking on the psychosocial aspect of this kind of interaction, basis for this line of approach can be found in George Herbert Mead's work, his main point being that consciousness is born out of interaction and not the other way around. [12] With our "embodied pet metaphor" we are trying to achieve an experience of a conscious system on for example a dog-level. By utilizing the embodied pet metaphor, the system will not be solely dependent on its own intelligence but is able to utilize the intelligence of the person using it as well. In other words, focusing on the interaction in a more Turing-test-like [13] manner if you so will. Again, in developing the system focusing on what the user perceives as being intelligent.

Using our "embodied pet metaphor" is one way of doing technology ambient by letting it take a different form. This kind of ambience is a way of transforms the technology rather than hiding it.

Stages & Timeframe

It is our strong belief that the current commercial solutions that are presently available, not only in a striking way demonstrated the existing relationship between the industry and the consumer, but also that embodiment and embodied UI is on its way into the home. The present state of the art have embodied AmI performing some vital but simple tasks in the home:

Electrolux Trilobite Vacuum cleaner [7] This vacuum cleaner is self sufficient in that, that it will be autonomous and avoid obstacles while at the same time go over cables and doorsteps. It is also possible to decide where it should not go by applying a magnetic strip. When it comes to recharging, the Trilobite can find its charging station and automatically charge itself. The interaction with the unit takes place through a panel on the front, and the user can tell the unit to clean/quick clean/spot clean.

Husqvarna Robomower [6] This lawnmower is similar to the vacuum cleaner in its operation. It is autonomous and can recharge itself when needed. Besides that, the user can lay out a boundary wire that delimits the workspace for the robot. The interaction is similar to that of the vacuum cleaner. That is to say, that it has a panel that lets the user control certain features, such as start/stop, delayed start, (If one wants to carry it to another mowing area.), antitheft.

Both the vacuum cleaner and the lawnmower perform pretty simple tasks. Tasks that can be forgotten about once they are initialized. Coming back to trust, the trust for these devices are important, and maybe most for the lawnmower. One does not want to experience that the mower mows down ones favorite flowers or worse. In addition to this, the fact that these devices are modular parts of a household gives a logical explanation to their success. A household is not really complete without a vacuum cleaner and/or a lawnmower, and these devices are usually replaced within a certain timeframe. We believe that this modular concept is one way of increasing the penetration of AmI in the home, since appliances will need to be replaced at one time or another. This will give the homeowner a possibility to add intelligence to the home in a gradual way and without big investments. An important point is that the new appliance has to either significantly change the way a task is done, (complete removal of labor), as in the case of the lawnmower and the vacuum cleaner, or create a whole "new" activity as is the case with the Sony Aibo below.

The Aibo is a robotic dog from Sony. [5] This robotic creature responds to its name and to other words that it has learned. The user can also purchase different software for the Aibo. This software enables the Aibo to interact better with its surroundings. Several Aibo owners have reported that their regular pets (mainly cats) interact with the Aibo as if it was one of them. Another piece of software gets the Aibo to alert the user when new mail arrives in the users inbox. This mail can be read to the user as well as certain WebPages. Interestingly Aibo seems to put in and act out emotions when it reads the mail.

In our opinion this is a sign of what probably will become standard in the future. Remembering that buildings and architecture tends to remain more constant over time than technology, and as stated earlier, a robotic pet could provide a good interface to the home. You could ask it to take care of your pets while you are gone, fetch some information off the web, or talk to other household robots such as the two mentioned above.

One of the more interesting pieces of software is the one that makes the robotic dog go through a development cycle, from baby via child and adolescent until finally reaching adulthood. This seems to create a bond between the robot and its owner. Even though the more tech-savvy, owners claim to understand that the development is nothing more than scripted behavior, they feel powerless to resist forming the strong connection. We think that this behavior towards the Aibo has nothing or little to do with that the users expect the Aibo to be more intelligent than it really is. The actual perceived performance/intelligence of the Aibo is higher than the expected one, and therefore the trust and the relation to the Aibo is higher than if it only was experienced as a dull toy dog.

