MOBILEMAN

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Mobile Metropolitan Ad hoc Networks

MOBILEMAN

Socio-Economic Evaluation

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Abstract: this deliverable presents the social evaluation activities about ad hoc networks that were carried out within the MobileMAN project. We describe all the steps that we made to determine the variables that ad hoc networks and MobileMAN need to consider when providing this technology to the public of potential end-users.

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SUMMARY

This deliverable discusses the activities that were undertaken at SUPSI DSAS to evaluate the social dimensions of ad hoc networks and MobileMAN. It goes through all the steps we did to reach our objectives to underline the variables that would come into consideration the moment that ad hoc networks and MobileMAN would come into contact with the end-user.

In Chapter 1, we present the methodology we chose for this evaluation, underlining the initial idea to use the participatory design approach. We present also how we changed our initial methodology and how we considered introducing 'comparative studies' of similar technologies. In fact, we chose mobile phones and WLANs to study how mobile individuals make use of them, with the objective to extrapolate information useful for MobileMAN, as well.

In Chapter 2, we describe our participatory design experiment with a group of students at HUT and the scenarios and applications they developed by working in groups either through a *wiki* website that we set up for this activity, or through traditional paper. We also present some results from a questionnaire we gave them after the activity.

After that, we present and discuss the results from the comparative study of mobile phones and ad hoc networks' devices. Following, we go through the second comparative study of public WLANs and ad hoc networks.

Afterwards, we present the interviews of the elderly to investigate their relationship with technology, in particular with communication technology. We investigated their use of technology, their opinions and ideas towards it. We tried to find out what types of needs the elderly have that MobileMAN could address, to enhance the quality of life of the elderly.

Last activity we did was participating into the observation of a group of students testing an ad hoc network of small-medium size (22 nodes). Although the test session was about technical solutions, we were able to initiate an interesting dialogue with a group of potential end-users that are technology skilled. We present the discussions we undertook with some of them and some conclusions about ad hoc networks and MobileMAN.

To conclude this deliverable, we present some theoretical contributions on the discussion about key aspects of MobileMAN, such as human cooperation, types of future-applications. We also indicate what we learnt in this project and what we believe are important considerations about social evaluation in technological development projects.

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1. METHODOLOGIES AND OBJECTIVES

As already stated from the beginning of the MobileMAN project, one of the objectives of the project itself was to provide an evaluation of the potential outcomes of a technology like MobileMAN on the social structure and interaction of individuals (see MobileMAN Full Proposal, February 2002). This evaluation required several changes in the methodology and the implementation strategies to reach the objective. This deliverable is entirely devoted to the sociological and behavioral points of view of MobileMAN and will go through all the steps and changes we made to better approach MobileMAN from the social standpoint. We will be focusing on the results of the studies we carried out to foresee what kind of acceptance by end users MobileMAN would find.

We would like to point out that this type of evaluation in projects that deal with low levels of the technical architecture is very new: for this reason, we are certain that lessons that we learnt will be useful for future projects that will include this social point of view as integral part of the project activities.

1.1. Initial methodology of users' participation

Initially, when considering what methodology and what type of activities we would carry out to provide the social evaluation of MobileMAN, we considered the following starting point: the fact that **technology can be designed and produced to improve individuals' life**. Secondly, we were guided by the principles of the "Social Constructivism" (or "Social Shaping of Technology"), whose main idea is that the technological development and the adoption of technology by individuals is not defined simply by technology itself, but is driven by a series of intertwined factors among which count also the individuals' psychological variables. For this reason, one specific technological product can be accepted with enthusiasm and become a mass product, whereas some other will be rejected.

Having pointed out these two principles, we envisaged the opportunity to take the approach of participatory design for the aim of giving a social evaluation of MobileMAN. Participatory design seemed the best approach, since it makes use of several techniques to involve potential end-users in the design and development phases of a system. By involving potential end users in the design of MobileMAN, we would have had the opportunity to know from near how the user perceives the MobileMAN technology and how they might integrate it into their life.

1.1.1. MobileMAN and specific categories of potential end-users

The MobileMAN project stated clearly that a technology like MobileMAN itself could have been an important **opportunity for some specific categories of potential end-users**. Among these, the elderly and disabled constituted a privileged group to involve in the discussion and definition of the MobileMAN characteristics and applications. We considered that new communication technology can be very positive for the individuals' life. Moreover, we aimed at addressing MobileMAN to those categories of individuals, "who are traditionally the last ones to be reached

by technological improvement". In other terms, MobileMAN addressed the **issue of the digital divide** and tried to give its contribution to decrease this gap.

However, the idea that technology like MobileMAN would be the initiator for the constitution of communities (intended as groups of users who share some aspect, and therefore who might be interested in sharing information or communicating over an ad hoc network) is not realistic. More viable is a view that considers MobileMAN as an **instrument** that broadens and supports the communication possibilities for an already existing group of individuals or that allows secondarily to extend one's social network through novel applications.

1.1.2. Advantages of the participatory design approach in MobileMAN

We identified the following specific advantages of a participatory design approach for the social evaluation of MobileMAN.

- It shows that there is the will to consider end users as potential source of useful information and their participation as beneficial and valuable to the designers.
- It gains points of view of individuals who have practical expertise, people who will use MobileMAN eventually and might have specific needs for applications, which might not be spotted by designers. It also allows designers to think of diversified needs and responses to technology itself.
- It starts with concept dissemination in early stages, gaining time advantages and involvement of not only the research community but also of the common users.
- It allows a reflection on the new communication technologies that we dispose of in our daily life and the relationship we have with them and the consequences, both positive and negative.

The theoretical aspects of the advantages of participatory design approaches were presented in the work done in the framework of the MobileMAN project in an MA thesis in Communication (Brazzola 2003).

1.2. First steps towards users' participation in MobileMAN

1.2.1. Need for a communication ground between users and designers

The very first step toward the realization of any participatory design is to create a **common ground** on which users and designers can **communicate**. This common ground is mainly a communication aspect: two worlds need to come into contact, so that designers and users can really communicate. Only if this prerequisite is satisfied it is possible to dialogue and exchange opinions and ideas between the group of users and the group of designers. The MA thesis on communication that was conducted within the MobileMAN project at the in the initial project months (Brazzola 2003) addressed this aspect of the concrete requisites for successful communication between "close" groups such as engineers and potential end users ('non-experts'). This common ground is not automatic, especially if the tendency for the past decades was to consider that end users are not to intervene in the definition and design phases of a system. The 'democratic' view of participatory design aims at making valuable use of all knowledge (more practical but exactly for this reason, extremely useful) of non-experts.

1.2.2. Realization of user-friendly material and test with a group of students

In line with the requirements stated in the previous section, the first activity we realized was to design and create some information material to give the potential users the most important knowledge of the characteristics of MobileMAN – both about the project and the basic technology of mobile ad hoc networks. This material was developed in the form of a small booklet with a simple interactive story, where the reader could choose between options about how to evolve the story. In this way, the attention and interest was kept active, as well as the story would have been semantically near to the reader, which would allow better comprehension of the content.

We already presented in an annex of D7 a summary of this work. We also presented the data from the pilot test we conducted with a community of students of the mentioned material. It is worth to remind here that we asked the students to describe an application or scenario of use for an ad hoc device, but the result of this activity was very limited. **Already from this task it was possible to see how difficult it is for potential and users to imagine the technology and potential novel applications.** This problem came out repeatedly throughout the whole series of studies and activities we conducted for the MobileMAN social evaluation.

1.2.3. Results and conclusions

Although the comprehension of the concepts of ad hoc networks presented through the user-friendly material was very high, it has to be remarked that it is not necessary to explain complex technical aspects to potential end-users to initiate a discussion about MobileMAN and ad hoc networks.

What is also possible to say is that the difference in mastering technical knowledge is becoming smaller between technology-literate and technology-illiterate; with time going by, more and more people are appropriating new technological devices and technology. The digital divide will become smaller, and in the future it will be easier to have a dialogue between designers and potential end users communities. In the meantime, it is positive that designers use participatory design approaches when possible to involve end users.

1.3. Review of methodology

The results so far gathered **called for a revision of the main concepts and methodology** for the MobileMAN social evaluation. In fact, the results from the test of the user-friendly material and the questionnaire about MobileMAN showed that individuals were not able to provide valuable contribution in terms of innovative applications or use scenarios. This can lead us to two possible interpretations:

a) the technology of ad hoc networks is too 'future-related' and abstract for the man of the street to be able to imagine "what I would like to do with a device that could allow me to communicate with other users not using any infrastructure" → **extrinsic limitation**, due to the difficulty to imagine something new and innovative;

b) the nature of ad hoc can only be exploited in very limited situations, such as military scenarios, catastrophe situations where infrastructure are broken or in places where it is impossible to place an infrastructure → **intrinsic limitation**, due to the very true nature of ad hoc itself.

1.3.1. Strong participation and weak participation

Considering participatory design approaches, it is possible to distinguish between strong participation and weak participation. Ideally, the more involved users are in a design project (therefore, the stronger their participation), the better it is. However, **it has to be recognized that in some cases, strong participation is not possible or not appropriate**. In a paper written and accepted for the MobileSummit 2004 in Lyon[1], we stated that many activities of strong participatory design that involve therefore users in heavy proportion are more appropriate for the refinement or further development of a technology that is already existing and that is in a late stage of the product life cycle. In fact, users know it, have already used it and by using it they have encountered problems or have come across new ideas. In this way, the system is not abstract; it is real, familiar and near to their life and uses. For these reasons, **we concluded that for the social evaluation of MobileMAN, weaker approaches were more appropriate**. This is also in line with the fact that killer uses of technology often are not the initially intended by the engineers, whose main example is the SMS application of mobile phones. It is the "serendipity factor", a series of reasons that are unpredictable and that define the success of a system.

1.3.2. Users are interested in high levels of architecture

Main efforts in the MobileMAN project are on the low architecture levels. **Users are not really interested in these technical issues: they want something that works, that is easy to understand and to handle and that responds to a concrete and real need.** MobileMAN has expressed the intention to address the untapped needs of specific categories of end users, namely those who are traditionally the last ones to be reached by benefits of technology. These individuals

[1] "Social Dimensions of MobileMAN – Opportunities and Constraints in adopting Participatory Approaches in ICT Projects" (Brazzola et al.2004).

are those with less affinity with technology and who require more strongly **devices that are usable and accessible**.

Ad hoc networks are still in an initial stage of research. It has very little to do with the public at the moment, since it deals with technical issues, such as routing protocols. For this reason, users have experienced huge difficulties to imagine new applications and scenarios of use for ad hoc devices, such as the iPaq for MobileMAN.

When designing a new system that lays on an innovative technical basis, the initial focus is on solving technical issues that are the ground for the functioning of the entire system. These technical issues are not of interest for the end-users. In fact, according to Carroll et al. (2002), they are interested in other aspects of a system or device, namely:

- affordable cost of access and use
- applications that respond to their needs
- usability of device (user friendly interface and logical organization of applications menu)
- fashion
- familiarity

This fact has created a difficult situation: a social evaluation, with studies on acceptance of a system and on behavioral observation, is really useful and delivers interesting results provided that the user can interact with a fully functional prototype, with applications, with a user interface and with devices that allow real mobility[2]. It is very limited to use laptops since they do not allow a full exploitation of the concept of users' mobility, that is, one of the central concepts of MobileMAN.

[2] Mobility is in fact, one of the key features of MobileMAN.

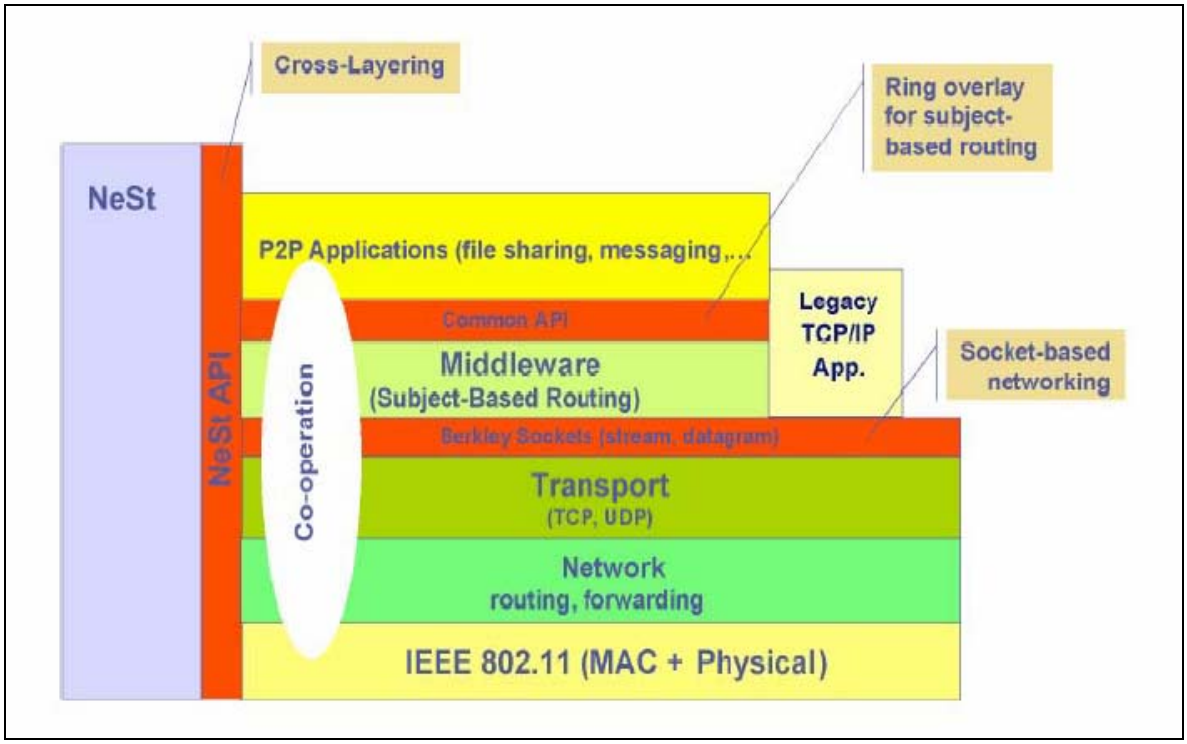

Figure 1 – Architecture of MobileMAN. As it is to be seen, the majority of the aspects are of technical nature

As the above scheme shows, the focus of the project is on the technical architecture, to build a system that will function without machines dedicated to routing and other service functions (that is, without infrastructure). This is obviously the first concern for the development of MobileMAN.

We expected to be able to dispose of a fully functional prototype to test in real user environment and gather data about users' reaction, difficulties, opinions and comments on the device and what applications it provided. However, this was not possible to reach in the project time and has greatly limited our social evaluation activities. In fact, it has not been possible to focus enough on the application and interface levels – that is, the most important and interesting ones for end-users. Anyway, we were able to gather interesting information even without this opportunity.

1.4. MobileMAN social evaluation methodology as outlined in D7

For the above presented reasons, we **reviewed** the methodology to be adopted for the social evaluation of MobileMAN. In the following sections, we remind briefly what was already presented in deliverable D7. However, we would like to point out that the objectives and the methods to carry out the MobileMAN social evaluation had to be constantly reviewed, to adapt to new challenges and unforeseen difficulties.

1.4.1. Users' participation in MobileMAN can only be partial

For the already mentioned reason that strong participatory design approaches are best used in later stages of the development of a system, we adopted participatory design techniques of a **weak type**. The activity with the potential end users involvement was the creative collective scenario building through a specific website with a wiki[3] section, where users could easily give their contribution in the form of scenarios and applications development or comments and remarks on the ad hoc networks concept. The other activities involved potential end-users but limited to the form of questionnaires or interviews about opinions of characteristics of ad hoc networks and their benefits or drawbacks and about their relationship with existing mobile communication technologies.

1.4.2. The realm for the social evaluation is "hypothetical"

Participatory design relies on the assumption that users are the better source of useful insights about applications and about the ways to improve features of practical nature. However, it is true that many successful applications that later have become killer applications cannot be predicted. In fact, this has been true for SMS: it has become the killer application but its initial use was far from the mass use that we can witness today. Other technologies simply do not break through the ceiling to become accepted from the masses and widely adopted, and it is not even really clear why. In fact, **the user can be very hard to predict**. This concept was kept in mind as a strong assumption, while carrying out this MobileMAN social evaluation. However, we considered that people can be imaginative, creative and provide interesting new ideas about applications that enhance communication, information exchange and mobility. In fact, as Holloway writes (Crabtree et al 2003), "the impact of new technology needs to be understood as a dynamic process between the intentions of designers and manufacturers, and the way in which users choose to experiment, modify and improvise with it".

Because of the unpredictability of the user's behavior in terms of adoption / rejection of a system, and because of the abstract nature of the MobileMAN technology for the man of the street, **the realm in which we have moved for this social evaluation has been very hypothetical**. A true empirical study on which to base our conclusions about the social dimensions of MobileMAN was not possible. However, we chose to proceed with a combination of empirical studies about similar communication technologies and hypothetical extrapolations from them to give a social evaluation of MobileMAN. As already mentioned in D7, "the study of people's relation to technologies in use

[3] A wiki section is a collection of web pages whose content is editable simply through a web browser. It can be compared to a shared whiteboard.

is an approach that is increasingly adopted to anticipate the response to forthcoming technologies (Brown 2001). Also, as Neil Holloway points out (Crabtree et al. 2003) "visions of a mobile future must be built on a firm understanding of the present. The way people use mobile technology at the moment matters just as much as future technical possibilities" and also "we believe that lessons learned from the extensive roll-out and use of mobile phones will be valuable in understanding the impact of other new technologies" (Crabtree at al. 2003)

1.4.3. MobileMAN studies for a social evaluation

For the reasons presented in the previous sections, we chose to perform the following studies to anticipate responses towards MobileMAN:

a) a collective **creative scenario and application building** activity, through an interactive wiki website;

b) a study on the **use of mobile phones** and the relationship that users have with this device;

c) a study on the use of **public hotspots** and the concept of "mobile connection"

d) a study on the **elderly and their relationship with new communication technology** to test whether MobileMAN could bring benefits to these people.

To complete the social evaluation, we also performed other activities, more of a theoretic nature, namely a theoretical reflection on the aspect of human **collaboration** – which is one of the core aspects of MobileMAN – and its application to peer to peer networks.

In chapter 2, we present each study with the main results and the conclusions that we considered useful for the social evaluation of ad hoc networks and MobileMAN. We also report aspects that are not strictly about ad hoc or MobileMAN but interesting for the concepts of mobility and future communication trends.

Results or discussions about core aspects of MobileMAN, such as the theoretical study on human collaboration, that were already included in other deliverables, will here only briefly recalled but not presented in extension.

2. EVALUATING MOBILEMAN SOCIAL DIMENSIONS

In this chapter we present the studies we have carried out to do the MobileMAN social evaluation. For each study, we briefly remind to the chosen outline, the changes we have made as new challenges arose and the interesting results that came out from the gathered data.

Activities already discussed and presented in previous deliverables will be only shortly addressed here.

2.1. Collective creative scenario building through wiki website

The activity of the collective creative scenarios and applications building through the wiki website that we realized for this purpose had three objectives:

a) to initiate a **dialogue** with individuals that would provide information, opinions and ideas for new applications and use scenarios for MobileMAN, as well as initiate **dissemination** activities among non-academic individuals;

b) to test "collaboration in use" by the students and "**collaborative interaction**" among users;

c) to test the wiki as participatory design instrument for this kind of activities (tool for collective brainstorming, independently from time and location of the single participants activity).

2.1.1. Initial activity design: two phases

Initially, to reach our three objectives, we considered to divide the activity in two phases: a first test phase with a community of students and a second, public, involving internet users interested in ad hoc networks and initiating a dialogue with them by means of the website itself. In the second phase we aimed at building a community of potential end-users, with whom we would maintain an ongoing discussion and exchange about ad hoc networks and their consequences. We set up for this reason a mailing list for users interested in this dialogue. The idea was to contact the subscribers on a regular basis and update them on the project status, the activities and engage them in discussions about MobileMAN.

However, as it will be shown later, the second phase was dropped due to the difficulties encountered. The website underwent a usability testing session, before the activity began, as already described in deliverable D8.

2.1.2. Phase I with a community of students: results

After the initial idea of involving a community of students in an informal way to evaluate the collaborative aspect, it was clear that **collaboration is not to be taken for granted and automatic**. Therefore, the next step was to involve a community of students, but to also reward

them for their participation. Even this way, the number of students who took part in the exercise was rather limited. However, this exercise provided us with the opportunity to draw a series of interesting conclusions. Here we describe in detail the activity and the findings that resulted.

The main objective of this activity was to involve a community of students in the definition of MobileMAN applications and use scenarios (participatory design approach). As already mentioned, we had other secondary objectives as well.

The collective creative scenario building activity was carried out in collaboration with a class of students of Networking at Helsinki University of Technology (Finland). The activity was undertaken from October 20th 2004 to November 30th 2004 and consisted of four stages:

1. description of the MobileMAN project to the students, clear statement of the activity objectives and its modality;
2. group activity of creative scenario and application building for MobileMAN;
3. commenting and completion of chosen scenarios among the produced ones during the previous stage (2);
4. filling of a questionnaire about ad hoc networks and the activity itself.

The number of students who participated[4] in the activity was thirty[5]. Most of them worked in groups of 2 or 3 people, one student worked alone. They were given the option to choose whether to use the wiki tool as medium for the exercise or to work without it (offline modality) and hand in their scenarios on paper. 10 chose to use the wiki, whereas 20 used the second option. It is interesting to note that although they are students of technology, almost all those who have filled in the questionnaire said they had never used a wiki before.

The created scenarios during the exercise were several and covered many different types of situations. Moreover, they were written in different styles: some were general whereas others had characters, locations and so on. It was decided to keep the styles as chosen by the students while reporting them in this deliverable. Scenarios and their subsequent comments by the students[6] are reported in the following pages. In the comments sections, text written in italic is comment provided by the students, whereas normal text is our consideration. We decided also to eliminate a few scenarios that were considered out of the scope, whereas **some others are reported even though they do not seem to exploit ad hoc features**. The reason for reporting them here is to show that students presented the difficulty to imagine true ad hoc scenarios.

A group of students provided a **military scenario**. Military application of ad hoc architecture is probably the most immediate setting scenario that one can imagine. This is due to the special characteristics of the situation: collaboration is granted because all have one common goal, that is, an enemy to fight. Moreover, military groups can be placed in a way that the network functionality is guaranteed (this is possible thanks to the hierarchy) and communication needs are important in military settings. The only issues at stake in this situation are the security and confidentiality of the transmissions. However, with this exercise we aimed at focusing on more "everyday" use of innovative applications with ad hoc as technological base for them. For this reason we do not report here this developed scenario. What differentiates this "everyday" use from a military setting is that in the former individuals (and therefore, nodes) are free to move and to choose to cooperate or not, as well as to what applications use.

[4] The activity was not mandatory: the students who chose to participate would get some bonus points for the final mark of one of their courses.
[5] The total number of students to whom the activity was proposed exceeded hundred.
[6] Basically this content was provided by the students taking part in the exercise. However, the text has been slightly changed and in some cases summarized by leaving out few elements considered irrelevant.

Emergency systems

Scenario:

Mr. Krister is going by car, form Helsinki to Tampere when he has an accident and gets seriously injured. The emergency ad hoc system of his car signals a SOS signal to the passing cars that also have the ad hoc emergency system.

The call is received by an emergency responding service that dispatches an ambulance to the location. The ambulance arrives. Medical teams use different sensors and relay the information to the nearby hospital, while some of the cars going on the highway voluntarily stop cars at appropriate distances so that information can be relayed to the nearest wireless infrastructure that would route the information from the sensors to the doctor trained for the situation. The doctor gives crucial advice to the emergency crew at the location and also discusses the case with other experts at other locations.

Thanks to the ad hoc emergency system, the paramedics can intervene quickly.

Comments:

We believe it isn't a good idea to expect people "voluntarily stop cars at appropriate distances" when they're driving on the highway. Perhaps some traditional media like GSM or TETRA would do the trick way better. Though tele-medicine is a good idea and is already in use in some countries (naturally without the ad-hoc network).

This scenario poses the issue of the quality of service (QoS): the described situation needs a system that does not depend on contingent parameters – if there were no cars near to the accident, there would be no way to transmit the information. **Since emergency in case of accident is a critical situation, the system must guarantee its functioning anytime and must be robust and reliable enough**. Pure ad hoc here would probably be not sufficient, whereas a backbone infrastructure would be more appropriate.

Conference in Paris

Scenario:

Tad is a businessman arriving in Paris to attend a conference. At his arrival at the airport, the organizers give him a device that can help him to organize his staying in the city. After installing himself in the Georges V Hotel, Tad wishes to explore Paris before the conference starts. The device will list the interesting places to visit. Tad can set an ordered list of preferred places that he wishes to visit. For example, he may choose the Eiffel tower, Arc de Triomphe, Moulin Rouge. To move around the city, he needs a taxi. The device provides him with his location and the location of the nearest taxi station. If it's really far from his location, he can request from a listed taxi company to come pick him up at his preferred time. The answer arrives to his device, allowing then to send his list of paths he made before. The taxi will be informed with the path, so he will know where to go. After a nice journey around Paris, Tad is afraid to be late to his conference. He asks his device to provide him the optimized way to get to the conference, taking into consideration many parameters like traffic jams, red lights and distance. He can book a taxi to take him back to his hotel after the conference end.

Comments:

There are a few aspects we didn't quite understand in this scenario. First of all why can't he use a traditional map of Paris instead of expensive ad-hoc gadget? It could be a lot of fun just to stroll around the streets of Paris and see a bit more than only the screen of your device. You could easily change your route if you for example see an interesting shopping street. Because Tad uses taxis there even might not be a situation where a map is needed.

The second thing that bugs us is the taxi station searching. Instead of fondling with his tool he could have only asked the receptionist if there are any taxi stations nearby. The receptionist would have probably told him that the nearest station isn't close by and asked if he wanted to have a cab ordered to the hotel. During his sightseeing we're pretty sure that he doesn't have look far for a cab station. There's got to be stations in front of these famous sights.

All in all we think that this scenario would cost quite a lot and brings almost nothing new to the consumers. It needs to have a city wide penetration of these devices to consumers and service providers to make the network possible. This could be implemented much more easily over traditional media (GPRS, UMTS etc.). Almost every service in this scenario is brought by a single source. For example the cab company informs the locations of their taxi posts and handles ordering of cabs. Where does this scenario use the advantages of the ad-hoc networks?

This kind of service is possible with PDA, cellular phone, GPS and "tourist card". This kind of card is a good idea. You can buy or rent a tourists card form the airport or railway station (or just load the information). The card has all the possible information like maps, shops, taxi, hospitals. The GPS points your location and new information authorities transmit new information via the GSM-network. But how about the ad hoc nodes? Every cellular phone might be also an ad hoc node. So you can transmit and receive data (location information, e-mail) and speech with your friends (you lost them somewhere near the tour Eiffel). If you don't have enough coverage then the secured messages can use local nodes.

This scenario truly does not present a situation where an ad hoc system would bring any real benefits to the user. The optimized route searching described, for example, would be more an issue for the taxi driver than for the passenger. Information about the landmarks or interesting places could easily be transmitted – as already anticipated by the students' comment – through GPRS to the mobile phone. In fact, a simplified version of this service is available in Italy through SMS.

Public festival

Scenario:

In a public festival condition there is unusual lot of people in a small area. The base stations are usually stuck in this kind of situations. Everyone tries to call or to get some other service. Maybe an ad hoc network could help the situation.

There is a group of three teenage boys who are interested in rock music. They are going to a summer festival in Kaisaniemi. Kaisaniemi is full of people and everyone has his own interests. With traditional cellular phones the only way to get the group together is to make calls or send SMS and arrange a meeting point. With their MobileMAN terminals the boys can find each other easily with the help of position information.

The town has supplied some portable toilets, but there are too few of them. Queues appear, but with the MobileMAN terminals the boys always know where the queue is shortest. Based on the positioning information and proximity of the toilets, previous users' terminals inform others of the queuing time. Similar time estimates can be queried for the drinking and food facilities.

It gets very crowded in front of the stages when the most popular artists are performing. Even the time it takes to move from one stage to another varies accordingly. One of the boys, Pekka, wishes to see Lordi who starts playing in ten minutes. His terminal tells him that the audience has already started approaching that stage and he would have to start walking in a minute to have any chance of reaching the front row. At the same time, his friend Tomppa has plenty of time left before he has to leave his current whereabouts for the performance of Tapani Kansa: the concert is a little behind schedule, as the terminal shows him.

The third boy Urmas doesn't like Lordi and stays with Tomppa. He is single and has set his profile in his terminal to "willing to meet girls". When Tapani Kansa starts his show, Urmas' terminal beeps and tells him that the girl near him has a similar profile. They start talking and find out that neither of them likes Tapani Kansa. Who knows what happens when they turn off their terminals...

Comments:

This scenario is a really good idea in the sense that the occasions where many potential ad-hoc device owners are in considerably small area will be rare for many years to come. Some problems could come with the usage of position information with queue length approximation, though. To get the queuing times there should be someone willing to have a device gathering and transmitting that data.

The problem that can be envisaged in the case of the information about queuing at the various facilities where there are numerous people gathered in a small area is that **this kind of information has to be processed and organized**, otherwise if everyone gets the same information and everyone decides to go to place A instead of place B, the problem of congestion will not be solved, since as a result, place A will be crowded and the problem would only be shifted to a different location. As a general comment, though, the festival scenario where there are typically great number of people gathered in relatively small areas is the **typical situation where cellular networks get congested and communication through mobile phones is impossible**. This is what happens often – for example – at new year's eve, where many people go to places and streets and the request for channels for either phone calls or SMS are high because of the particular moment. In such cases, ad hoc would provide a functional network.

Multiplayer game

Scenario:

Mobile ad hoc networks could be used for simple multiplayer gaming. For example, if you want to play poker, you start your mobile connection and search for peers to play with. There should be plenty of players in a metropolitan area or a smaller 1-2 km area if the games are simple and appealing enough. This could be nice entertainment for lunch of coffee breaks.

Also, games suit well for packet loss if you play games with a lot of action, because it doesn't matter if the player sees some lagging on the screen. Mobile ad hoc networks that are used in this way would be quite similar to Bluetooth multiplayer gaming (like Nokia N-gage), but with larger radius and more players.

Comments:

It is a good idea to have such scenario implemented on a large scale ad hoc network. I think that gaming is and will be a hot topic for young people in the very near future. It may even be

addressed as a requirement to any future mobile network. What I have seen today concerning gaming issues is that it is only supported in terminals within a limited area with Bluetooth. If this limited scope of gaming could get stretched to larger areas, it could be a promising business case.

As it is possible to see with mobile phones, multi-player games have had great success among young people. In this sense, it can be said that indeed this game applications could be an interesting way to use ad hoc networks. However, in our opinion, **it is not possible to conceive MobileMAN as a device designed only or mainly for this kind of application**. It is in any case an interesting value-adding type of application.

Reactive journey planner for public transports

Scenario:

In the region of Helsinki there is a popular service called Journey Planner. It finds an optimal route for a passenger using buses, trams, trains and subway trains in the Helsinki region. It is used mainly via an internet site (http://www.reittiopas.fi/), but it is also possible to use it via SMS queries from a simple GSM phone. The Journey Planner has one great shortcoming: it is based on predefined information about schedules of the vehicles. It cannot react, if vehicles are late or ahead of schedule for any reason, since it does not know anything about the movements and whereabouts of vehicles.

Our solution is to distribute the backbone of the system to the buses, trams, trains and possibly even on subway carts. The ad hoc network is based on backbone nodes installed on vehicles. A backbone node has a powerful computer to do the required computing, a powerful transmission unit and a good antenna system. This is possible to do on a vehicle, but not in a handheld terminal. In addition, backbone nodes have information about their location (via a satellite positioning system) and the schedules of all the vehicles in the system (updated each time there are changes in the schedules, at maximum a few times in a year). The vehicles act as central nodes of the network, while moving in the urban area. They constantly update the network information about other vehicles. When a backbone node detects that its vehicle is running late or ahead of schedule, and the difference to the schedule is greater than normal variation, it broadcasts this information to all the other backbone nodes. The same applies if the vehicle becomes inoperable (for instance due to an engine failure). The backbone nodes update the information of differences to the schedules in their local databases. Naturally, if a backbone node detects that it is again within normal variation with regards to the schedule, it will broadcast to the network that the situation is back to normal.

Querying for suggested route

If a user of the system wants to know the optimal route (in a physical sense) to their destination, they use their terminal to ask the network for the service. If there is a backbone node nearby, it answers to the terminal based on its current database. If no backbone node is reachable, the query can be relayed via other terminals.

The suggestion of a route requires (in addition to the information about the desired destination) knowledge about the location of the terminal asking for directions. This can be achieved in multiple ways:

- terminals have built-in satellite positioning system or they know their location because the user tells their location when doing a query;
- the backbone node answering to a query estimates the location of a terminal based on the direction (and possibly hop count) from where the query arrives.

Analysis of network traffic and availability of the service

In our network, all continuous broadcasting is done by backbone nodes to maintain the network information. Other broadcast traffic is done only when changes to accuracy of the schedules occur (by backbones) or when querying for a route (by the terminals). The terminals have to listen for network traffic in order to learn about routing requests and to listen for backbone nodes to know if a backbone node is possibly reachable. In a dense urban area, it is likely that there are enough backbone nodes to keep the network operation. We estimate that backbone nodes can communicate with each other over distances up to twenty kilometers. The terminals can communicate with each other within distances up to 500 meters and with the backbone nodes up to 2 km. It does not seem impossible to reach a backbone node via a few hops through other terminals. Of course, the network would have to be based on best-effort model, since there is no way of guaranteeing availability of the service.

Comments:

Basically we like the idea that one could know where the buses are going and if there are any delays etc. And if there is a delay the terminal would show an alternative route to the destination. But we don't find the use of ad-hoc networking quite justified in this scenario. Why can't the buses use GSM? GSM-networks are already up and running basically everywhere where the bus must operate. Then there could be a GPS/GSM system in a bus which sends a text or GPRS message to a dedicated bus location server. The server then informs each bus stop also via GSM.

Actually they are planning to insert a similar system to the "Jokeri linja 550" buses in Helsinki. Then, at each bus stop there would be a screen where you can see the expected arrival time of the next Jokeri bus. Cutting down the transmission expenses is the only reason we can pick to use ad hoc networking in this scenario, but then again the supposed 20 km transmission range sounds pretty optimistic.

This scenario presents an interesting application. This is even more justified by the fact that if cities can provide better public transportation service – more efficient and effective – citizens could decide to rely on this instead of using their own car. Thinking of the pollution and congestion problems of modern cities, this improvement of public transport could be a solution. However, it is true that already set up **GSM networks could serve this purpose**.

Ad hoc in auditoriums

Scenario:

This scenario is about the different devices to be found in a typical auditorium. Normally, there is a computer, audio/video appliances and usually they are connected by wire. The wires are usually in a mess and it is almost impossible to connect, for example, a laptop to the system.

We had a vision of a system that has no interconnecting wires, where every device would be able to communicate with each other automatically. It would be also possible to bring a "foreign" gadget into the system. For example, a Power Point presentation could be shown from a visiting presenter's laptop. Also controlling the presentation would be possible with a small handheld device. This way, the presenter doesn't have to break his speech to move to the next slide.

This kind of network should be fairly easy to implement to present day auditoriums with Bluetooth. All it needs is a single Bluetooth receiver to receive information from the "foreign"

gadget, a couple new open standard protocols to handle the information. All the other devices could be connected using traditional wires.

Comments:

This idea is good and there's definitely a need for this kind of system. The only thing is that we don't quite see where the ad-hoc nature of this system is used. Everything depicted could be realized with a simple base station instead of an ad hoc architecture. Every device in the auditorium could use the same Bluetooth (or whatever) receiver that the "foreign" gadget uses in the scenario. Certainly, there are issues with reliability and so on, but still the ad-hoc version doesn't seem very useful in this kind of situation.

One of the issues related to ad hoc networks is **mobility**, issue that is not really present in this situation. Moreover, since the need for mobility is rather low here, wires could be used also for power transmission, so that batteries would not be consumed. It is however true that the presented scenario is a situation where probably cooperation among network users would not be a problem, since individuals are gathered for a specific and common purpose that makes them more willing to cooperate to make the ad hoc network function.

Ad hoc in moving vehicles

Scenario:

This scenario is about a network between cars where it would be possible to send information to other people on the road and also the vehicles would be able to communicate between each other and make the journey safer.

The main idea is a network of access points along main highways connected to each other and possibly to some bigger network. Passing cars would then form a network around these access points and between each other. The poles could be a source of information that the vehicle would then show to the driver. The information could be for example the speed limit on the road, or a warning of slippery road ahead. This would be extremely helpful in situations when the conditions on the road change rapidly. The authorities would then be able to change the speed limit according to the weather. The network would also be able to warn the driver to brake before they hit heavy traffic or warn of a nearing crash site.

A "pole-based" network would require major investments from the government, possibly new communication wiring along the highways, but the system could also be made completely independent so that it works completely between cars. This way it would be possible to get information even on smaller roads, where building access point poles would be too expensive.

Use case:

Two friends are driving their cars from Helsinki to Rovaniemi along small roads with light traffic. Matti started an hour before Timo. Matti receives a message from a passing car that a major car crash blocks the road 100 km north from his location. At the same time his car tells him that he is running out of fuel and that there is a gas station after 10 km and advertises cheap hamburgers on sale there. Matti would then send a short voice message to Timo that he will stop at the gas station and wait for the road to clear and maybe they could eat a hamburger there. Timo's vehicle then receives this voice message from another passing car and stops at the gas station. They then continue together their journey when the road is clear again.

The example brings up a few problems in this type of ad hoc network. How long should every car store messages if there is no one else to send them to? How to route packets in heavy traffic where there is a node every few meters? With a lightweight set of protocols and regulated access (only vehicles are allowed) to the network it might be possible to build an efficient enough network. Some parts are already in use, for example RDS radio can send text based information and advertisements and coupled with GPS navigation system a driver might get information about heavy traffic, but an ad hoc network of this scale would offer a wide variety of services easily modified to different needs.

Comments:

Nice! We especially liked the part where passing cars inform of heavy traffic and crash sites ahead. Also the way cars driving in a line form a network to reach the nearest access point sounds very "ad-hocish". The way devices inform of problems ahead could efficiently replace headlight flashing that can today mean anything ranging from a big animal on the road to a police speed control warning.

Gathering the information could be made pretty simple if a car driver pressed a certain button of the device (or maybe use some voice command) when they see some problems that someone going to the opposite direction might be interested to know. Then the device would actively transmit the data to cars passing by.

Also, one must-have functionality for the device would be some sort of counter of how many cars have reported of certain kind of a problem ahead. With this data one could decide how trustworthy the information is and should he take a detour or just keep going.

The GSM services (SMS) and the RDS-radios and radio stations already send this kind of information. The market is open and customers could be willing to buy it at a reasonable price. The solution is not simple. The quality of service might be a problem for example when hundreds of cars are in a traffic jam or in a local road. The solution requires base stations, which have a good coverage. Ad hoc node solution must be cheap so that car manufacturers are willing to set it into all new cars.

This scenario offers the opportunity to consider the speed related issues: in this case, mobility is a high requirement of ad hoc network systems, but on highways, cars travel very fast and therefore the **network topology changes quickly, requiring high dynamics and exchange of information between the network nodes.** However, the interesting aspect of this scenario is that a device inserted in an electronic car system would not pose any battery problem, since power would be provided by the system itself. The authors of the comments on this scenario raise two important aspects:

- if the source of information is centralized, there is no issue about the need to control the information to assess its authenticity[7];
- however, a drawback is that centralizing the source of information would first of all slower the process of transmitting information (it would in fact be quicker if a user could be distributing the information almost real-time, without the need to a two-step process: car – central and central – network users) and secondly, it would not truly be an ad hoc system.