Looking at some more examples, there are notably two that stand out. NeCoRo and Tama. [16] NeCoRo is designed to mimic a live cat as much as possible in terms of looks and behavior. Tama on the other hand is more iconic in its approach and can even function as a computer terminal.

The future of AmI in the home

What is striking about these solutions is that they are all free, embodied, autonomous AmI-agents in some way. However, some of them lack networking ability. Communication is a must, and why? Communication is a part of acting intelligent. [12] With the ability to communicate there are a lot of synergetic effects. Looking back for a moment on the lawnmower and the vacuum cleaner, that both lack the capability of networking, we can see two reasons for this:

1. If they could network, whom would they network with?
2. Networking ability costs money, especially wireless networking.

When it comes to the first point, we have a catch 22 situation. This will hopefully be solved in time by the industry when it realizes that there is money to be made. Yet, if the research community can be vigilant and proactive, there are some important research questions here in terms of interoperability of AmI-enhanced appliances. Standards, languages and protocols need to be decided. As for point two; wireless networking will very likely go down in price over the next few years just like most things in the computer industry.

Research in Sweden

Research in this area is in Sweden divided in different areas that could be connected to Ambient Intelligence. Some of the research is still in the traditional Artificial Intelligence area, mostly because the area of Ambient intelligence uses many of the techniques and language from the traditional AI research. When it comes to the focus of home and what technology can do for the home there is some projects in home informatics and home communication. For instance in Linköping there is the HomCom project, a jonit project with both the industry, university and the city of Linköping.

With the view presented in this chapter there is also very interesting to connect research in the area of usability and interface techniques in general and especially intelligent interfaces. This kind of research is well represented in Sweden, besides the work done in Linköping and Santa Anna, it is worth to mention Nada at KTH, Stockholm and the Victoria institute in Göteborg.

Conclusion

In closing, the future of AmI in the home is very bright, particularly since we already have appliances (Aibo) that trigger social behavior from the users.

The software in the embodied AmIs for the home has now reached such a level of sophistication that it is not only necessary to gear the efforts solely towards the software bat also towards the hardware, and in particular the experience of the software through the hardware.

A fear that has been vocalized by among others Maes, is that if a user relies to much on the recommendations or advice of a system, the user might become too passive with regards to manually update the system with information. [1] This is true, but only because the AmI that generates such behavior from the user is

erroneously designed. A properly designed AmI will know its limitations and advise the user accordingly upon approaching them.

AmI and Agents in the home has a potential to provide a greater quality of life for all people, from the disabled with their special needs, to the average consumer his/her demands of more spare time and increased efficiency.

References

1. Maes, P. Agents that Reduce Work and Information overload. CACM-92
2. Koda, T. Maes, M. Agent with faces: The Effects of Personification of Agents
3. Höök, K. Steps to take before IUI becomes real
4. Wexelblat, A. Maes, P. Issues for Software Agent UI
5. http://www.aibo.com cited 2002-02-25
6. http://www.automower.com cited 2002-02-25
7. http://trilobite.electrolux.se cited 2002-02-25
8. Russel, S. Norvig, P. Artificial Intelligence. Prentice Hall
9. Rich, C. Sidner, C.L. Adding a Collaborative Agent to Graphical User Interfaces, UIST-96
10. http://www.t9.com
11. Bohnenberger, T. Jameson A., When policies are better than plans, Proceedings of the 6th international conference on Intelligent user interfaces 2001 , Santa Fe, New Mexico, United States
12. Mead, G.H., Mind, Self and Society, Ch. Morris, Chiago, United States, 1936
13. Turing, A.M., Computing machinery and intelligence. Mind, 59, 433-460, 1950
14. Parise, S. et. Al., My partner is a real dog, Proceedings of the ACM 1996 conference on Computer supported cooperative work 1996, Boston, Massachusetts, United States, ACM Press New York, NY, USA
15. Wærn, A., Local plan recognition in direct manipulation interfaces, Proceedings of the 2nd international conference on Intelligent user interfaces, 1997, Orlando, Florida, United States, Pages: 7 - 14 Series-Proceeding-ArticleYear of Publication: 1997, ISBN:0-89791-839-8, ACM Press New York, NY, USA
16. Ishiguro, H., Toward interactive humanoid robots: a constructive approach to developing intelligent robots, Proceedings of the first international joint conference on Autonomous agents and multiagent systems: part 2, 2002 , Bologna, Italy, Pages: 621 - 622 Series-Proceeding-Article, ISBN:1-58113-480-0, ACM Press New York, NY, USA
17. Blumberg, B. Old Tricks, New Dogs: Ethology and Interactive Creatures, PhD Dissertation. MIT Media Lab, 1996