[7] In a situation where any user can publish content there is a threat about the authenticity of information. This is what we can say about internet, where anyone can publish something. The drawback is that there is the need to be able to identify good quality articles or opinions from bad ones. It is a matter of the reliability of the source. If the source is an authority then we assume that the information is true or veritable. When anyone can publish information it is not possible to make this assumption. See on this subject, section 3.1.4. of this deliverable.

Resource sharing system between mobile terminals

Scenario:

Practically every hand-held communication device has some upload and download stream to internet. It may be GPRS or EDGE, even WCDMA in the near future, but in the users' point of view, it's always too slow. Also, in every device there is some processing unit, for compressing still-pictures, video or sound to some more disk-effective format.

Users' don't use these mentioned things continuously, but as brief sessions every now and then. Here comes the very basic idea of using ad hoc network: let's share our own capacity (internet connection or processing power) to neighbors.

Simple web-browsing is a good example: most of the time we just read the text, or view the pictures. During that time our connection is idle, so it can be easily lent to any host in our network. In the same way, we get more download-speed while getting the next web page.

How about video-clips? We take a short (10 minute) video clip, and want to compress it with some high-quality algorithm. While the resolution and color-depth of video is getting better all the time, compressing also gets more CPU-intensive. If the ad hoc network is a broadband net, then it would be easy to split the video clip to pieces, and let all neighbors to compress their own small part of 10 minute clip. If the neighbor-host is not doing anything CPU-intensive (as it probably is not) then it's definitely not a problem to share the workload.

What do we need?

Ideas like these are not new. There has been a server-clustering for years in the market, but bringing the concept to mobile, low power consumption hand-held devices is a brand new thing at least to our knowledge.

From the hand-held device we need basically the capacity. There is, and there will always be both old and new devices deployed. Hi-end products are more valuable in this kind of resource-sharing, so we need a "critical mass" of these to make the whole thing to run.

We also need bandwidth, especially when sharing CPU-power. This kind of "Seti@HAND", would then work on small hop-count ad hoc networks, maybe just one hop. This is because we feel it is not efficient to transmit information too far in the ad hoc network. This is perhaps not as metropolitan as MobileMAN wants, but we thought this was also worth sharing.

Comments:

The idea for sharing processing power among distant devices is good; however the problem is how to convince every user to share their limited resources? A solution could be borrowed from the p2p sharing services (eMule) - if one is ready to share more of their resources, they will get a better service when they need it.

This is a good idea! It has been proved that this kind of stuff works and people are willing to share their resources for example on the Internet (p2p systems).

There's only one problem with mobile devices. When you use normal computer's excess resources, those resources aren't "away" from anyone. Instead with mobile devices some CPU intense activity always reduces the lifetime of the battery. The question is: how many of you are willing to recharge your mobile device a couple of times every day just because the kid next to you wants to encode some new Britney Spears mp3's?

Perhaps with some restrictions to who can use the resources and how much could make this scenario possible. Or if the battery lifetime is multiplied due some new technology people could become more willing to do their share.

Hunting group

Scenario:

If we wish to create an ad hoc application that could work in the near future, we should direct it to a group of people already familiar with each other and sharing a common activity like hunting. Then, they could have similar ad hoc devices capable of communicating seamlessly and we wouldn't need a large penetration or a universal standard.

We would get the most out of the ad hoc nature of the network when these gadgets were used in absence of base stations and traditional communicating networks. This kind of scenario would be natural if we were for example in the wilderness or at open seas.

We assume the device's range would be around 200 meters and devices further away couldn't communicate directly. Therefore, if the users were in a formation where everyone cannot transmit directly to all, the data should be routed through the ad hoc network. The network would be created dynamically when the group comes together and wants to communicate. The device should have multimedia capabilities and an integrated GPS unit. In addition to location information, GPS could be used for geographical ad hoc routing.

Use Case

A group of friends wants to go hunting to the wilderness and they take their ad hoc/GPS/multimedia devices along. They decide to form a line where they are placed approximately 100 meters apart. They check on their devices on-screen map where everybody else is located and draw shooting sectors to the touch screen. The information is distributed through the ad hoc network and everybody knows where they shouldn't go if they don't want to get shot. If somebody decides to move, the device informs other devices about this according to data of the GPS unit. When someone sees a deer or some other animal, they can point the location of the animal on the map of their devices and then everybody knows where they should shoot if they get a clear shot. They could also use the multimedia abilities of the gadget to inform others of interesting events by voice or pictures. This functionality would be similar to camera phones we have nowadays, but when the data is routed through an ad hoc network it would be free of cost and independent of operators and base stations. For voice communication the device should have a separate headset with a voice-activated microphone so one wouldn't have to fiddle with the device to communicate. Speech could be directed either to all others (broadcast) or only to a single device.

In the future, when ad hoc is implemented in regular mobile phones, similar applications could be realized by a relatively simple piece of software. Then everyone with such device could participate in ad hoc enhanced hunting and other activities.

Comments:

This would be a very expensive hunting gear... and usually groups are not large or well organized and people go there for fun and not to follow screen instructions.

We believe this could have applications in the military where a scout group could use this technology to inform about each other's relative positions and also point to enemy locations (this

technology could be used instead of location data, obtained by spying satellites). The group could communicate with their base by dropping transmitters while on their way to a recognizance mission.

We believe that speech is not an application for ad hoc. It consumes power and you already have short wave radios, so we see no need for it.

We strongly disagree. This gear wouldn't be expensive at all considering that today many hunters use GPS and similar devices. Certainly, the technology today is rather expensive, but when it's as common as GPS the price tag wouldn't differ too much.

And you claim that groups aren't large or well organized. That's true for some forms of hunting (no need for an army to shoot a rabbit), but when you're hunting bigger game (as in our use case) it's very common that there's over ten hunters striving for a common goal. Actually a friend of ours who is hunting elks told that ten hunters is a minimum for a successful hunting trip.

And yes, people go there for fun, but the screen instructions don't do any harm. For example the screen instructions increase the safety of this hobby and just make it more fun!

Your spy scenario makes sense though. But the claim that speech consumes (too much) power is a bit absurd since our cell phones (and the short wave radios you mention) already transmit speech successfully with today's battery technology. When we get better batteries to our ad-hoc devices the power consumption shouldn't be an issue in this case. And it's always one device less when you don't need a separate GPS and short wave radio. Then there are also issues with short wave radio blind spots that ad-hoc devices could overcome with smart routing.

Hand-portable hunting radios are popular and quite cheap. Ad hoc-network would be an interesting solution. In this scenario the ad hoc-network provides better coverage than traditional radio network. The hunting group could use larger area and transmit or receive data or speech.

Ad hoc-nodes with GPS and map make it easier to navigate in the forest and location information of hunters is a good life insurance. Radio solution might be combination of VHF-hunting radio and GSM- or UMTS-phone.

The hunting data and speech will be transmitted in the VHF band and the GSM will be used as a support and also as an emergency phone. This kind of hunting radio might be one solution for node 3 in military environment (look at the military scenario).

The interesting issue introduced here is the fact that **a MobileMAN ad hoc device alone would be useless**[8]. The idea of introducing it first to close groups of people who have a common goal seems a good way to market such device. Unless there is a way to connect such device to already existing networks such as GSM or UMTS a single user would not buy it (like it would make no sense to buy one walkie-talkie alone, and not in pairs!). A similar scenario is the military use of ad hoc: there are a number of variables that are in common.

[8] This aspect was raised by several participants in our studies. Being the ad hoc network not integrated in other networks, two individuals need both to dispose of an ad hoc device to communicate with each other or share files and documents.

Conference files sharing

Scenario:

When traveling at conferences, it would be convenient to have local access and file-sharing of corporate reports or transaction databases. For tradeshows (such as CeBIT), collaboration between various vendor displays could harmonize demonstrations and show compatibility of software, hardware, or other mobile-enabled devices that need to communicate with one another that might not necessarily need access to the internet itself (such as calendars, timers, registration information, maintenance, etc.). As an example, a Bluetooth connection has a radius that is too small for large scale trade conference applicability, but ad hoc networking would be ideal.

Comments:

The idea is good. Every fair event where there is anything that works with electricity, ad-hoc file sharing would be needed. There may be problems to solve regarding authentication and encryption, but modern handheld-devices have enough processing-power for that so it's 'only' software issue. One application would be "ask-the-speaker", where the audience could make anonymous questions to the lecturer with some sort of messaging system. Also, one could define an interest profile of the topics in the conference or fair. Then the ad-hoc network could notify of events (keynote speakers, presentations etc.) that are marked as interesting in the profile.

The comment is on a technical misconception. Bluetooth also allows an ad-hoc network facility (in a different way) and its range can be as large as 100m with a relatively better battery/power source. In fact, this scenario doesn't need necessarily an ad hoc network, because there is no dynamism in the topology. Nodes form a pretty good static setup, so Bluetooth can serve the purpose if the participants are less in number.

Again, this scenario could make use of an already existing technology that relies on a (limited) network infrastructure. Moreover, the application about **anonymous messaging would present the security issue** – anonymity can trigger some malicious attacks. Security is a huge issue in ad hoc networks, since there would be no way to control the communication processes

Vehicle annual inspection and automation functions

Scenario:

Someday, cars will have computers inside. An environment that would be easily used for ad hoc networking is when a vehicle is taken for its annual registration inspection. The inspection institution could access the computer of the vehicle and determine if all components are in order. Secure serial numbers and MAC addresses may someday replace VIN (vehicle identification number). Another application is related to GPS positioning of vehicles. The headquarters of some organization may wish to keep an updated status of the location of all of its delivery vehicles and the status of completed deliveries or to provide updated delivery information to a particular delivery vehicle and simply transfer the updated routing information through its ad hoc network of delivery trucks.

A related field is in the automation of factory production functions. Robots, computer, ERP systems, and personnel may need to share data in order to optimize the production schedule, perform manufacturing machines set-ups or changeovers, or even to provide status information on order fulfillments. An internal ad hoc network could be used between the various devices as

needed. Sometimes people, trucks, goods, or work-in-progress inventory leave one factory location for another and serial numbers or RF tags can be used to share information at various points in the network.

Comments:

The idea of controlling vehicles from distances is not new. It does not require much bandwidth, but it has to work everywhere. In ad-hoc networks the low bandwidth-requirement is fine, but ad hoc's don't work everywhere. There has to be enough nodes to create the network. So, this annual inspection would be better to do with existing GSM-network. Single SMS-message once a year is enough to do the trick. Especially when it comes to corporate vehicle tracking, it's not enough that network is up, say, 80% of the time. It has to work 24/7, so an ad-hoc net is probably not the best technology to use. As stated in the scenario, an ad-hoc network of the vehicles combined with GPS could provide organizations using many vehicles (taxi firms, authorities, etc,) with an up-to-date picture of the vehicles locations and help optimizing the logistics. This requires that the network technology used is powerful enough to form the network of all vehicles in the desired operating area. Luckily vehicles are identical platforms: power consumption would not be an issue, and a proper antenna would be rather easy to install.

As already mentioned, in this scenario there is a need for a wide ad hoc network, which might be difficult to have in a total ad hoc way. One option to overcome this shortcoming can be the **combination of ad hoc with an infrastructure-based backbone**. This could guarantee the presence of the network in places where nodes density might not be sufficient. A difficult issue in this scenario is the protection of **privacy**: who could have access to the information of car-location? And would it be possible to switch off the tracking system? All these issues would need a clear and unambiguous legal regulation to prevent privacy harmful use.

Entertainment broadcasting

Scenario:

Some people may want to broadcast music or movies, by creating their own radio/television station that distributes content to local computers in an ad hoc network. For example, if someone holds a party at home and wants to have the music/video feed to all the rooms in the house during the party, this could be done through a secure local ad hoc network that streams the feed to all televisions, monitors, speakers, and connected devices in the home.

Comments:

I think that telecom regulatory will have some words on this. Besides, this scenario will need special TV / radio / computer that support ad hoc networking; this means that one needs some new system. Moreover, there are plenty of available systems that can give a similar kind of "local broadcast" service without ad hoc networking. I think that local broadcasting is out of ad hoc network scope.

Indeed a very good idea, but needs more optimization. During this broadcast, routing tables can also be updated more frequently. Another prospect is the practicality of this idea. Perhaps this can only be deployed in a non-commercial setup. Because of ADHOCness (i.e. dynamic NW topology), there may be islands in the network so that not all nodes may be in contact with each other. Hence the broadcast may not reach all nodes.

A similar system is already in commerce for audio applications: Apple AirPort Express[9] is a system that broadcasts music stored in the iTunes library on someone's computer to the stereo via an access point and an adapter to be placed in the stereo. Although this is only a limited application, it uses the same concept. Again, **there is no strict need for ad hoc, although it is true that ad hoc provides the advantage of having no infrastructure to set up**.

Regarding the telecom regulation issue, this should not be a problem since it is for private use in a personal environment (home) that needs no regulation (as Bluetooth).

Business use

Scenario:

A company could have a project that a consulting firm (BCG, Mc Kinsey) is working on for the company, but may have only restricted file access. A dedicated laptop with the unrestricted access files could be given to the consulting company for use in analyzing the case/project. Similarly, as the computing power grows, when a company has its annual report audited by and independent auditor (such as KPMG), the auditing company could be given access to all transaction files for a given year (ERP database) by use of transporting a laptop to the consulting firm for collaborative auditing done by the auditing firm. For larger organizations, several auditors may be required and by giving them simultaneous network access to files without having to transfer them over the insecure internet (through ftp) makes ad hoc networking a perfect opportunity. The time needed to complete an audit would be reduced and all parties benefit from the positive effects.

Comments:

This does not seem to be a problem that ad hoc networks are invented for. The access limitation has nothing to do with mobile networking. Nowadays there are plenty of software solutions that are addressed to implement access limitation on top of any network. If we think of giving some consulting company a remote access we can do this over the internet using some VPN with controlled username and password. If you are giving unlimited access by a laptop, there is a huge risk in this if the laptop has moved or was stolen by somebody else... I think that companies will not be willing to use such scenario with such risk.

We've similar comments. In this scenario, it was not mentioned how the ad-hoc principle (establishment of dynamic network without configuration) in general would serve the purpose. Perhaps the co-ordination of multiple auditors itself can enjoy benefits of ad hoc networking.

Definitely, this does **not seem to be a scenario for an ad hoc network**. The problems raised in this situation are not the typical of mobility and ad hoc networks.

[9] See http://www.apple.com.

Remote control

Scenario:

This scenario is about the possibility to configure another device remotely (i.e. alarm clock). Such kind of service will open the window for some two use case as examples.

Use case 1:

A mother outside her home wants to remind her son at school, to pick up his sister from the kindergarten at 4.00 pm. She has an important meeting starting at 3.00 pm and ending at 6.00 pm, and will therefore not be able to use her mobile device in the meeting. She is afraid that if she called her son before 3.00 pm, he may forget, so she will use the alarm clock of his son's mobile device to be at 3.45 pm with the text "do not forget to pick up your sister".

Use case 2:

A woman has an old mother who has some illness and easily forgets to take her medicine. One day, the woman leaves her mother alone while she is sleeping. She has some important issue outside home to do. The woman does not want to wake her mother up to remind her about the medicine time, and she is in a hurry to catch the bus. So, when the woman catches the bus and she is sitting in it, she can use the feature "configuring another other device remotely" to set up the alarm clock of her mother's mobile device at 9.00 am with the text "do not forget to take your medicine".

Comments:

This is an interesting type of application for a handheld device. However, the question to be posed is whether an ad hoc type of network is appropriate or perhaps a combination with a stable infrastructure backbone would be better. To be really interesting, such application should be usable from distances. There would be in fact no point in commanding a VCR device from the kitchen to the living room. It becomes, instead, useful when there are distances between devices. In this case there is the need to have a network of big dimensions otherwise it does not make real sense.

Calendar server service

Scenario:

This scenario is about a calendar server service for corporate/business usage. Nowadays, everybody carries their mobile device, but not all of them carry their PCs or laptops along. Even those who carry them do not always remember to synchronize their calendars and there is a very high probability that mobile device and PC/laptop are unsynchronized. The mobile device is the one that we carry all the time. So, the mobile device calendar should be the reference/main calendar for every corporate employee or businessman. The application consists of the possibility owned by every mobile device to update and read its calendar from a specified calendar server "online" and not from its memory "offline". This kind of idea can also be used for presence aware services.

Use case:

I wish to invite my colleague to a meeting so I send them from my pc an invitation request by email. They get the email and accept the meeting. My calendar and my colleague's one are both

marked with the same meeting. The mobile calendar server hast to be synchronized with the email exchange/calendar server to have this information. When I check my mobile device calendar, it will contact the mobile calendar server and show the meeting, and it may as well copy it to its own memory (update). The same thing will happen to my colleague's mobile device calendar. In this case, if my colleague or I forgot to synchronize our calendars with outlook there will be no need to do it. The mobile calendar server might be exactly the email exchange server, but there has to be a light client in the mobile device to be implemented to download the information.

Comments:

This application may be also extended to other kinds of data (emails, documents, website favorites) that a person might have stored locally on a PC and might need even when not sitting in front of it. However, it is not really clear where the ad hoc nature comes into play in this scenario.

Travel and shopping guide

Scenario:

"You have to bring these things today, don't you remember? How many times must I remind you?" This was the daily life conversation between Imran and his wife. He's become used to such scolding by his wife, so without murmuring any words, he had to leave his experiment in the middle. While taking the list of things to be bought, he was ready for the next attack: "And listen! Don't waste time gossiping with your friends on the way or in the shop. And if you missed something, I'll lock out your lab and you'll have to go to the shop again."

Was he dumb or was her wife cruel? A person like him cannot be dumb. A genius of his field, he was the chief engineer of a company. Sometimes he was even busy with his innovative thoughts in his private lab. In those times, he was really occupied with the thoughts that he even used to miss the bus stop, forget to buy things, and even take more time to locate things in the shop. Naturally, her wife was suspicious of him wasting time in some other activities. How a genius could be both smart and simple?

But this time he was really afraid of his lab being locked. He couldn't afford this at that particular stage of his experiment, so he finally decided to act on a plan; he was thinking of for quite a while but forgot each time. Instead of going to the supermarket, he went to some other place and came back with someone. He spent some time there with his new companion and then continued his travel by bus. Surprisingly, he didn't miss the exact stop, nor did he take the wrong bus. After reaching the shop, he went to the exact places where he picked all the required things in the desired quantity. When he went back home, his wife couldn't believe that he wouldn't miss any thing and would return so quickly. Leaving her surprised, he entered the lab and closed the door. He picked out a small gadget like a PDA and placed in the drawer. This was his small companion, which guided him all the way.

Indeed, this small device was capable of doing many things with the innovative technology of the time. At the bus station, it would help him catch the right bus by indicating the bus number and time of the bus for a particular destination. During the journey, it will indicate the appropriate stop with a beep. If the list of things to be bought is feed into it, it'll locate the shop to buy the things from. While passing though the shop in search of things, it'll notify if something in the list is available in the nearby rack. Imran decided to reveal the true account to his wife at the dinner, so that she could remind him using it again next time.

Comments:

In this scenario it is not clear where the true ad hoc nature will give an added value to the applications. In fact, although these can be seen as interesting and useful, they can be provided through an infrastructure-based network, making use of various access points and central databases with information to be accessed with a query by the user through their devices.

Where-to-party

Scenario:

One great way to use MobileMAN would be Where To Party-service. It works in big cities where there are too many options to choose from. We have this imaginary fellow called Peksi who is a tourist (he may as well live in that city). Peksi is going out and he asks his MobileMAN which would be the most suitable place to party. MobileMAN asks Peksi what kind of partying does he like, how much money he has and what kind of people would Peksi like to meet. MobileMAN sends a query to central database and returns a list of suitable places nearby. Peksi has now something to count on. Peksi can ask for further information (prices, crowdedness etc.). Now Peksi chooses one option and MobileMAN tells Peksi the easiest way to get there. The most interesting part of this scenario is that now Peksi can search for other MobileMANs information and find out whom else is going to the same party. MobileMAN gives a small profile of other participants and Peksi can now make the final decision whether he wants to party with these people or not. Peksi can even make a ticket reservation to make sure he won't miss the party. Now MobileMAN has done its job, the rest is up to Peksi.

Comments:

Maybe every mobile station could have some kind of database which tells the users plan for night. The persons whom the user doesn't want to meet might be bar hopping and the user doesn't want to end up in the same bar at any point of the evening. Or maybe the user would like to join them later.