CONCLUSION&REMARKS

Chapter 12 Strategic issues

Disruptive developments

Two main disruptive developments have been identified within the project, »interaction models» and »peer-to-peer».

Interaction models

Interaction models, that is, the way people utilize and view the means of, in this case, communication, is pivotal in the development of an ambient intelligence. The failure to recognize the importance of interaction models could possibly lead to a delay in realizing the visions of an ambient intelligence.

Moreover, the interaction models in wide spread use today, the OS-model and the Web-model, are limited in applicability for mobile ambient intelligence applications. The need for models supporting the mobile life of peers include aspects such as distribution of interaction over time and space, dynamicity and activity of objects and peers, layers of service provision and privacy, sharing of services and information, etc.

We believe that such interaction models can be well designed and well researched today, if provided with sufficient resources.

Peer-to-peer

Peer-to-peer, regarded as a network communication possibility, is disruptive in the sense that it could possibly provide long range communication, without utilizing the infrastructures of today's operators. Architectures for multihop-communication, viral spread over equal peers, etc already exist.

Peer-to-peer is a powerful communication possibility often viewed as more in line with the visions of the Internet, than is operator driven network communication. But reaching the visions of ambient intelligence is hard to do relying only on peer-to-peer communication with short-range communication means between handheld terminals. At least two other developments are provided for such a development to actually be disruptive. First of all, people will need to accept to carry around large amounts of computing power only to provide services and communication means for other peers. That is, the handheld we will be using will be a PDA with communication features. Secondly, there will be need for advanced location features, provided either by GPS or some other centralized structure combined with peer-to-peer triangulation. We judge that these developments are not very likely to continue at the required pace and with the required coordination to be assessed as a sufficiently disruptive development.

Instead, we believe that the developments within peer-to-peer communication will feed into and coordinate with developments within Mobile Network development. This development will be of benefit to both areas.

Moreover, an outline architecture, as seen below, will be much more powerful when it comes to fulfilling the visions of ambient intelligence. Location, context, service provision etc., will not require the dependence on a handheld with the computing power of a small PC, but does not disregard the possibilities with such a handheld.

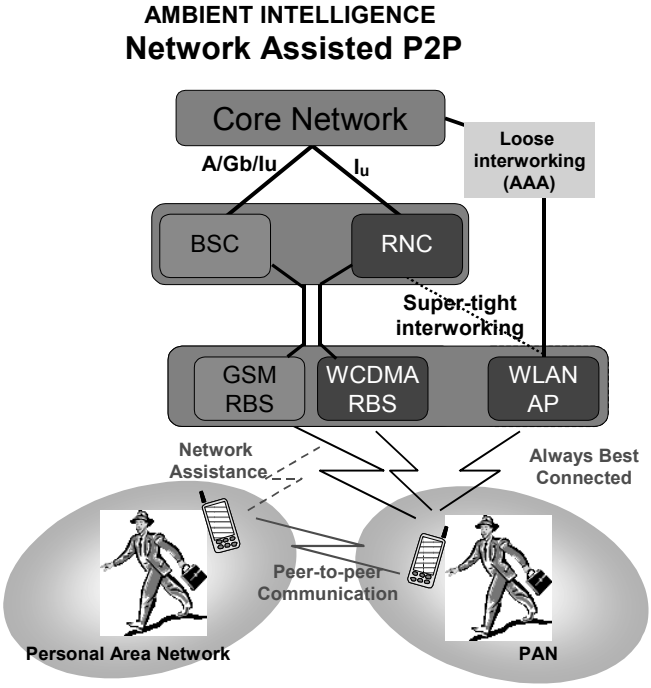


Figure 7. Outline architecture for Network Assisted Peer-to-Peer communication

The Swedish position

The Swedish position within mobile technology is very good. There is both world-class research and development activities going on. Thus we are well equipped to meet and provide possible developments of disruptive. The main risk lie with becoming too focused, thus providing tunnel vision and becoming blind for disruptive technologies arising.