That guy in the scenario wants to meet new people, so the service should somehow be able to define users' profile. Add a camera and artificial intelligence: styling tips and a shopping list.

There are already city guides over internet that give information about where to go and what to do when visiting or living in a city. However, a mobile device like the one described in this scenario would add the mobility of the users. An added value could be a user profiling function so that one can see where there are other persons that share their interests and would like to meet. This is an application type that would combine mobility and already existing internet applications that allow someone to extend their social network.

2.1.3. Encountered challenges

The first encountered difficulty during this activity is the **attitude to collaboration of the individuals**. This aspect is rather important for MobileMAN, since it directly relies on the level of collaboration of the users. The activity shifted to a later period than planned because it was necessary to find a strategy to involve the students in this activity. The collaboration with HUT students required that participation of the students was tracked so that they could be rewarded for

their actions. This presented the technical issue of setting a compulsory login to access the wiki so that it was possible to identify who did what on the wiki pages.

Secondly, we must say that a wiki interface is not easy to handle for new users; many of the students who participated said that they had never used a wiki before and that it took some time for them to become familiar with the features of the pages. Some tried to use it but switched to paper as medium for their scenario building because of the difficulty to use it.

A third difficulty (and perhaps the most important aspect for us) was the **abstract nature of ad hoc networks**. In fact, many of the created **scenarios do not really exploit the nature of MobileMAN as ad hoc network**. This confirms what we already said in this concluding deliverable: individuals have huge difficulties in seeing the aspects that are specific features of ad hoc networks.

2.1.4. Results from questionnaire and comments

As a general conclusion, one student wrote: "*After reading a bunch of possible scenarios for the MobileMAN technology, the biggest problem seems to be that most of the stuff that could be done with ad-hoc networks can be done way easier with traditional (base station based) technologies. The situations where ad-hoc network is clearly the best or only solution aren't, at least according to the scenarios, very common. And that's exactly what we would need to make the networks possible: a common every day killer app.*"

The activity – although did not involve a great number of students – provided several different scenarios: some not too original in the applications, some others instead presenting interesting potential application areas. **In general, the question is whether an ad hoc architecture underlying the applications is appropriate or not**. Looking at the mobile phones development in Japan (iMode by NTT DoCoMo) it is possible to see that interactive applications similar to some of the ones presented in these scenarios can be served to the users through advanced 3G networks. This kind of networks avoids some problematic issues typical for entirely ad hoc networks. The consequence is that we need to **carefully identify where a technology like MobileMAN would give an added value**.

Results from questionnaire

After the scenario creation and comment activity, a questionnaire was given to the students. The questionnaire covered several topics, such as evaluation of the activity itself, questions about technology in general and more specific questions about MobileMAN. 19 students filled in the questionnaire and returned it by email.

A part from one student, all worked in groups of 2 or 3 (9 groups of 2 and 9 groups of 3). At the question about how difficult they experienced this activity, 9 responded they found it easy, 9 of medium difficulty and only 1 found it difficult (see figure 2).

Question: How did you find this activity?

EXERCISE DIFFICULTY	FREQUENCY	%
it was easy to imagine applications / scenarios	9	47.4
it was of medium difficulty	9	47.4
it was difficult to imagine something about the future	1	5.3
Total	19	100.0

Figure 2 – Repartition of the answers to the question about the difficulty of the activity of collective scenario / application building.

At the question about whether they found the wiki interface complex to use, the students responded in the following way: 5 said it was complex, 7 said it was a little complex, 4 said it was not complex and 3 did not respond (see figure 3).

Question: Did you find the wiki interface complex to use?

WIKI INTERFACE WAS COMPLEX?	FREQUENCY	%
No answer	3	15.8
yes	**5**	**26.3**
a little	**7**	**36.8**
no	4	21.1
Total	19	100.0

Figure 3 – Overview table of the answers to the question about the difficulty level of the wiki interface. If we group the positive answers we obtain a total number of 12, which is rather high.

An interesting result from the questionnaire was the answer pattern to the question about the future relationship between ad hoc and infrastructure-based networks: a part from one, who did not respond, all (18) had the same opinion that **ad hoc and infrastructure-based networks will complement each other** (figure 4). This is also in line with the initial idea of MobileMAN: "MobileMAN is not intended as a replacement for current infrastructure based (wired and wireless) networks. It is intended to complement them and to enable new application scenarios in which a centralized infrastructure is impossible, undesirable or unnecessary." (MobileMAN Full Proposal, Part B, 4).

Question: Do you think that ad hoc networks will replace infrastructure-based networks or rather support them?

	FREQUENCY	%
No answer	1	5.3
ad hoc and infrastructure will complement each other	**18**	**94.7**
ad hoc will replace totally infrastructure	0	0
ad hoc and infrastructure will compete	0	0
no idea	0	0
other	0	0
Total	19	100.0

Figure 4 – Overview table of the answers to the question about future development of ad hoc networks and their relationship with infrastructure-based-networks.

The trend of the responses to the question whether people might become too dependent on technology shows us that **potential dependency is perceived as a potential danger by 68.4%** (13 people) of respondents, whereas 4 people did not think that we might become too dependent on technology and 1 had no opinion.

Question: Do you think that we might become too dependent on technologies?

TOO DEPENDENT ON TECHNOLOGY?	FREQUENCY	%
No answer	1	5.3
yes	**13**	**68.4**
no	4	21.1
no opinion	1	5.3
Total	19	100.0

Figure 5 – Overview table of the answers to the question about potential dependency on technology.

One question was about the concern of privacy and security issues of new technologies. 15 respondents (78.9%) said they are concerned, 3 said they are not concerned and 1 had never thought about this (figure 6).

Question: Are you concerned with the idea of privacy and security issues of new technologies?

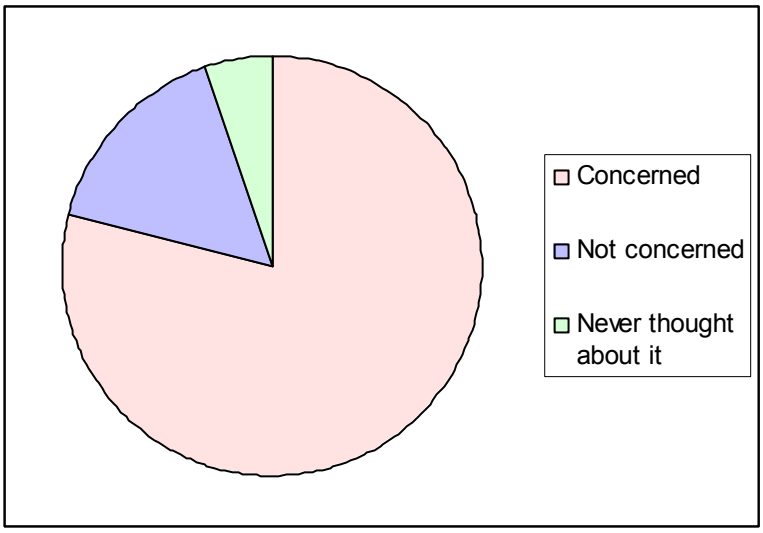

Figure 6 – Graph representing the repartition of the answers about the question about concern on privacy issue of new technology. Interesting is that the great majority (79%) expressed concerns; only 16% of the respondents said not to be concerned.

All in all, this test phase has provided the ground for some thought over ad hoc networks and their application types. Although, as already said, participation by the students was not too extensive, it has to be said that for course reasons the activity could not go longer than two weeks, which is a rather short time to get acquainted with a new type of technology and an instrument to be used. However, the students who participated in this exercise provided us with some ideas for innovative applications. As already mentioned, **the question of the appropriateness of the ad hoc architecture for the services presented in the developed scenarios is the main open issue**. In fact, many of the hypothesized services could be provided using an infrastructure-based network, i.e. advanced cellular phone network (UMTS).

2.1.5. Phase II with public website and open wiki

After the phase with the students of HUT, we disseminated the URL of the website on several topic-based website about ad hoc networks, mobile computing, wireless networks, future communication technologies, discussion forums, mailing lists and so on. As previously anticipated, we also created a mailing list service to maintain a dialogue with individuals interested in the MobileMAN project and in providing their contribution in the form of comments and discussions.

Encountered difficulties

The public phase of this activity did not in fact take place. After several considerations, we decided to stop the activity of the collective creative scenario building at the end of phase I with the group of HUT students.

One first difficulty was about **disseminating the wiki website link**, on specific websites on the topic of ad hoc networks, discussion forums, newsgroups members of similar subjects etc. Although it seemed that people would have been interested in this kind of activity, we had to consider that very few individuals actually visited the website and provided contribution to the scenario and content of the wiki that was already there from phase I.

Secondly, it has to be realized that the number of forum websites and discussion groups over the internet is huge and continually increasing, and even though one might be interested in a topic, the time resource one can dispose of is limited. For this reason, one has to limit the websites they want to participate to. Constant participation to a discussion group or topic-based virtual community is actually happening only when the users are highly motivated and involved in the group. Being the topic of ad hoc networks still prerogative of academicians and researchers, it is obviously not easy to involve individuals outside this circle.

Another reason that limits traffic is that a wiki website needs to be maintained massively, especially in the first times to **stimulate users' participation**. In fact, Woolley[10] says: "I think [building a community] is a lot harder then it used to be, mainly because there's so much competition for attention". Users need to go through a series of stages to become members in the sense of being committed to participate regularly and provide cooperation. Duggan identifies four stages: stranger phase, passer-by phase, lurker phase and regular phase; each of these stages requiring particular tasks and actions to ensure that a sufficient number of users move to the next phase and the community becomes solid.

Another issue is, again, about the nature of ad hoc networks: **users cannot see immediately what they could benefit from**, that they cannot have through an infrastructure-based network, such as for example GSM or UMTS. For this reason it was very difficult to involve actively individuals to participate in the scenario and applications developing exercise.

Also, it needs to be said that there are inevitably security issues to consider when a website is public and "open" to everyone: we experienced misuses of the some wiki pages and of the mailing list we provided for subscription to receive information and updates on the project and ad hoc network research.

For all these motives we decided to stop the activity and concentrate the efforts on the other studies that are part of this MobileMAN social evaluation.

[10] Cited in: Heather Duggan, "Getting and Retaining Members" Article published on the web at: http://www.fullcirc.com/community/retainmembers.htm

2.2. Mobile phones and ad hoc networks

This study has focused on the relationship of the user with their mobile phone and was of a qualitative nature. As already mentioned in D7, we chose to consider the mobile phone because of the huge success it has had in the last decade and the consequent profound changes it has brought about to the way people live and interact with each other and with their time. Because of the similarities that exist between the mobile phone and the initial idea of MobileMAN applications (which are **communication applications** mainly), a comparison between these two types of devices meets its justification. As it will be shown later – and as other social and behavioral studies about mobile phones confirm – **costs about applications use** (voice communication, SMS, download of emails) constitute a barrier to a broader use of them. The absence of an operator that characterizes a mobile ad hoc network results in virtually no cost (in terms of money) for the user, who can for example send messages or call other users without the need to pay for the service.

Being qualitative, this study has no presumption to provide a generalizable picture of the type of relationship that people have with their mobile phone. Its objective was to understand what type of uses people make of their device and of the **potential needs they have that ad hoc could address**. It is also an opportunity to ask people what they would think of the use of a device that allows them to communicate over an ad hoc network and to capture initial response to it.

2.2.1. Study outline

After considering several instruments to gather data for this study, we decided for a sort of diary where the user would collect all activities and interactions with their mobile phone over a period of one week. At first we had the idea to provide a sort of list to categorize information, however we decided for a blank booklet where users would collect the data. We only gave instructions as **to collect any action they did with their mobile phone with the indication of date and time**.

The second part of the study consisted of a questionnaire to be filled in. The questionnaire was mainly made of multiple choice questions and a section covered specifically the concept of ad hoc networks and scenarios in which MobileMAN would be interesting for the user.

Because of its qualitative nature, we chose a limited number of participants, possibly with very different profiles. To incentive the participation and to guarantee data quality, we gave a monetary reward to participants.

At the beginning, we intended to include also a period where the participants in this study would use the wiki to interact and discuss ad hoc issues and provide their contributions to the already developed scenarios and applications by students at HUT. However, we decided not to pursue this idea, for the same reasons described in the section of this deliverable related to the wiki activities (section 2.1.).

2.2.2. Results from mobile phone diaries and questionnaires

In the following we report the information from the daily diary about the use of their mobile phone and the results from the questionnaire we gave them afterwards. The names are fictitious and have been modified for privacy reasons.

Peter, 24, university student, 'techno-freak'

Peter (24) is a student writing his final graduation thesis. Although he could easily be categorized as a "techno freak", his mobile phone is rather simple: a Nokia 3330 that he has been using for more than three years. Being a student, he cannot dispose of a big amount of money and uses therefore a prepay card. In fact, his monthly expenses consist of less than 50 CHF (which corresponds to about 32 EUR). At the question "if your phone was an animal, it would be…" he indicated a mouse. This symbolizes an object that is often unseen, kept in places that are not exposed. In fact, Peter does not convey the idea of the user who owns the latest mobile phone model to show to others, but presents a rather more functional view and use of the device.

Applications he uses regularly are very few: SMS (which are, by the way, preferably sent via PC, at no cost), time, stopwatch and alarm applications. Curiously enough, from the diary he kept about his use of the mobile phone, **the majority of activities were related to time function** (alarm, watch). During the night he keeps his mobile phone switched off. This aspect denotes the wish to keep the world outside during the night, and the absence of need to be perpetually in contact. He feels no problem in giving his mobile phone number to other people. Concerns about privacy and surveillance are not perceived, since he thinks that messages are not stored in any database for security reasons. An application that he would find useful on his mobile is an ebook reader. This however, raises concerns about the usefulness of such application on a small screen.

Costs concerns are very important to him, and a fact that also prevents him from using applications such as chat SMS. In the section about ad hoc and MobileMAN opinion, he indicated the advantage of communicating and sending messages over an ad hoc network at no cost as the most important of the advantages listed.

As for the disadvantages, he indicated as the most important the battery consumption issues and second, the quality of service. One question asked whether he would accept to communicate free with limited quality of service; he chose to accept this but provided that it is easy to switch between operated network (mobile phone) and ad hoc network and at any moment possible to choose between the two methods available on the same device. This underlines the fact that **the use of mobile phone** is so **rooted** that the option to dispose of a device that uses the operated network – and that works continually – is important and needs to be present. Said this, it has to be considered that portability issues raise here: two devices (mobile phone and ad hoc device) would be uncomfortable to carry around. An interesting solution for MobileMAN would then be a unique device that contains both options: an operated network mode and an ad hoc mode, where the user can switch between the two.

What results from Peter's diary is that **his phone is very rarely used as a phone**. The great majority of activities made with it are time-related functions, such as reading time, using alarm, and chronometer. During the reported period of time, only one record of the diary was about a voice call. Being often in front of his pc, he also replied to receive SMS by sending them via internet, which means at no cost.

Claire, 31, psychologist, teacher and researcher

Claire (31) is psychologist working in an academic institution and lives alone. Recently, she has bought a new mobile phone model (Motorola MPx 220), which has a great number of functions. She has a subscription and pays between 81 and 120 CHF per month (about between 50 and 80 EUR). Since her mobile phone is one of the latest models, she has started to make use of more functions than with the previous device on a regular basis, such as SMS, MMS, voice call, time related applications, e-mail client, phonebook, games. During the night, she keeps her mobile phone on, mainly for working purposes, since she is psychologist specialized in emergency situations and needs therefore to be reachable any time. At the question "if your phone were an animal it would be…" she indicated a dog. This signifies fidelity and vigilance, and expresses a sort of affection for the object. Like a dog that follows its owner, the phone is carried wherever the user goes.

Claire makes use of GPRS for data transfer and uses a mail client to read her email. She would give her number only to people she knows fairly well and **would not accept to receive advertising messages on her phone to be able to pay less**. Privacy and surveillance issues do not concern her since she thinks that SMS are not stored in any database for security reasons. Among the applications she would like to dispose of on her mobile phone, she indicated a browser and instant messaging applications, however these present two particular issues: the browser poses the problem already known of usability that was the cause of the failure of WAP, whereas the instant messaging would pose the problem of billing: if the user had to pay for data transmission of an IM conversation it has to be verified whether they would accept it. **IM is an application that would be valuable in ad hoc networks**, since one could use it without having to pay for the connection and data transmission. She never used chat SMS services, but subscribed to a traffic update service via SMS. The fashion trend of personalizing the mobile phone does not appeal to her, since Claire manifested no interest in downloading ring tones or games or display pictures and logos. Interestingly, she indicated the possibility to use an ad hoc network also in catastrophe situations, where it is very high the risk of not being able to rely on a communication infrastructure.

In line with some other considerations about cost, she stated that she prefers paying for good quality service than not paying but use an unreliable network. She also said she would not be sure to collaborate to make an ad hoc network function.

Yasmin, 30, married, employee

Yasmin (30) is a young married lady, originally from Taiwan. She has recently completed her studies at the University of Lugano and is looking for a job. She has been using her Siemens C55 for more than three years, and uses a prepay card. Her monthly expenses are on average less than 50 CHF (32 EUR). Regularly, she makes use of voice communication, watch and phonebook. Normally, she keeps her mobile switched off during the night, although in some particular situations it remains on. She uses GPRS for data transfer through her mobile. She says that she only gives her phone number to people she knows fairly well. **Although she is concerned about costs of use (and uses a prepaid card), she is not sure whether she would accept advertising SMS to be able to lower costs of use.** Yasmin thinks that SMS are stored in some database for security reasons.

From the diary of the daily activities done with the mobile phone, what strikes is that **it is not really used as a communication device**: most of the activities are just holding the device and check either the time or missed calls. This is a rather passive use of the device. It is curious that

sometimes she just keeps it in her hand, without doing anything with it. Also, in the questionnaire, she stated that she was only partially agreeing with the statement about the opportunity to stay more in touch with her existing social network. She expressed her interest in an application such electronic wallet to quickly pay at supermarkets, cinemas, and so on. Yasmin never used chat SMS or news services. She does make a limited use of her mobile phone as a communication device.

Although the absence of cost was indicated as the major advantage perceived, she said that she is not sure about whether to collaborate to make an ad hoc network function. It is interesting that the profile of this person appears to be of someone who is not really interested in ways to communicate and does not actively use her mobile phone to contact people in her social network, but more **to be reachable**. The compromise of a unique device where to easily switch from ad hoc mode to operated network mode seems interesting for her.

Marian, 29, single, logopedist

Marian (29) is a single logopedist working with children who have language difficulties. She works both in private and in the public sector (in the public sector, collaborating with schools). She lives alone but often goes to her parents' home to spend weekends. Although she has long working hours, Marian has a very active social life and **uses her mobile phone heavily to organize and coordinate social activities and appointments**. It has to be remarked that she uses her mobile phone both as a private communication tool and for working purposes, therefore these two spheres are overlapping. At the question "if your phone were an animal, it would be…" she indicated a chameleon. In this case this symbol can represent the blur of the professional and personal life. It also indicates an object that can be kept in unseen places (handbag, pockets) and is not used to convey self personality, but is used to better organize her personal life.

Interesting is that she uses SMS and voice calls with about the same frequency, but however with parsimony: she indicated between 51 and 80 CHF (about 35 to 50 EUR) the monthly expense for the mobile phone use. She indicated a regular use of the most common applications, namely, SMS, agenda functions, calculator, time functions, and phone book. It is rather clear that she views her mobile phone as a tool that allows her to better organize her life and is not interested in personalizing any aspect of the device or in playing games. In fact her view of the mobile phone is very much of a functional device to better organize her life. In fact, she has never used services such as chat-SMS or news services. She also does not seem interested in new functions, such as e-mail client, or electronic wallet.

Francesco, 18, high school student

Francesco (18) is a young student in his last high school year. He has been using a mobile phone for 3 to 5 years and has switched from prepay to subscription, whose amount is paid by his parents. His actual mobile is a Nokia 6230 that has owned for slightly longer than a year. His monthly amount to pay is on average between 81 and 120 CHF (50 to 80 EUR). If his phone were an animal, it would be a mouse. As already said for another participant in this study, the mouse symbolizes an object that is often kept in places that are not exposed and seen. Francesco is not the user who owns the latest mobile phone model to show to others, but presents a rather **more functional view and use of the device**.

He indicated as regularly used the following functions: SMS, voice communication, agenda, integrated photo camera, time-related functions, phone book, games and music player. He also said

that his phone is normally switched off during the night, a part from some particular occasions. Francesco would not be willing to receive advertising messages on his phone even though this would lower his use cost. Electronic wallet seems to him an interesting application, whereas the chat SMS services are in his opinion useless and expensive. Francesco has the ring tone and the desktop of his mobile personalized, but is not too concerned about personalizing his device. **He said he would cooperate to make an ad hoc function; however, he would still require a certain level of quality of service**.

Monique, 34, architect, employee for a non-profit organization

Monique (34) is an architect working for a non-profit organization. Her mobile phone was given to her by the company and she is using it both for working and private purposes. She has recently changed her model and owns now a Nokia 6230. Monique has been using mobile phones for between three and five years and has a subscription. On average, the monthly expenses for her mobile phone are between 81 and 120 CHF (50 to 80 EUR). Although Monique's actual mobile phone disposes of advanced functions she makes a very "traditional" use of the device: she indicated that uses regularly SMS, voice communication, time-related functions and phone book. In fact, in her diary the majority of functions she has recorded are voice-calls, SMS, phone book viewing. She never indicated the use of the integrated camera, or games, or agenda. During the night she keeps her mobile on, since she needs to be always reachable for working purposes. Her relationship with her mobile phone is of a functional nature. If her phone were an animal she indicated that it would be a grasshopper. This symbolizes something negative, with an unforeseeable behavior due to its quick movements. For Monique, the mobile phone is sometimes a rather disturbing object, not always attuned with herself.

In fact, she is not interested in innovative applications such as electronic wallet and considers games in phones as useless. The fact that she has not in any way personalized her phone confirms this "**functional view**" of the device. Curiously, she is very attentive to the cost factor: she considers SMS chat services as expensive and when asked if she would collaborate to create an ad hoc network and make it function answered positively. What also accounts for this aspect is that in her diary, Monique indicated several times that she looked up a number in the phone book but then used a landline phone to make the call, at more convenient rates. However, **she maintains that under a threshold quality level would not accept to trade quality with cost**. Monique valued that the actual operated network for mobile phones is good enough for her communication needs and would not be interested in a PDA that allows her to communicate and share files on an ad hoc network. An interesting aspect she noted and expressed was the fact that when she checked the time on the mobile phone display, the motive was not really about knowing the time, but more about checking if there were missed calls or SMS messages. Interesting was also that she indicated one day the action of deleting some SMS messages because the memory was full. This behavior denotes the will to keep the messages until possible and to delete them only when there is no other option.

Frederic, 64, divorced, entrepreneur

Frederic (64) works in Italy for a small medium enterprise dealing with veterinary products. He has owned a Siemens S35I for more than three years. He has a monthly subscription and on average spends more than 120 CHF (more than 80 EUR) for mobile phone use. Among the applications that Frederic uses regularly, he indicated voice communication, time-related

functions, phone book. He also indicated that his mobile is on during the nights. From his diary results that he uses regularly his phone as an alarm clock to wake up in the morning. Although he uses his mobile for private and working purposes, he said that he gives his number only to those who he knows fairly well. Frederic has **a rather "traditional" way of considering the mobile phone**, which is also to be seen in the types of application he uses daily. An interesting aspect that results again from his diary is that often he **diverts calls** made to the office to his phone, using it as an "extension" of it when he is out of office. He has a subscription to receive daily sports news update through SMS. He would not accept advertisements as SMS to lower the cost of service use. He considers that the mobile phone allows him to better manage his life and to keep in contact easily with his family and friends. If his phone were an animal he indicated a bird, which represents balance and positive attitude towards it.

Interestingly, he owns a PDA but does not use it, despite being an individual who has great interest in technology and devices. Regarding applications, Frederic has stated that there are no applications he feels his mobile should have or not have, but has also expressed interest in the presented application of the electronic wallet. About ad hoc networks, he said he would cooperate to make an ad hoc function and to be able to use it, although he **underlined the importance of the quality of service in mobile communication**. This is rather understandable, since the actions he recorded in his diary were in the majority of cases for working purposes (calls, appointments reminders). His interest for a mobile device running on ad hoc network is contingent upon the possibility to switch between operated network and ad hoc network depending on the situation of the user.

Valerio, 42 and Cecilia, 35, married, sharing one phone

Valerio (42) and Cecilia (35) are married and have two kids. Valerio is employee. They own a mobile phone but they use it in a particular way: they **share** it depending on the situations. The interesting fact from the diary they kept for one week is that the use of the mobile phone is split in two, even though both might be together in the same place. What we do not know is whether they managed their phone in the same way as a landline phone is managed, that is, it is kept in a "neutral" place and when it is need, each one just takes it. They have owned a Nokia 6610 for less than a year, but they have had previous models for more than five years and have a monthly fee that is on average less then 50 CHF (30 EUR). Valerio uses regularly SMS, voice communication, time-related functions and phonebook. Cecilia makes use of the same features with the exception of time-related functions. During the night they keep the mobile switched off. They both agree on not accepting any advertising messages (SMS) that would lower their usage expenses. They also agree on saying that their phone has many useless and too complicated functions, they are not interested in. For Valerio and Cecilia the mobile phone is not an instrument that helps them extending their social network but it is a way to stay close to their relatives and friends. They are not interested in novel types of applications, such as the electronic wallet: Valerio said he finds the idea not interesting, whereas Cecilia has no opinion about it. They are also not interested in personalizing their phone. They **both show a rater strong resistance to innovations: they use the mobile phone in a traditional way**, have never received any news via SMS, and would definitely not cooperate to make an ad hoc network function. From their diary it is possible to see that Cecilia often uses the mobile phone as an **"extension" for their home landline phone**, by activating the call divert function, so that calls made on the home number are diverted to the mobile phone. Comparing quality of service and cost of use, they disagree: Valerio would accept a lower quality to be able to communicate free of charge, whereas Cecilia would not. At the question of whether they would be interested in using a PDA being part of an ad hoc network, providing free communication applications with a lower quality of service they both say firmly that they are

not, since these functions are already available satisfactorily (reasonable costs, with good quality) with mobile phones. What is interesting in their diary is that it is not always the same person that switches on and off the mobile phone. This shows that for both of them, it is only an instrument that allows them to communicate and to be reachable. In their case, the mobile phone does not assume the status of an object that conveys the owner's personality to others; instead is a device that has only a functional meaning to the owners. The animal associated with their mobile phone also confirms this: they both indicated that if their phone were an animal, it would be a bird. As already said, this is a symbol for something positive that expresses balance. The object is in fact shared by the two and is in a balance-position, not expressing personality of the owners and is seen as a helpful device to coordinate daily activities.

2.2.3. Comments

Two questions of the questionnaire asked the respondents to order a series of **four advantages** and of **four disadvantages** from the most important to the least important. The following tables (figures 7 and 8) show the data provided by the participants to the study.

	ADVANTAGES OF AD HOC			
	MOST IMPORTANT	SECOND	THIRD	LAST
Resp #1	No cost	Democracy	Less electro smog	Catastrophe
Resp #2	Catastrophe	Less electro smog	No cost	Democracy
Resp #3	No cost	Catastrophe	Democracy	Less electro smog
Resp #4	Catastrophe	Less electro smog	No cost	Democracy
Resp #5	Less electro smog	Catastrophe	No cost	Democracy
Resp #6	No cost	Less electro smog	Democracy	Catastrophe
Resp #7	Catastrophe	No cost	Less electro smog	Democracy
Resp #8	No cost	Catastrophe	Less electro smog	Democracy
Resp #9	No cost	Catastrophe	Less electro smog	Democracy

Figure 7 – Table showing the order of importance of ad hoc networks advantages given by respondents.

Interestingly, the "ideological motive" (democracy of the system) is considered by most of the respondents as the least important advantage. **People are more interested in personal and practical benefits**, such as "no cost" and functioning in case of catastrophe. If we sum the times that the cost advantage appears in the first and second position and compare it with the sum of the **advantage of functioning in catastrophe situations, we can say that this factor is rated as more important than the cost factor**. We would not have expected this result. Perhaps the events of terror attacks in major cities that have happened in the last years and reported in the media extensively have given to this advantage a higher value in the mind of people.

	DISADVANTAGES OF AD HOC			
	MOST IMPORTANT	SECOND	THIRD	LAST
Resp #1	Battery	Quality of service	Cooperation	No control
Resp #2	No control	Quality of service	Battery	Cooperation
Resp #3	Battery	Quality of service	No control	Cooperation
Resp #4	Cooperation	Quality of service	No control	Battery
Resp #5	Cooperation	Quality of service	Battery	No control
Resp #6	Quality of service	No control	Battery	Cooperation
Resp #7	Quality of service	No control	Cooperation	Battery
Resp #8	Cooperation	Battery	Quality of service	No control
Resp #9	Battery	Quality of service	Cooperation	No control

Figure 8 - Table showing the order of importance of ad hoc networks disadvantages given by respondents.

From the table above, we can see how important is the disadvantage of a lower "quality of service" perceived by the participants in this study: in eight cases out of nine, this aspect appears either as most or second most important disadvantage.

It is interesting to note that the mobile phone, although it is by most individuals considered as **expensive**, has reached a status that is very difficult to change: people expect to be able to use it almost in every situations and locations, and they also expect a certain quality of service (no echo when talking, instant communication and no transmission delays, no communication interruptions). Even if MobileMAN were able to provide the option to communicate at no cost, a low quality of the system would be a powerful drawback to the adoption of the technology. No cost is certainly a great asset for MobileMAN, but from the results of this study, it is clear that **cost is not the only variable that comes into play when adopting new technology**.

The tendency to adapt to a status quo situation, even though it may be far from being optimal, is also to be seen in the following aspect. At the question "how do you consider the option of using a PDA for voice-communication, messages, and file sharing on an ad hoc network?" the participants in the study answered in the following way:

Answer	**Answer option 1:** Interesting – I would carry two different devices (PDA and mobile phone) to be used in different situations	**Answer option 2:** Not interesting – mobile phones already provide these functionalities at reasonable cost and with good quality.	**Answer option 3:** Interesting if I could use two different modes (ad hoc / operated network) **in the same device**.
Number of users	0	3	6

Figure 9 – Table showing the overview of answers to the question about willingness and interest in using a device that would allow the user to use both, an available ad hoc network and an operated network.

Mobile phones are so much intertwined with our life that they are almost not replaceable and individuals are **used to rely on them**. Another aspect that is to be considered is the fact that real mobility requires that a person does **not carry around too many devices** or devices of too big a size. These aspects, in fact, are real hinders to mobility and need to be carefully taken into account.

Let us consider again the aspect of the **quality**. The problems that might arise in this field are the two following:

- **Delay** in the delivery of data packets: either in voice communication or in texting and message exchange we are so used to instant delivery (or almost instant) that it would be very difficult for a user to accept a quality level for the same service that becomes lower. In fact, what we expect is that development of product or service leads to their improvement. Particularly in voice communication, delay is highly problematic and may make communication almost impossible for physiological reasons. Systems such as Skype[11] and other VoIP tools must deal with such issues often and even a small delay in voice communication makes it very difficult and annoying to communicate, that users decide to communicate in other ways.
- **Packet loss** during transmission. This is even a bigger problem, unless there is a system that controls that packets have been lost and the sender is informed when this happens. This aspect can cause big issues in the relationship dynamics, because in our mind:

Message sent by A	**=**	**Message received by B**

But actually, this equation is not automatic since in case of packet or message loss for the receiver is as if the sender had never sent any message. Problems arise when the sender does not know that their message was lost and assumes that the receiver has got it. In the case of SMS or email messages, this is often causing relationship issues.

Therefore, it is not acceptable that a communication system cannot guarantee quality of service of a minimum level. Email clients for instance, have developed the system of the option of receiving a message when the mail was viewed by the receiver. A system like MobileMAN would need a mechanism to inform the sender about whether the message was delivered or not to the receiver. At this regard, it is interesting to not that **none of the respondents of this study seems to have activated the "SMS delivery report"**, that is an SMS that informs the sender of whether the sent SMS was delivered to the recipient or it is kept on hold.

Another curious aspect that resulted from this study is the fact that many people use the mobile phone to see the time or to use other time-related functions (such as alarm, reminder for tasks to remember, chronometer) making almost superfluous the wrist watch, and in fact, some people do not use a watch anymore. This is certainly a not intended use the mobile phone that is gaining importance.

[11] Skype is a widely used Voice over IP client. See: www.skype.org

2.2.4. Conclusions for MobileMAN

This study about the use of mobile phones in every day life has shown us that in most users the phone is part of their life, even though to different extent: some individuals could not live without their phone, whereas some others do rely on it but are less depending from it. In any case, **users are used to being able to rely on their phone** and expect most of the times to be able to use it with success. This implies a number of factors, such as a battery that has a life-duration of a certain minimum[12], a network available at any moment, and good service quality (message delivery rate high, no delays in voice communication).

Also, the percentage of people who own a mobile phone is very high: those who do not dispose of a mobile phone are a minority. Nowadays, specific models tailored to the elderly are tapping a market segment that was not penetrated by this product. Communication via mobile phone is more and more an aspect of our life that we take as granted. This means that mobile phones have been interiorized; in fact, people often may say: "I cannot live without my mobile".

Voice communication requires, as already mentioned, that the network functions in a good way. Packet loss or significant delay during a voice call can cause great problems. For this reason, voice communication over ad hoc networks might not be the most indicated application. The network variables (number of nodes, stability of links, quick adaptation to changing network and so on) need to be stable to guarantee functioning of this type of application.

Mobile phones have shown very clearly, through the SMS application, how something that was not intended as user-side application has become the killer app of the entire system: the number of SMS sent everyday is very high and often SMS is preferred to voice.

This study on the use of mobile phones has shown us important aspects that we can say for MobileMAN. It was somehow surprising the way that users are concerned about costs related to their mobile phone use, but also the importance they give to quality. This shows that **even though mobile ad hoc networks could provide an alternative paradigm to communicate without the need to pay any subscription or fee to an operator, the need to be assured about the quality of this alternative system is very strong: users need to know that MobileMAN is reliable, at least in the same way that operated cellular phone networks are.**

An aspect that is typical for ad hoc networks is the impossibility to control the content of information that runs over such network. We indicated this aspect as a public security disadvantage. However, when asked to judge this drawback, the participants of our study showed not great concern: six individuals indicated no control of information as third or least important disadvantage. Even though potential end-users might not consider this aspect as important, authorities are indeed concerned about security, especially after the breaking of terror attacks in major cities.

Mobile phones are an integral part of many people's life. There is in fact **resistance to abandon such interiorized technology for another that does not ensure to provide at least the same applications and service.** This is also indicated by the fact that participants to our study expressed interest in an ad hoc networking communication, such MobileMAN, if it was integrated in a common mobile phone, allowing the user to choose whether to use an operated cellular phone network or an ad hoc network in different situations, where requirements are different. In fact, six

[12] A battery that has a too short life is often the trigger aspect that motivates a user to change phone: since buying a new battery is often as expensive as buying a new phone, an individual decides to buy a new model, profiting of the many offers that mobile phone provider companies give to new subscribers or for contract extensions. This approach is to be seen in Switzerland but it has to be remembered that it is not to be seen in all countries.

of them where willing to adopt this communication paradigm if the device was one with the two functioning modes to switch. **No one was interested in a specific device for ad hoc networks and was willing to carry both a mobile phone and an ad hoc PDA**. The other three respondents said that they were not interested in an ad hoc device that provides the same features of a mobile phone, even though it may allow them to communicate for free.

2.3. Wireless internet access and ad hoc networks

2.3.1. Initial study design: students with WIA on university campuses

As outlined in deliverable D7, we planned to conduct the study on the use of wireless internet access (WIA) with two communities of students, one that has introduced WLAN in its campus recently, and one that has had it for a few years already[13]. These two groups would have been interesting to compare, to see whether a heavy use would bring about changes in the perception of the service of WLAN and in users behavior. Students are also individuals who are very enthusiastic about new technology and are rather skilled when using electronic devices.

2.3.2. Redefinition of community of interest

However, after careful consideration, we realized that **students were not the ideal target for this study**. In fact, they are not the typical public WLANs users. Hence, we chose to involve another type of individuals, namely the **working persons who use technology heavily and who travel frequently for job purposes**. This type of person is very "mobile" and requires (because of their type of job) internet connectivity and are more likely to be public hotspots users. This group, being extensively in contact with technology is also able to provide comments and ideas about ad hoc networks and potential benefits and advantages to exploit. We could count on the collaboration of IBM Switzerland to ask a number of their employees to fill in our questionnaire. IBM is a company active in the field of software development and has consultants who travel often for working purposes.

2.3.3. Study outline

We designed the data collection instrument, which was in the form of an online questionnaire. The fact that the people that were asked to take part into the study were highly skilled in using computers allowed us to use the web to access the questionnaire.

The questionnaire consisted of several sections:

- a section focusing on use of **public hot spots and applications** used while being mobile;
- a section focusing on **ad hoc networks** and opinions towards it;
- a section focusing on **socio-demographic information.**

The questionnaire consisted of 26-27 questions, mainly of two types: single-choice and multiple-choice; and required up to five minutes for completing.

[13] In fact, we identified the opportunity to collaborate with the Swiss Federal Institute of Technology of Zurich (ETH), where the WLAN was introduced in 2000, and the University of Lugano, where it was introduced in 2004.

IBM employees were selected by their job function (consultants were ideal because they are frequent travelers) and were contacted through an internal email, which briefly explained the objectives of the study and provided the hyperlink of the questionnaire. Participation was on a voluntarily basis, and the questionnaire was available through a web browser for 15 days, during the month of August 2005[14].

2.3.4. Results

The number of the contacted persons who agreed to collaborate and took part into this survey is rather limited. This aspect limits greatly the information that we can present in this report. In total, individuals who participated were 21. However, 6 of them did not finish the survey either for technical reasons or for other impediments. Of the 15 who completed the survey, 4 were women, whereas 11 were men. 14 out of 15 were between 26 and 45 years old, and the remaining were between 46 and 55. Considering the highest education title obtained, 14 had at least a University degree or equivalent (4 of them had also a PhD or a Master), whereas only 1 had a high school certificate. The majority of the respondents (11 corresponding to 73.3%) use a computer for private reasons (at home) daily, 3 a few times a week and 1 once in a while (not regularly). For the first question we were interested in knowing how often they use public hotpots:

Question: How often do you use public WLAN hotspots?

HOW OFTEN DO YOU USE PUBLIC WLAN HOTSPOTS?	FREQUENCY	%
daily	1	6.7
more times in a week	1	6.7
about once per week	2	13.3
occasionally	**9**	**60.0**
never	2	13.3
Total	15	100.0

Figure 10 – Table showing the repartition of the answers to the question about how often users use public WLANs.

The majority of the respondents use public hotspots only occasionally, which is somehow surprising, since we would have expected a heavier use.

The most used hotspots by the respondents are those in **hotels**: 12 people indicated that they have used a public hotspot in hotels; 7 indicated to have used one in airports and only 2 in bars or cafes.

All the respondents who answered to the question of whether they would like to be able to connect to the internet while traveling by train, all answered positively. 8 individuals said they use public hotspots only when traveling for working purposes, 5 said they use them both while traveling for private and working purposes and nobody indicated an exclusive use when traveling for private reasons.

[14] The period was not optimal because it is the moment when people go on holiday. The process of authorization request to IBM for the collaboration and the reviews of the questionnaire delayed the activity.

The main device to access a public WLAN hotspot is the laptop: **13 out of 15 use a laptop**, 1 uses a PDA and 1 uses a smart phone.