The Swedish position within user interaction with technology is good. Mainly there is world-class research activities going on, but less development. We are thus fairly well equipped to provide well-grounded solutions for future development.

The really weak spots of Sweden lie in the utility, service, interaction models and design aspects. Research and development has mainly been technology driven and motivated by infrastructure development. Some efforts are made to do research and development on these aspects. But, focusing even more on

becoming better in class within these aspects would position Sweden in the forefront of the development of a well-designed useful intelligent ambience.

An outline of an innovation system

Just to give a hint on how the innovation system might be described we will use the tree metaphor and put in some of the actors, which we have made acquaintance with during this project. It is not a comprehensive list of all possible actors, regard it as a starting point, where other as well as new actors might further the specificity and generality of the picture.

Chapter 13 Future work

The plethora of possible future work within the larger frame of ubiquitous computing is amazing. However, with the narrower arena explored in this white-paper the suggestions for future work presented here only embraces parts of the larger area, and is not an exhaustive list of possible future work even within the narrower frame. There is an extensive interdependence between development within the larger area and the possibilities and development within the narrower arena.

A stepping-stone for the future work proposed here is the slight change in terminology from Ambient Intelligence to Intelligent Ambience. The change might seem small, but it is significant; it bears with it the same kind of connotations that the change from ubiquitous computing to calm technology has. It puts focus on the ambience and the development of the ambience instead of the intelligence. We should not focus primarily on the intelligence but on developing a well-designed, useful and balanced ambience; with and without the support of advanced computing technology.

The challenge for future research and development lies in going from the technology centred and the human centred towards the use centred. A use centred perspective is design oriented and embraces the technological, the environmental, the social and the human/e as a whole.

> » Ubiquitous computing, the intelligent ambience, the wired world, only serve to suggest the clear fact that the triumph of technology has already occurred, that the shift from agency to behavior has become the focal point of technology research. »
>
> *Timothy Druckrey, 1995*

We have identified three broad areas within which future research to accomplish an intelligent ambience should operate. » Living with the terminal », which alludes to the conception of the cell-phone as a terminal. Of course within this area the main interest does not actually lie with the terminal in itself but in the way we live with and without it, the cultural and sociological study of the assumptions and possibilities with the envisioned technologically supported life of peers. » Interaction models », which alludes to the conception of modelling. The main interest within this area is the different ways we will interact with each other, with the technology and with the intelligent ambience. It is the design and communicative study of the assumptions and possibilities with the envisioned technologically supported life of peers. » Infrastructure and networking », which alludes to the conception of something stable. The main interest within this area ranges from the stability of a network infrastructure to the possibilities to provide flexibility and ephemerity. This is the technological and engineering study of the assumptions and possibilities with the envisioned technologically supported life of peers.

Living with the terminal

Mark Weiser in a keynote speech he held at CoBuild 1998 emphasized the fact that ubiquitous computing had failed mainly because of the challenge to design for a proper model of the human being. This challenge is far from solved when writing this 5 years later.

Some research has been done regarding what it means to live with the kind of technology that is calm, ubiquitous, mobile or contextually sensitive. Where most activity has been put is within the writing of scenarios. What is needed now, is to utilize the full strength of available technology to realize at least in part these scenarios, for assessing their possible value. We also need to utilize other forms of representation than written scenarios to provide interpretations of the envisioned futures; from prototypes and provotypes over other narrative forms than the short story, to cultural probes.

Interaction models

In a not so far away future we will experience a world where our mobile device/s will be a service and information appliance to any one of us. We will share services with our peers, provide information for public use, we will have a wide range of services offered to us, as well as information. These possibilities will be made possible with distributed services and information coupled with network support. We believe that this not only is a change in technology but also a change in the way people will experience themselves being in the world.