As for the type of hotspot the respondents have used, 3 said they use only free of charge hotspots, 2 only hotspots subject to a fee, and 8 have used both types. About the opinion about the cost of use for hotspots subject to a fee, 92.3% (12 out of 13) of the participants in the study said that they think the fee amount is too high. Of those who use public hotspots subject to a fee (that is, 10 individuals), 3 pay themselves for the use, and 7 are refunded by the company. To these latter respondents, we asked what they would do if their company did not pay for the use: 2 would not use these hotspots, whereas 5 would still use them but would pay attention to the connection time and limit it to the necessary. To the 3 people who pay themselves we asked if they are concerned about the costs. They all responded that they are and limit the use only to necessary situations.

We compared a laptop and a PDA considering issues of **usability and portability**, and asked the respondents to choose between five options. The following table summarizes the given responses.

Question: Considering usability and portability, you think that:

POSSIBLE ANSWERS	FREQUENCY	%
laptops are better than PDAs, since they allow a full use of connectivity	8	61.5
PDAs are better than laptops, since they are more portable	**0**	**0**
both are good to carry around and use hotspots	2	15.4
both are not ideal either for weight, use interface, etc	1	7.7
I have no opinion	2	15.4
Total	13	100.0

Figure 11 – Overview table with the answers to the question on usability and portability of devices.

Interesting here is that nobody answered that PDAs are better than laptops for portability reasons. It seems that PDAs are not as diffused as are laptops. It might be that PDAs do not really respond to a clear need. It is also to be noted that respondents have indicated that they use public hotspots in airports or hotels and only rarely in bars or cafes. We can differentiate between **micro-mobility** and **macro-mobility**: the first one is mobility related to everyday traveling or wandering in town, whereas macro-mobility is related to particular traveling, for instance, when going to a client in another region or country. For macro-mobility one will probably carry a laptop, especially if it is needed for work. For micro-mobility, instead, what we carry around is a mobile phone, and not a laptop. A curious question can be why people do not own a PDA or a pocket PC: these devices could be the ones to be used in hotspots available in bars or cafes. However, it seems that people are not interested in this type of connection. This aspect results also from another question, regarding email checked through mobile phone. We asked if they had ever checked their mail through their mobile. The answers were as follows: 2 respondents said they do it regularly, 2 do it sometimes, 3 only when there is no other way to check email and 8 have never done it. This indicates that **being able to check one's mailbox is not perceived as an impellent need in micro-mobility, but it becomes important during macro-mobility**.

In fact, looking about the **applications** that respondents have indicated to use in public hotspots, we have the following figure:

Question: Which of these applications do you use in a public hotspot?

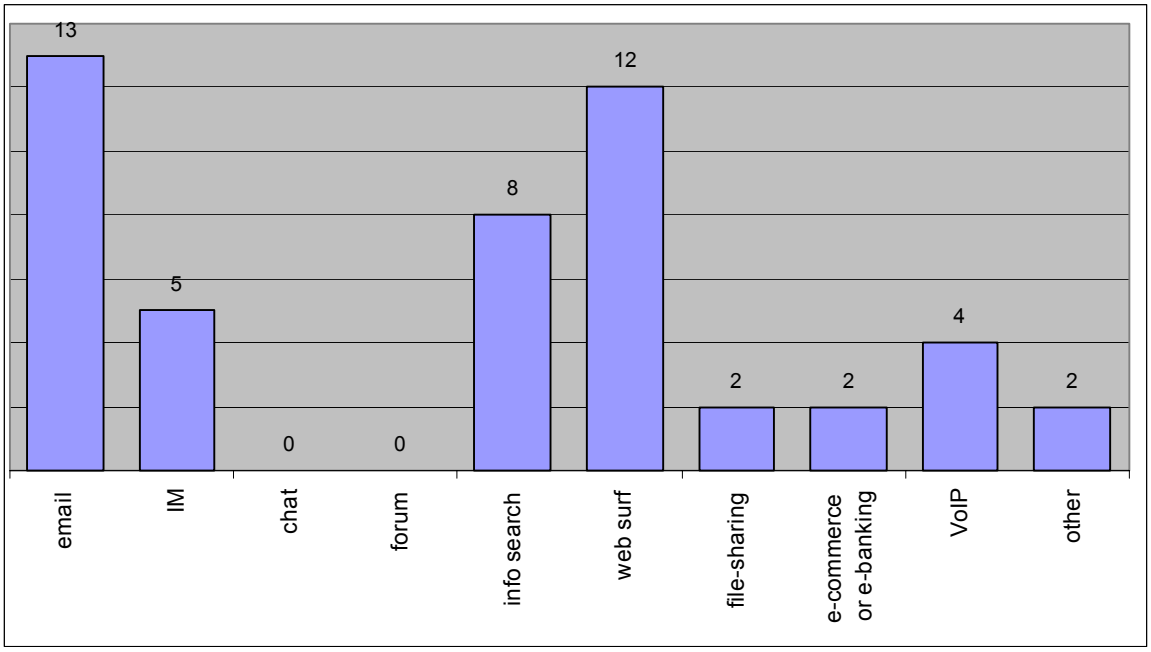

Figure 12 – Graphical representation of the used applications in public hotspots indicated by respondents. The number above the single columns indicates how many people have indicated to use the corresponding application. N = 13 (individuals who have answered to this question)

Sending and receiving email, web surf and information search are the mostly used applications. Instant messaging and VoIP come afterwards. It is surprising that surfing the web is in second position; however, it has to be said that the difference between "information search" and "web surf" might be not so clear. The importance of web surf application is rather significant: if this is one of the main applications that people use when traveling, MobileMAN needs to take this into consideration. The **display size plays also a fundamental role**: it is unthinkable to provide a web browser on a small device: the result would be the same as with the WAP protocol for mobile phones.

Regarding the aspects that they like about public hotspots, the respondents indicated that they appreciate "the possibility of filling in empty time slots" (indicated by 10 people) and "the opportunity to be online at any time and 'anywhere'" (indicated by 7 people). None said that they like "its innovative character" or "the enhanced mobility". This is an interesting aspect: public WLAN hotspots are not used and liked just because they are innovative but because in those situations **there is a need to be filled**, for instance the need to be reachable and to communicate with others. 3 individuals indicated that they particularly appreciate the perpetual contact with the office: "ability to work and attend virtual meetings while traveling or while in transit between locations", "be able to send / receive important and time critical files", "get work done / synch mails / download docs".

We were also interested in knowing their opinion about security issues in wireless environments.

Question: Are you concerned about privacy intrusions in wireless environments (lower security)?

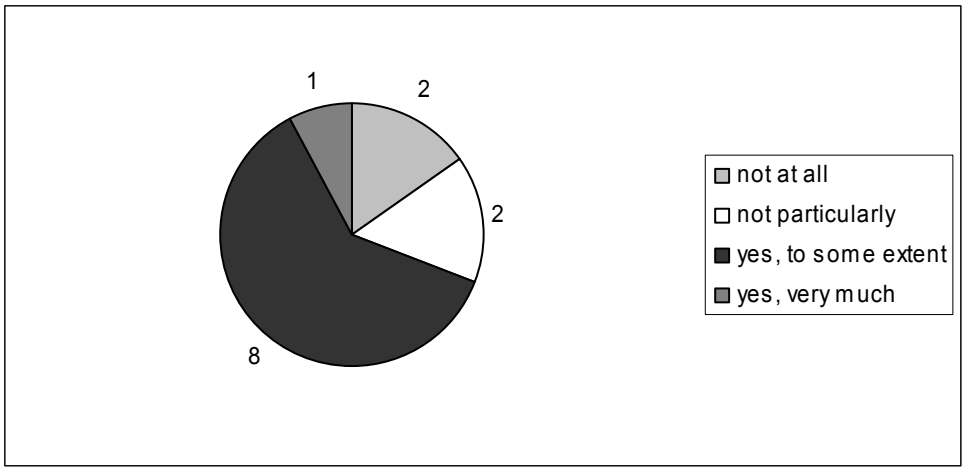

Figure 13 – Repartition of the responses to the question about privacy issues in wireless environments. Roughly two thirds of the respondents said to be at least to some extent concerned about this subject.

A second section was dedicated to **ad hoc networks**. We presented briefly the main concepts of ad hoc networks and asked for opinions about potential advantages and disadvantages. We indicated three advantageous aspects of mobile ad hoc networks and asked them to rate each one of them according to their personal opinion.

Question: Being ad hoc networks not run by any operator, these networks are a totally democratic system. How important is this advantage?

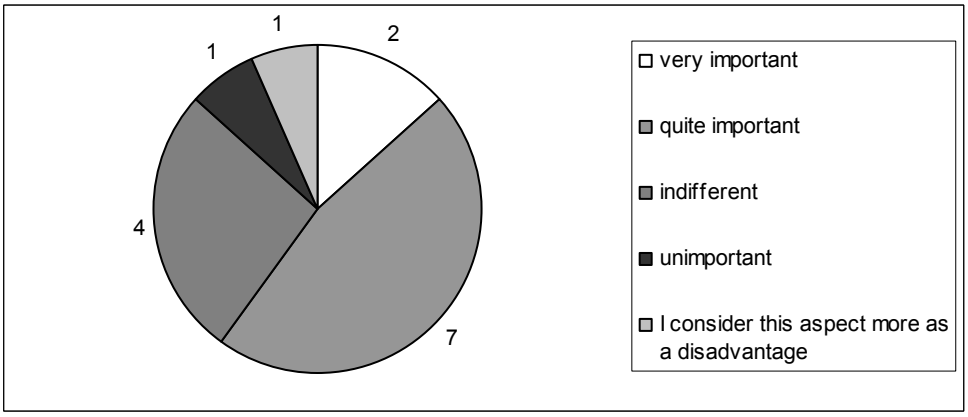

Figure 14 – Repartition of the opinions about the aspect of the "system democracy" of ad hoc networks.

The "idealistic" aspect of a democratic system, that is, a system where all nodes are at the same level and there is no operator who provides the service functionalities is rated at least quite important by 9 out of 15 of the respondents.

Question: How important is the advantage of the absence of antennas in ad hoc networks?

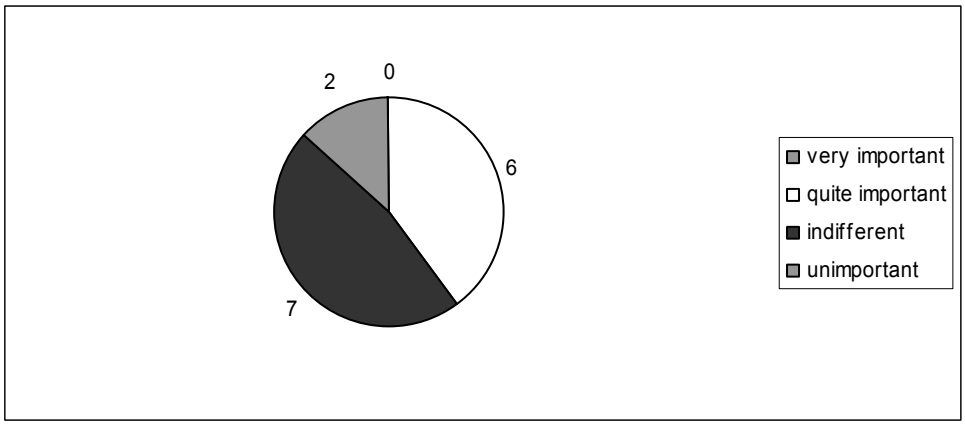

Figure 15 – Graphical representation of the answers to the question about absence of antennas in ad hoc networks.

Absence of antennas in an ad hoc system is not perceived as a particularly important aspect, since only 6 respondents indicated to be concerned, whereas the majority considered it either indifferently or unimportant.

Question: How do you consider the absence of fees to pay to use an ad hoc network?

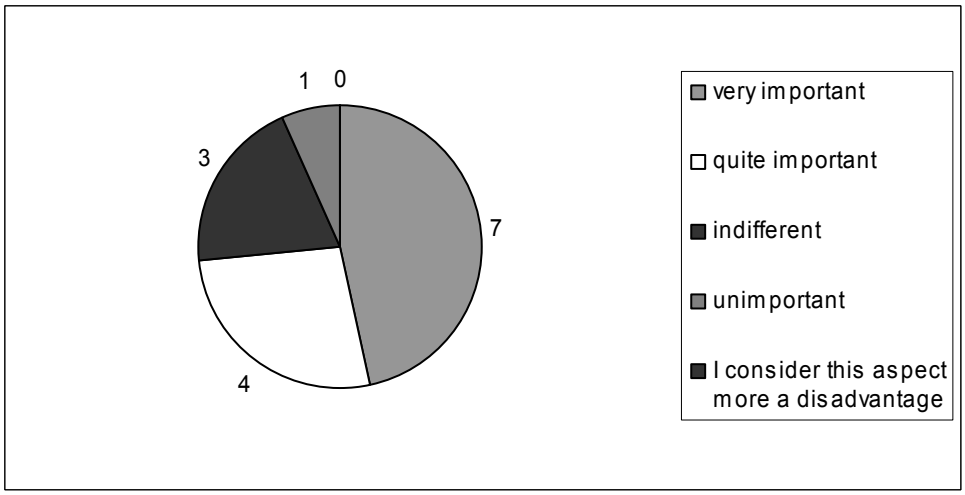

Figure 16 – Graphical representation of the answers about the importance of not paying a fee to use an ad hoc network.

The issue about the absence of fees to pay on ad hoc network gathered **more value**: it was considered as quite important by 4 people and very important by 7 people, which together make almost three quarters of all respondents. This answers need also to be read remembering that **12 out of 13 judged hotspots subjects to a fee as too expensive**. The cost is therefore an important factor; however we need to take into consideration the aspect of the quality of service over ad hoc network. We asked the respondents to rate the fact that the absence of an operator means also that nobody can guarantee quality service for the users.

Question: An ad hoc network presents the disadvantage that quality of service is not guaranteed, since there is no operator. How do you rate this drawback?

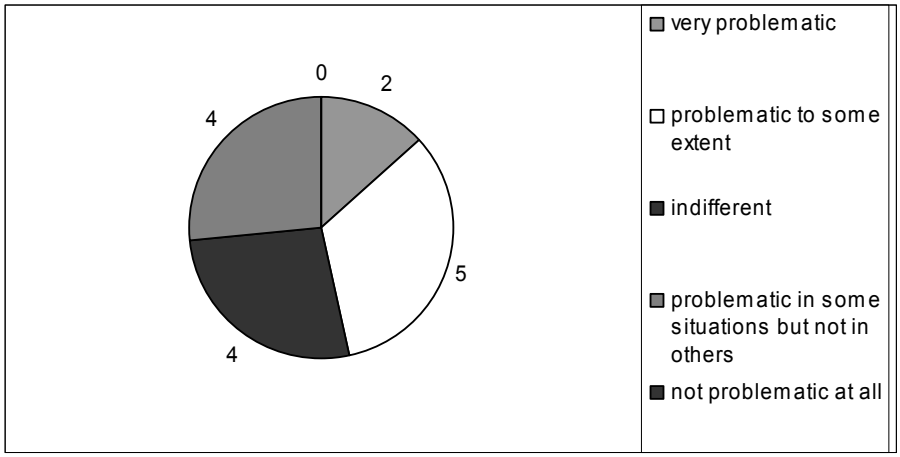

Figure 17 – Perception of the importance of the quality of service issue in ad hoc networks.

Respondents have expressed concerns about this aspect related to the quality of the service in a great majority: those who thought it is very problematic were 2; those who considered it somehow problematic were 9, whereas 4 individuals were indifferent to this aspect. Near to this aspect is also the contingency of the system upon cooperation level of the users. We asked people to rate this facet as well.

Question: One key characteristic of an ad hoc network is its contingency upon spontaneous cooperation of users, which is uncertain. The infrastructure is made of users' devices that provide services. How do you rate this uncertainty of networks functioning?

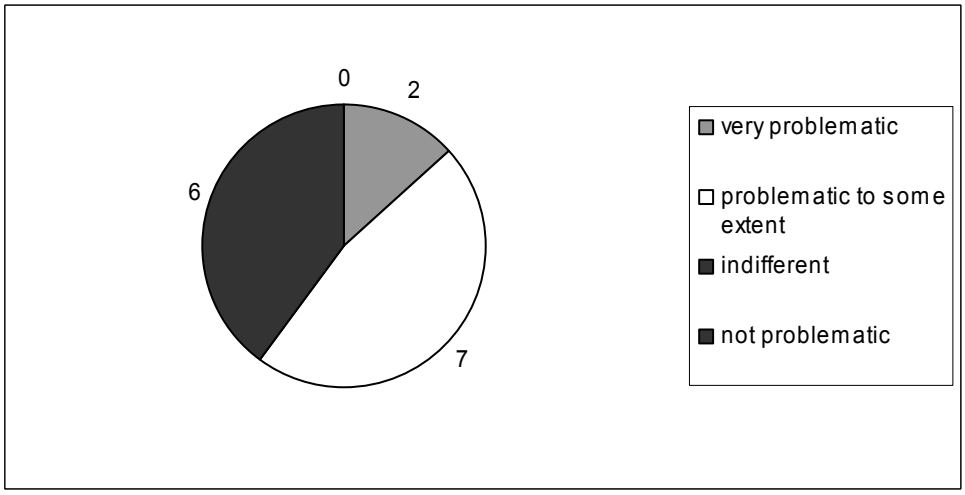

Figure 18 – Perception of the uncertainty of users' spontaneous cooperation in ad hoc networking.

Those who considered it to be very problematic or at least somehow problematic were 9, whereas 6 expressed indifference to this aspect. Nobody said that this aspect was not problematic.

After all these questions, which gave our respondents an overview of ad hoc networks, we asked them if they would cooperate to create such network, underlying the cost in battery power.

Question: Would you cooperate to make such network function, even though it may cost you in the form of battery power?

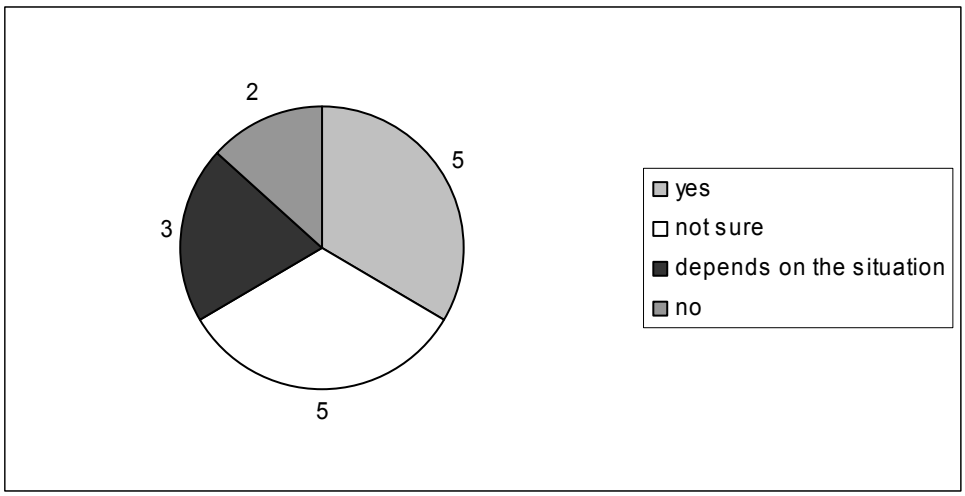

Figure 19 – Importance of battery as cost to participate to the ad hoc network on the decision to cooperate or not.

To this question, 5 people answered that they would do it, 8 are not sure or it depends on the situations and 2 would not do it. From this answer pattern we can conclude that attitude to cooperation is rather limited. We could also say that **people are used to be able to rely on devices and services** that guarantee a network and that do not require much effort (just paying for using the network and the service) and do not feel the need for a system as ad hoc networks. It can be that adaptation to an existing situation makes individuals less willing to know or try different systems.

We presented the following scenario:

You have a PDA (electronic agenda) that works both as mobile phone (GSM network) and as ad hoc device (not using any operator). GSM network is subject to a fee payment and provide good quality, whereas ad hoc is free but the quality of service is variable and not guaranteed. You can switch easily from GSM to ad hoc and vice versa on your device.