At the moment there is a lot of work being done looking at the architectural groundwork for such a networked mobile life, as well as developing and testing individual services. Less work is performed regarding the *overall interaction model* of such a networked mobile life of peers. The aim of this project is to provide groundbreaking results and insights on such holistic interaction model research.

There are three assumed interaction models in common use. First, we have the *Web-model*, which is characterized by browsing, hyperlinking and downloading. Secondly, there is the *OS-model*, characterized by installing, the enhanced desktop metaphor and finding. Last, we have the *UbiComp-model*, characterized by self-organization, distributed and embedded computing and existence. These constitute three different genres, or formats, with their own very specific properties and qualities. Both the web-model and the UbiComp-model are fairly young and immature, especially with respect to powerful mobile devices, and the provisions for their utilization have changed rapidly over the years.

We believe that we do not know enough about how peers best interact in a mobile distributed service and information world. Intelligent ambience based on peer-to-peer applications need a sound and well-designed interaction model for in-and-out-of-the pocket devices. Most important then is to understand and design such interaction models in terms of their qualities and their potential

usage, to be able to judge whether they are plausible or usable for mobile devices.

Infrastructure and networking

The visions of an intelligent ambience face a number of technological challenges. These have been expressed by Nixon (2003) in terms of the following problems for a comprehensive architecture to address:

- Embrace contextual change
- Encourage ad hoc composition
- Facilitate sharing
- Support local and global computation
- Have multiple viewpoints

Among the three areas presented here infrastructure and networking has received, and receives, the most attention. The development within this area is described as enabling technologies for the realization of the scenarios. Within IST/FP6 a set of large projects have been launched to provide such basis.

Most important within this area is to perform comprehensive research and development projects, which provide possibilities for wide ranging research within the other areas. Thus infrastructure and networking research need to be driven by other means and goals than the technological.

There is also a need to weed out key enablers that might be swiftly converted from research test beds into development projects, assessed by the industry as well as users, and introduced in the appropriate open standardization forum, such as OMA. Finding ways of opening up connections between the research communities and forums such as OMA, thus become very important.

Concluding this report we wish to cite Mark Weiser once more.

» … we must avoid the academic tendency to fractionalize, to divide, to emphasize our differences. We are on a common mission: how to create technology that truly honours humans. The challenge dwarfs our disagreements. »

Mark Weiser, 1998

References

(references for deep dive chapters, see end of each chapter)

"Book of visions 2000". (2000). Wireless Strategic Initiative.

Nixon, P. (2003). "Wot, no computer?". http://www.cis.strath.ac.uk/~paddy/ChristmasLecture/TheChristmasLecture_files/frame.htm

"Scenarios for Ambient Intelligence In 2010", ISTAG Report, ftp://ftp.cordis.lu/pub/ist/docs/istagscenarios2010.pdf

Schollmeier, Rüdiger (2001). "A definition of peer-to-peer networking for the classification of peer-to-peer architectures and applications". In Proceedings of the First international conference on peer-to-peer computing. Los Alamitos: IEEE.

Weiser, M. (1991). "The computer for the 21st century" draft for Scientific American no 9/91. Available at http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html

Weiser, M. (1998). "The invisible interface: Increasing the power of the environment through calm technology." Keynote Speech at CoBuild 98. Available at http://www.darmstadt.gmd.de/CoBuild98/abstract/0weiser.html

Ambient Intelligence To Go, edited by Andreas Björklind, Stefan Holmlid

Working in a vision and scenario oriented project, designing a cell-phone based in and out of the pocket application family promoting and supporting interaction and communication in ad-hoc and dynamic environments in everyday life for passive and active peers is an inspiring task.

In this White Paper we have collected the experiences from the participants of the AmIGo project and researchers attached to the knowledge development of the project. We hope that you will find inspiration from the paper, and that you will want to further the knowledge and horizons of what an intelligent ambience could be like.

There is still some way to go before we can realize the potentials of what intelligent ambience actually means for people living with mobile peer-to-peer technology. Trying to realize some of its potentials and reflecting over these is one important step to create better understanding of the issues and better designs for the future.

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