We asked them how they considered this hypothetical device; we can summarize their answers in the following way:

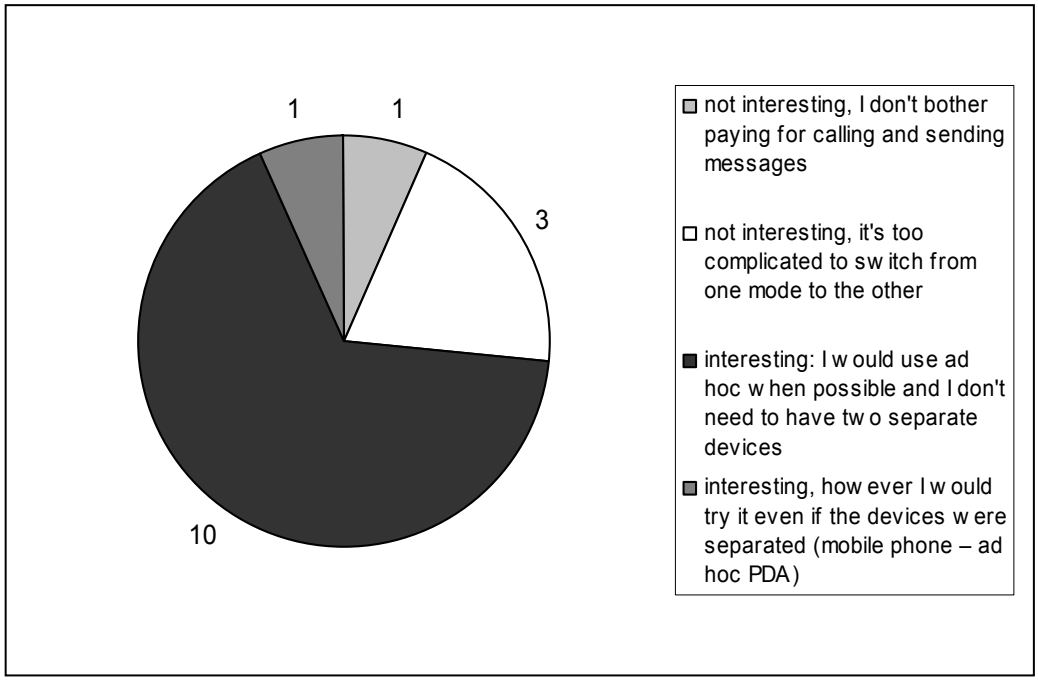

Figure 20 – Overview graphical representation of the opinions about the presented device with two modalities of functioning.

As already said, individuals would be willing to try a new communication system when the required effort is not too high. If can imagine an ad hoc module that can be implemented in mobile phones or other devices that users already have (an alternative could be a wristwatch for instance) without the need to buy a dedicated device, such for example an iPaq or other PDA, the user might be willing to try and eventually adopt it. 10 participants out of 15 said they would find this option interesting. Nobody of the respondents said they were interested in a new device for ad hoc to buy and carry around.

2.3.5. Other important aspects for MobileMAN

Study on WLAN use in city buses of Zurich

As already pointed out, all the respondents of the online survey said that they would be interested in the opportunity to use internet connection to trains, during their traveling and commuting to work. An interesting study, carried out at the Swiss Federal Institute of Technology in Zurich (ETH), tested the use of a prototype of public hotspot on selected city buses. The results of this study show valuable aspects that are of interest for MobileMAN as well. In particular, because **it tests the use of wireless internet access under real mobile conditions**. Objective of the study was to test the mobile access on these buses and learn what needs have the users in relation to this service. The transmission rate was up to 48 kbit/s, and was depending on the number of users accessing the network at the same time.

During the test, questionnaires were handed out to the users in two different periods. The first one was rather short and its results will be left out; we will instead focus on the data that came out from the second set of questionnaire handing.

First of all, the questionnaire showed that the main users of the shuttle bus connecting ETH in the Centre and the main Campus (Hönggerberg) were **students (72%)** and people working there (21%).

The use of the wireless access was **not heavy**: 15% used it many times; 21% only once and 63% have never used it.

Interesting is that 47% of those who tried to use the wireless access only managed to connect after several trials, 47% got it working the first time and 7% did not manage to make it function.

Important question was the one relative to the **type of applications and uses** of the wireless access in the bus:

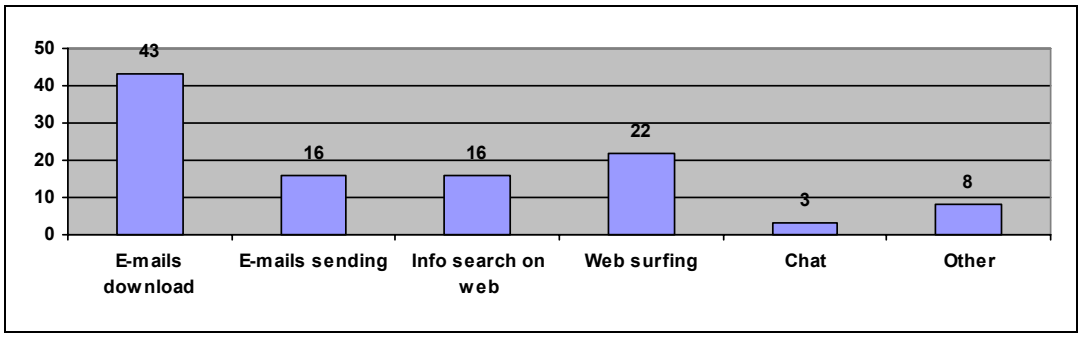

Figure 21 – Types of applications used on bus with public WLAN access. Source: ETH report 2004. On the right is the number of users. Total number of respondents: N=45.

As it is possible to see from the graphical representation, **email download and sending are the main applications for which to use the wireless access on the bus.**

The explanation for this information can be found in the fact that the buses connected two rather near locations and therefore users used the access with laptop for a short time just enough to quickly check the mailbox. Other uses (such, for example, chatting) were not worth due to the short time.

Focusing on the **quality of service**, one question regarded the speed of the connection and the associated satisfaction degree of the users. Results showed that 9% of the respondents found the connection quicker than expected, 48% found that it was inline with their expectations and 43% considered it too slow.

To the question about the utility of a Wireless LAN service on public buses, the respondents answered as following: **18% said they do not need it; 64% said it could be useful but they would not pay for it; 18% said that it would be a useful service and they would pay for the use**.

The questionnaire provided also the opportunity to give some comments (open question) on the experience and their opinions toward the use of Wireless LAN in the bus.

Generally, the trend of the provided comments was that it is considered more interesting and appealing to be able to use WIA on a train, where people stay for longer trips, there might be electricity plugs and tables and it is less chaotic than in a bus.

Someone said that in an occasion, the bus had to brake suddenly and a user's laptop fell to the floor. Someone reported that it is difficult to use a laptop in a moving vehicle often crowded with many people and that **it would be much easier and useful to use a PDA instead**.

A user complained about interrupted connections (possibly due to interference with Bluetooth), and long download time (low transmission speed).

A questionnaire respondent also expressed their concern about electro smog issues: they said that it is not worth to install everywhere access points just to provide a service for a small number of users "compifreaks".

Interesting aspects for MobileMAN

The experiment of introducing a WIA in a public transport bus (therefore, in micro-mobility context) has provided us with some issues that are important, namely:

1. **Portability of devices**: laptop computers are the devices we normally use in relation to Internet; however, when on-the-go laptops are too big (limiting therefore mobility) and are not devices that we normally carry along (as opposite for example to mobile phones). Moreover, for quick use of a WIA while mobile (email check, public transportation schedule, instant messaging) a laptop takes too long to be ready to use. In such situations, access through a PDA or a smart mobile phone is to be preferred. Problems also arise in crowded places: an object that is usable with a hand is much better and less subject to falling to the floor than a laptop that requires a surface to rest on.
2. **Electro smog issues**: research in this field is unclear – some claim that radiations are dangerous, while others believe it is not. In such a confused state, some people reckon that it is risky to cover cities and towns with access points that irradiate electromagnetic waves in the air. In this aspect MobileMAN and ad hoc could have real advantage.
3. **Technical problems**: for inexpert users it was difficult to configure their laptop to connect via WIA so as to succeed in doing it. To be something available to a great number of users, it must be **easy to use**. WLAN (802.11) is known to have interference problems with Bluetooth, which might break a connection when getting in the transmission range. This affects the quality of service that needs to reach an acceptable level for people to adopt it.
4. **Use of the technology (applications)**: while mobile, users do access Internet to surf the web, and for communication purposes (email, chat, instant messaging) or to search for punctual information (train schedule, an address, a telephone number). This is an important fact for MobileMAN, so that the right applications will be designed for the "mobility context".
5. **Cost of use**: many applications such as email, messaging – in the form of SMS – and information searching are more or less available with the majority of the mobile phones on the market. However, users pay for these services. Some wireless access points are subject to a fee for the users who wish to use them, whereas others are free of charge. How much is the user willing to pay to use an access point to connect to the Internet when walking on a street, sitting in a bus or on a park bench? This might be a major advantage of MobileMAN if the system gets to work and at no costs (at least in monetary terms) for the user, but offering at the same time good service.

2.3.6. Conclusions

After having conducted this study on the use of public WLANs we can draw some conclusions that are important for our social evaluation of MobileMAN.

First of all, it is interesting to reflect on the type of applications that participants in our study have indicated to use while mobile (macro-mobility). Email, web surfing and information-search were the mostly used by our respondents. It is interesting to note that the same applications were indicated by the participants in the study conducted in Zurich of WLAN access on some city buses (micro-mobility). By the comments provided by some participants to the study on WLANs on city buses, it is interesting to see that for the two different types of mobility, two different devices are more appropriate:

- Micro-mobility → handheld device (PDA, smart phone, pocket PC, to have ease-of-use and portability)
- Macro-mobility → laptop to access full connection-related applications

MobileMAN could address the micro-mobility context, exploiting the need to have real, everyday mobility and therefore making use of a PDA. In fact, nobody wanders around going for shopping with a laptop in the bag! However, in this situation one might be wanting to check their mailbox or to do any information search. **Requirements in this situation are ease-of-use, portability and easy technical set-up**. Many people who wanted to use buses WLANs said to have experienced problems and managed to connect after several trials, whereas some others did not make it function at all. Users want something that works and that is easy to use.

From our study – even though we do not generalize any result – it was to be seen that electro smog is not a perceived issue. It has to be remembered that information on the subject is unclear.

An important aspect is the **relationship between cost and quality**: almost all participants in our study have indicated that **hotspots use fees are expensive**. In this ad hoc could have a real advantage. However, certain quality aspects are necessary to make ad hoc really acceptable. Differentiating between micro-mobility and macro-mobility we can also say that in the two situations, requirements are different: I might have more tolerance for quality faults in micro-mobility contexts (if I cannot check my mailbox while I am in a bar, I can do it later when I am at home), than in macro-mobility contexts (if I cannot check my mailbox on ad hoc it might be impossible for longer times, while travelling and so on). However, it has to be remembered that when we get used to certain quality it is very difficult to accept a decrease of it for the same service. If we can dispose of a VoIP application that allows us to communicate via voice from a hotspot and the quality is at least acceptable, we might reject strongly a voice communication application that works over ad hoc that does not present at least the same level of quality.

The last aspect that we wish to underline is that **people who participated in our study expressed interest for ad hoc in the case that it is an available modality in the same device that acts also as mobile phone**. In such situation, the user has always the choice between ad hoc and operated network and does not need to carry around two separate devices, which is a practical aspect of mobility. It is also a "softer" way to break the resistance to innovation in those individuals who are very bound to routine and who would never buy another device specific for ad hoc networks.

2.4. The Elderly and communication technology

2.4.1. Study objectives

The objective of this study was to "raise awareness about the factors that need to be taken into account in technology development if a product is intended to target, not only the masses, but also people with specific needs and constraints" (see D7). In fact, **the majority of technological products are not thought for elderly users, who are therefore excluded from the potential benefits** that they might provide. In fact, ICTs may contribute to enhance their social inclusion, work opportunities and independent living or my lead to their further marginalization (Treffers 1998). Also, "technology can host an avenue for new relationships, provide a means for continued learning, facilitate personal growth, provide an outlet for hobbies and new experiences, or re-define careers and roles in retirement as losses increase. Communication [was] rated as a primary importance in computer ownership and communication often can become even more important as individuals age" (Ashford, Lecroy, and Lortie, 1997, cited in Opalinski 2001). Opalinski (2001) says also: "vulnerable, at risk, and isolated individuals can benefit from technology. Because isolation is one of the greatest risks in aging, communication via computer can help to limit the levels of isolation by providing a means for friends and families to keep in contact".

We intended to capture what relationship the elderly have with technology, both with specifically tailored types such as the tele-care wristband and mass market types such as mobile phone, computer, and internet. The personal interviews were to explore their relationship with technology and to understand **what kind of needs the elderly might have that MobileMAN could address to improve their lifestyle and the quality of their life.**

2.4.2. Study outline

To understand the elderly and their relationship with new communication technology, we went through the following steps:

a) interview of key people dealing with elderly;

b) interview with a group of users of tele-care wristband, who live at home and mostly alone;

c) interview with some elderly who used QualiLife[15] products.

The first interviews with key people working in the sector with elderly aimed at individuating topics to be covered during the interviews with the elderly in the subsequent phases of the study. We interviewed seven people active in different areas, namely: the CEO of QualiLife, an enterprise making special software and hardware interfaces for elderly and disabled people; the

[15] QualiLife is a company that realizes software specific for disabled people and elderly. They offer a simplified version of all common software (email client, browser, typewriter, SMS-sender, phone management programme, games and others) with a simple, accessible and completely customizable interface. See: http://www.qualilife.ch

secretary of Elderly Association of the Canton Ticino; emergency tele-care alarm operators, people who provide the tele-care wristband service and one person of MobiClick AG[16].

We chose to meet some elderly[17] who make use of the tele-care wristband (assistive or exclusive approach – see later in this chapter) and some elderly who have been introduced to mass products provided with specific simplified interface (complementary approach). We aimed at comparing the attitudes towards these two types of technology and identify needs that the elderly have that MobileMAN could eventually address to **enhance their quality of life**.

2.4.3. Interviews with key experts about the elderly

Interviews with the above mentioned experts gave us valuable information: needs, their relationship and attitudes towards technology and other major issues of the elderly were topics of the interviews. They all perceived that the main challenge for the elderly is often a **communication problem with the outside world**. They feel often isolated because they do not dispose of a real social network that gives them support and enhances their quality of life. The fear they have with regard to new information and communication technology is real and very strong. The elderly fear greatly what they do not know. It has, however, to be remarked that they have lived the majority of their life without all the electronic devices and equipment we dispose of. All these opportunities to communicate that are normal and granted to us appear to them as incomprehensible and superfluous.

What has also to be remembered is that at an advanced age, individuals have often physical impairment, sight issues, and difficulty in handling small objects (devices' keyboards!). These aspects are not of little importance and limit greatly their possibilities in adopting new devices and technology.

More than one expert pointed out that **the elderly have fears to be abandoned once a care system or a technology is given to them, since they think that it is a substitution for human presence**: in their mind the mobile phone allows relatives to visit them less often, which is not appreciated by the elderly. In fact, they value a real and concrete social network, whereas **they do not understand how a virtual community would bring any benefits**.

The importance of a device or service at **low cost** was underlined by the expert working at MobiClick, the company that developed a type of mobile phone mainly thought for seniors: it has only four buttons (three buttons have each an associated phone number to call and the last one is the switch on/off). The buttons associated to three phone numbers have different colors, which helps the user distinguishing them. The phone has no display, and the number of buttons limits the numbers to be called to three, which is an ideal number to be remembered. He also said that many elderly have fear to go out because they feel that in case of need nobody will see and help them. They also are afraid not to reach the telephone when they need it. MobiClick responds to these needs and provides real accessibility because of its simple interface and features.

[16] MobiClick is a specific mobile phone created for the elderly. It has a very simple interface with only three buttons, each corresponding to a pre-memorized number. It was launched to the market about in Summer 2004. We had the intention of interviewing MobiClick customers, but the company would not release any data for protection.

[17] It is difficult to define at what age an individual is considered "old"; discussions about this aspect are very lively among researchers and policy-makers. We did not define an age; however, the age of the individuals that we interviewed for this study is between 68 and 90.

An issue that is very much concern of the elderly themselves and of their relatives is their **security**, and the opportunity to be assisted when in need as soon as possible. To this requirement it is possible to respond following two approaches, which will be explained in the following sections.

Exclusive approach

This approach provides systems and technology exclusive to the elderly. An example is the tele-care wristband, which consists of four parts, namely:

1. a bracelet with the emergency button that the user wears;
2. a base station that is plugged in the phone line;
3. a list of phone numbers of relatives or persons at disposal that are contacted with a cascade by the assistance central when the user in need activates the alarm;
4. the assistance central that responds to the alarm of a user who is in need and alerts the relatives or persons in the user's list or the ambulance, depending on the situation.

The functioning principle of this communication system for persons in need is the following: when the user pushes the button on the bracelet, it transmits a signal to the base station that connects to the first aid central via phone line. The base station has a speaker so that the user can communicate with the person in the first aid central; depending on the need of the user, the first aid decides whether to send to the user's home someone from the personal list of relatives or acquaintances or the ambulance.

This type of products or services are specific for the elderly (or disabled people) and may have a connotation that **the elderly themselves do not like, since they convey the idea of a person in need and incapable of self care**. When the user does not like and does not accept the instrument, it is as if they did not even have it. In fact, many tele-care wristband users do not wear the bracelet because they feel shame or do not accept their state of need. Not wearing it has the same result as not having it, making the entire system useless.

Complementary approach

The complementary approach consists of using technology that is for everyone, such as mobile phones, or other devices. This second approach is in our opinion better, because it allows the user to **fully integrate with the communication habits and means that other categories of people use**. However, to really be beneficial to the elderly, mass technology such as mobile phones need to take into consideration specific aspects, so that they allow a full access to them. As already said, QualiLife is a small medium enterprise that has developed software and interfaces that allow users with any type and degree of disability to communicate with e-mail, phone, fax, SMS, use internet, view photos and movies and command home electronic devices. Their products are similar to common Microsoft software but are tailored and simplified so that anyone can use them. One of their objectives is to make communication between generations easier and richer.

Other examples of this approach are specific mobile phones, such as the Secuphone, or MobiClick, which are designed taking into consideration the specific needs of the elderly.

2.4.4. Interviews with elderly using tele-care wristband

We interviewed eleven elderly who make use of the tele-care wristband, chosen following a convenience sampling. We aimed at involving users of this system of different profiles. Being this study of a **qualitative nature**, we did not have the objective of involving a sample that would be representative of the entire population of tele-care users. However, we were able to identify key issues regarding the elderly who make use of this type of technology.

Interviews were conducted between April 27th and May 24th 2005 at the domiciles of the participants, that is in the regions of Bellinzona, Lugano and Mendrisio. To respect their privacy, the persons were contacted in advance by the people in charge of the management of this service to ask whether the users were willing to collaborate in this study. Mainly, the contacted elderly were very willing to participate. In the following, we report the most interesting aspects that resulted during the interviews. The names have been changed for privacy reasons.

Tatiana

Tatiana (75) has a son and a daughter; they both live in Zurich. They have an intense communication exchange, mainly through the phone. Locally, she has relatives and acquaintances that she sees regularly and often. She said that initially she did not accept the tele-care system because it gave her **the idea of "old" and "invalid"**. She also does not like the look of it and says it gives feelings of shame. This lady showed a **strong rejection for the computer** and all the related applications, although she used a computer when she was working in a bank. She is not interested in any way in electronic commerce, internet, and communication. **She underlined that what she is interested in is her local network of friends and acquaintances. The fact that is real and present is important, and she does not care about opportunities to be part of virtual communities.**

This applies also to the mobile phone, which she owns but only uses when she goes to the town and has the need to call a taxi. At the question whether she uses SMS, she firmly said that she does not. She said that **she does not understand why even children own a mobile phone, and believes this is a loss in the quality of communication and interpersonal relations** (less face-to-face communication). Moreover, she said that mobile phones are too small, keyboard is too small and it is difficult to see clearly, which is an impediment to real access and use.

Renata

Renata (75) has two sons, who live in the nearby. They have not an intense communication exchange. She said that they call each other only if there is a reason. She has not a big social network and mostly sees a neighbor and goes for short walks with her dog. Before she experienced some health problems she used to go to gym and singing groups. From what she said it is possible to sense the fear of living alone. She also indicated that the tele-care gave her a feeling of security. In fact she said that in case of emergency because of thieves for example, she would press the button. This is not actually the idea of the tele-care system, but it is perceived by this person as a quick way to alert someone in case of any emergency. She has no mobile phone, but it has to be remarked that Renata seems not to have at disposal much money. In this case any cost assumes a high importance. **She values computer and mobile phone as useless and not interesting**. She

said that it is not a problem that when she goes out the tele-care system is out of reach and does not work, because she is in a public space and someone is always there when in need of help.

Elena

Elena (69) has had the tele-care wristband for ten years and has used it several times. She has a son and a daughter who lives rather near and who she sees regularly. In the past she used to work as a grocery seller. At present she has a rather limited social network; and when she goes out she does it by herself, relying on a taxi service. She enjoys doing things such as patchwork while watching TV. She said that the tele-care wristband is **very useful and appreciates it, although she never wears it**. This is a sign of a sort of barrier towards technology. In fact, she owns a mobile phone, but she only calls or takes phone calls; SMS are in her opinion too complicated. Elena said an interesting opinion: **TV and the phone, radio, even VHS are part of her life, are "like furniture"**. In some ways they have been interiorized. Mobile phones, computers have not, and they are rejected, and considered as "unimportant, useless". She bought her mobile phone herself, but only because she couldn't find any payphone in the town and became difficult for her to be able to call. She also complained that mobile phones have too small buttons. She has never used a computer and stated that she has no idea about how to switch it on.

Anna

Anna (90) has a restricted mobility and goes out very few times. Her niece lives in the same building and helps her. This lady is a **typical person who could gain benefits from technology**: not being able to go out often, she could set up contacts of virtual type. However, this person has owned and worked in a small shop, and has never used a computer. It seemed that her life when she was younger was filled with other things than technology. Anna, also, has no mobile phone, although her son wanted to give one to her. She considers it useless. It is true that in her situation, since she never goes out alone, a mobile phone would be rather useless. She said also that if she were in the condition to go out by herself she would appreciate a mobile phone with her.

Lorenza

Lorenza (78) is a rather isolated person; she has very few contacts and does not take part into any activities. To some extent this is due to her personality, but also to the fact that she has moved more than once and has lost the contacts she used to have. She has had the tele-care wristband for about six months and admitted that at the beginning **it was not easy to accept it** although she realized it was necessary, after she fell at home. She has no mobile phone, which is rather normal due to the fact that her social network is very limited she also has no need to own one to keep in touch and communicate. She feels **irritated by the fact that everyone on the street or in the bus talks on their mobile or writes messages**, since she cannot see the need for this.

Alda

Alda (68) is a person that lives alone and has one son who lives abroad. Around her she has only acquaintances. She has health problems and for this reason she has a restricted mobility. As a consequence, she has also a rather limited social network. Alda has moved several times, although always remaining in the same region. She said that in her building **people are continually moving so it is very difficult to maintain stable relationships**; she also lamented the typical aspect of urban individualism, when she asked someone in the neighborhood to keep one of her keys in case of an emergency ("people do not want trouble"). It was also possible to feel that she completely familiarized with those devices that she has always had, such as the TV ("I could not live without my TV"), whereas other newer technology (computer, mobile phone) does give her the sense of unknown and stranger, as well as not appealing and useless. Significant was that she said **"one has to grow with technology"** and "you know, these things are for the young".

Erminia

Erminia (85) lives with her son. Apart from her son, she has three other daughters, two of whom live in the nearby, whereas the third lives in Italy. The tele-care wristband is useful when she goes out and her disabled son is alone at home, but also in case that she herself needs help, since she said: "I'm not so young any more". Erminia was a teacher and her daughters are all graduated from university. For this reason, and also because Erminia insisted on it, they all are computer literate. For example, Erminia **owns a VHS but she never uses it: when she needs to record some television program, she asks one of her daughters to it for her, because it's easier**. She has owned a mobile phone for more than six years; however, the only functions she uses are the very basic ones. She doesn't particularly like SMS, and communication for the sake of itself. She has sent few messages but she forgets "to check the received ones", because **it does not cross her mind to do so**. Her daughters feel better if she has a mobile phone when is out. The only reason that she has a computer at home is that it is very useful for her son, who likes writing letters to his friends. In fact, she herself is "not interested" and although she admits that the opportunities that new technology gives are good and positive (information is quickly obtainable), she is not interested in getting closer to it. Her son has a great pleasure in communicating with the people in his social network, but due to his situation the better way for him to communicate is voice; therefore, technology like MobileMAN would hardly provide him with evident benefits. For instance, a mobile phone is too difficult for him to manage, due to the small buttons and to his sight difficulties.

Angela

Angela (78) lives alone but her granddaughter goes to her for lunch every day. She stated that her relationships with all her relatives are very good and they see each other and keep in touch frequently. She lived in other towns of Switzerland before she arrived in Lugano. Apart from family relationships she does not have any other meaningful people around herself. She said she had a mobile phone for a while but did not like it and gave it back. Paying for its use was expressed as a burden – in fact, she mentioned this aspect several times during the interview. She also is **bothered by all people carrying mobiles around, calling while walking or being on a bus**. This individual is very attentive to costs. She also appeared irritated at the question whether she would like to use a computer and it was not clear if she was interested or not. **For her,**

communication via modern technology such as email, webcam chat, even SMS or calls over mobile phone network is a loss with respect to past methods, such as a letter. This is a cliché, however, since technology like email is just a quicker way to send text content than a letter.

Jeanne

Jeanne (85) has as son and a daughter, one lives near her, whereas the other slightly far away. However, she has a strong relationship with both. Other people are in her social network and she is a very outgoing and active person, who balances going out and staying home reading books and watching TV "like everybody". This comment tells us that watching TV has become a routine, both individual and social, and the television is an object that is very familiar to everyone. An interesting comment she provided is the following "I don't manage well the mobile phone because I use it rarely, because **I'm not used to it and it does not cross my mind to use it**". And, also "**I don't feel the need for it**". Evidently, the mobile phone that she owns was given to her by her son and daughter. At the question whether she was interested in learning to use computer and internet, she expressed not interest. The motive: "I know that when one begins to deal with computer, then they stay in front of it for hours, I prefer reading".

Adele

Adele (76) lives some time in Switzerland, near her sons, and some time in Italy. She has strong relationships with her sons, who check up on her regularly, everyday. She was a very active person until she had to undergo surgery; now she is still recovering and must limit her activities. What is interesting about Adele is that **she has spotted the opportunities that internet give, and the fact that it allows easy finding of information, discussion groups, community websites** and so on. She was given a pc by one of her sons, but on her request. It is true that she has used a computer when she worked, but with internet she had no experience before a couple of recent attempts to enter a chat. Adele is attracted to the opportunities to "focus on various topics" and to communicate with people of her age, discuss about similar problems; she said "I need the contact with people of my age". Interesting is that, **differently from all the others interviewed, she does not feel that virtual contact is a less valuable type of relationship**. What she perceives as important is the opportunity to interact with other people of the same age who live in similar conditions.

Ottavio

Ottavio (77) is the only male that we interviewed. Although this sample has no intention to be generalizable, this proportion reflects strongly the real proportion between male and female users of the tele-care wristband, who are in the great majority women. He was married twice and had four sons. One lives far away. The contacts with his relatives are not very tight, as well as any other acquaintances. He said that he was very known and outgoing when younger, but now has isolated himself and does not like to go to a bar. He does not make heavy use of technology: apart from TV and VHS, he does not own a mobile phone ("I threw it away because I don't need it") and he has a computer but never uses it. In summer he is occupied with his garden, whereas in winter, it is more difficult and feels loneliness. The impression he gave is that **technology does not really belong to his world**.

2.4.5. Comments

As already said at the beginning of this chapter, these interviews had the objective to give us the opportunity to explore the way the elderly live and how they relate to technology and a world that is changing at a great speed. What do they think of technology, of mobile communication, of virtual interaction with other individuals living far away but in the same situation as them?

After eleven encounters with elderly who live alone, we can draw some conclusions that – we repeat – have no intention of offering a general picture. First of all, we can say that isolation and lack of human contact is a very common issue among the elderly. Those who make use of the tele-care wristband live alone for different reasons: because they don't want to be a burden for others, because they have no relatives near, because have no relatives or close friends at all. This is a result of the modern society, where the extended family does not exist anymore. In fact, these individuals are those who might benefit from the opportunities of new technology: discussion forum, online communities. However, there are a number of obstacles to take into consideration:

1. **language** barrier: the majority of websites and of materials and discussion forums are in English, a language that not many elderly know, especially those whose education was rather limited;
2. **computer illiteracy**: at an old age, all that is new is very often perceived as a "foe" and automatically rejected. Learning to use a computer can become even more difficult, having never had a real contact with such technology;
3. **will to be confronted with new things**; many elderly expressed a sort of "stepping-back", they said "these things are for the young, not for me";
4. **costs**: technology has not indifferent costs and many elderly – especially those who had jobs of low income level – cannot afford to buy it. This is even a greater barrier if they cannot identify what benefits they can gain;
5. **power of routine**: this aspect is closely related to the third point; when routine is deeply rooted people tend not to be interested in new things.

From our point of view, it is a pity that exactly those individuals who are rather isolated who would benefit greatly from new communication technology are the ones who typically reject technologies, who feel that technology does not belong to their life and are afraid to try to use it. As already mentioned, the **cost factor is an important hinder** for many people to adopt or try something. However, an important consideration that we need to underline is related to the type of life many elderly have conducted. More than one, during the interviews, has pointed out that **it is necessary to grow with these instruments, to intertwine them completely in someone's life**. When they are considered normal, ordinary, then it becomes impossible to live without them. In the same way as for someone who has DSL internet at home, and suddenly has to move and there is no DSL available. How can people who have lived for most of their life with one phone to be used scarcely understand why young adolescents keep sending SMS to their friends or calling them more times a day?

The elderly who own a mobile phone received it in most cases from their sons or daughters. These elderly use their mobile phone to communicate with their **family network**, and not other people. An exception was the use of the mobile phone to call a taxi while being out of home by two of the interviewed elderly. Younger people, instead, use their mobile more for contacts with their social network other than with their family.

2.4.6. Encounter with elderly introduced to QualiLife products

The elderly hostels of the city of Lugano in collaboration with QualiLife introduced computers equipped with QualiLife products at disposal of the elderly and organized courses and demo sessions to show them what opportunities they offer.

To understand what the elderly think of new information and communication technology when they have real access to them, we met three elderly women, hosts of the Residenza Paradiso (Lugano), and the person responsible of this project.

Figure 22 – An elderly person using a computer equipped with QualiLife software and simplified hardware.

We met Maria[18] (75), Eleonora (88) and Esther (90). Maria and Eleonora showed interest in the opportunities that new technologies offered them, whereas Esther said that these things were **too complex and difficult for a person of her age**. One of the declared objectives of this activity was to favor communication between generations. QualiLife offers the opportunity to send messages as SMS, e-mail, fax, all via applications that have simple and similar interfaces, with very few passages to perform. They were all very happy to be able to communicate with their grandchildren, who live far away and only rarely can come to visit them. The fact that it is possible to use both the e-mail and SMS allows reaching almost everyone, since almost everyone has at least one of the two means of communication (an e-mail account or a cell phone). Greatly appreciated was also the opportunity to send photos of the organized events at the hostel to relatives who live far away or

[18] Again, the names have been changed for privacy reasons.

receive photos from them. Photos that can be easily and quickly sent and shared have the power of bridging distances between individuals. This is particularly important for the elderly, who very often, have their closer relative who live in other regions or even countries. **This resulted very clearly from the interviews: sons and daughters have moved away and there is a physical important distance that makes visiting elderly relatives difficult.**

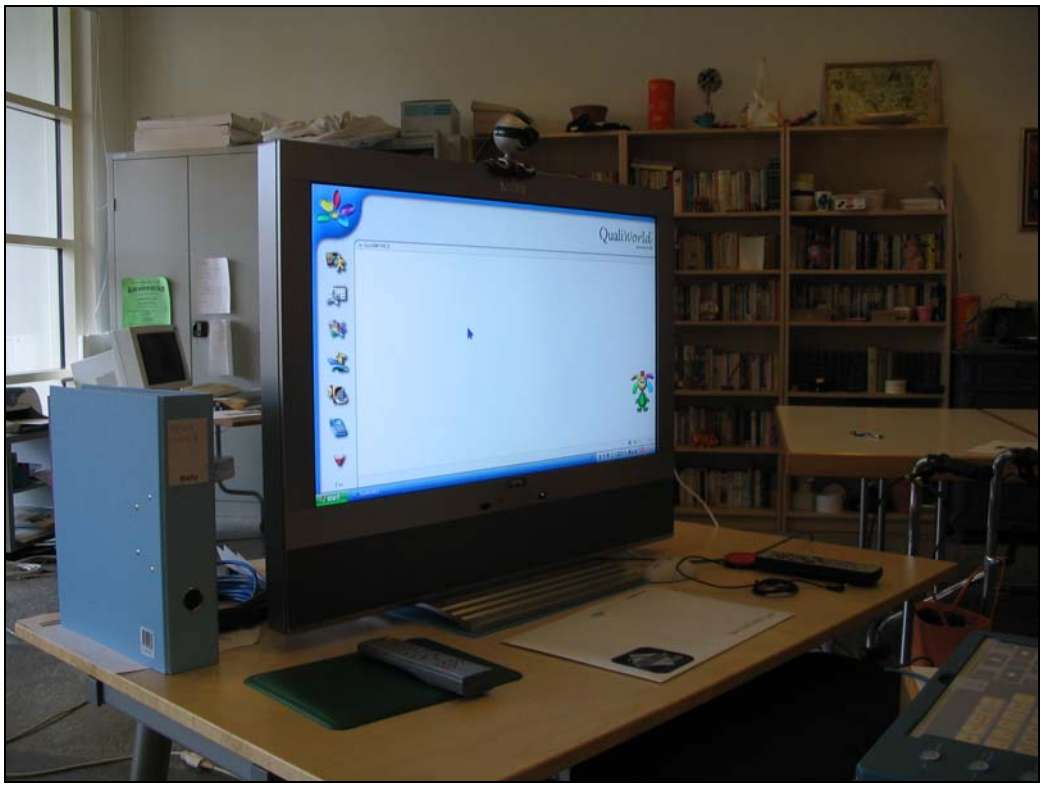

Figure 23 – The big-size screen to enable elderly users to view and read better and easily. In this case, this is an essential aspect of real access of technology.

An interesting aspect is that in this house, they specifically chose a **display of big size**, to make it easier for the users to view images and text. Also, the person who accompanies the elderly in learning how to use these instruments and in knowing what potentialities they offer uses very particular words, semantically near to them, to make these persons understand. For example the computer is a sort of "magical TV", and email is compared to traditional mail. In this way, by using metaphors, the elderly understand better and **feel less distance between themselves and technology**. In this way, their rejection towards technology is less strong. Another important aspect is the fact, as already mentioned, that for the elderly, access to technology goes through very small things, as for example the "double-click" with the mouse. It is difficult for them to perform this action. A solution is simply to eliminate the double-click from the settings.

The elderly particularly appreciated the VR interactive images and photos they could see: photos of their town or of places they have visited or also they have never been to. Visual stimuli are very powerful and can trigger emotions, interest in the elderly.

The computer that the Elderly Home has bought acts also as Media Centre, and is interesting that a part from allowing the users to communicate with relatives who live far away more easily, has had a repercussion on the physical social network as well. In fact, grandchildren or even sons and daughters are interest in seeing the equipment and have an incentive to go visiting the elderly there to see and discuss with them about technology and so on. In short, two worlds have somehow a bridge that connects them.

2.4.7. Conclusions for MobileMAN

A question that this study has raised is **whether the elderly actually want to be included in this communication society**. Not because they have pleasure in being isolated, but because of their historical background: they have lived through very different social and cultural times, they have lived during the wartime, when they were younger the telephone was not to be found in every house. They did not have all the commodities we have now. What resulted from the interviews was the feeling that they are not at ease in our present society, dominated by mobile phones, by the Internet, by digital TV and complex electronic equipment. This generation of elderly has been confronted with huge changes in individual's everyday life; a change that the next generation of elderly will probably not live so brusquely. The sensation as for today's elderly is that they are confused by the speed of new technology and that they do not want to be part of this world. **The point is about their right to choose whether to follow this changing world, or not to follow it**.

With this kind of individuals **it becomes even more difficult to talk about technology that does not exist** and about what they would like to do with it to improve their quality of life.

Another aspect that intervenes heavily is that the elderly have real **difficulties in seeing the small keyboards of mobile phones or text on displays**, and in dealing with small keyboards buttons. Even though the QualiLife products are thought for desktop home computing and not for mobile devices, including them in this study has given us the opportunity to think about important issues for MobileMAN.

First of all, as already said, this generation of elderly has not had much contact with technology, especially information and communication technology. For them it is incomprehensible that we have mobile phones, we exchange SMS or MMS, email, chat and so forth. Some elderly have expressed appreciation for the opportunities that new technology gives, but more than one of the interviewed said that it does not cross their mind to check for messages, or to send one. This is typical for a process that has **not been internalized** and is not really part of someone life even though they might make use of it.

An important comment is that **mobility** does not really apply to this group of potential end users. Elderly people, in fact have not a big mobility; since they do not work they spend more time at home and normally the majority of them do not spend much time traveling and are less mobile than younger individuals.

As already said, portable devices are difficult for elderly people to handle: **buttons are small; text is also small and difficult to read**. For these reasons they do not really like this type of object and use only few features of mobile phones, that is, the ones that are nearer to what they already know.

What is also important for MobileMAN is the **absence of an operator**. Although this aspect is being seen as positive – in fact, one of its consequences is that there are no cost of service to pay to the operator – it may also be considered in an opposite way. The network operator is responsible for the functioning of the system, and when it does not work, the users have someone to blame, who has to take the responsibility to repair the damage or make it work. Users also rely on service

providers for questions about their device, configuration, and functions. Often, service providers' sale points offer the service of configuring clients' phones. For those users who are not very skilled, knowing where to go when in need is very important. **An ad hoc system, completely infrastructure-less, with nobody who takes charge of supporting users can be unappealing for unskilled users for this reason.**

Sons and daughters often have given a mobile phone to their elderly parents so that in case of emergency situations they can always contact someone. Another motive can be the fact that they can in any moment check up on their elderly parents and see if everything is ok with them, independently from their location. This introduces a **sort of "virtual presence"**: the presence is constant, since any moment they can receive a call from their sons or daughters, but is virtual in the sense that it is not a real physical presence.

However, the success of QualiLife products[19] demonstrates that when individuals have real access to technology and they learn how to use it, they become familiar with enhanced communication and greatly appreciate the opportunities it gives them to maintain contacts with relatives both far and near. This accounts for an appreciation of the "complementary approach" to design of new technology for the elderly: giving real access to the elderly so that they can use the same means to communicate as younger people do is a good way to provide technology for all, in a way that it allows a better quality of life.

An important remark that needs to be underlined is that **in the next ten years, the "new" elderly will probably be in a better situation**: through their sons and daughters they will have been confronted with new information and communication technology. They might even have adopted it themselves and **used it for enough time to become familiar with it**. However, constraints such as small buttons and displays remain important issues for devices that are thought for being accessible to the elderly as well as younger people. A question, however, remains: whether the next generation of elderly will be more mobile than today's elderly, because of the cultural and social environment they have lived their life.

[19] QualiLife has expanded very quickly with sales networks and collaborations all over the world. Moreover, in the press there were interviews to their products' users who expressed their satisfaction in using them.

2.5. Observation of prototype tests with students

Although the MobileMAN test phase has been addressing very fundamental issues of technical nature (such as routing protocols, topology changes management, etc), we decided to participate into the last testing session of a series of 4 full days, each held in Pisa with a span of one week in between. Even though tests were mainly of technical nature, **we took this opportunity to gather the opinions and ideas toward the mobile ad hoc networks paradigm** of a defined type of potential end-users: those who might be the pioneers of this technology. Testers were a group of twenty students of engineering in different study years. People of this group presented the following characteristics:

- young and enthusiastic about new technology
- technology-skilled
- they were paid for participation, therefore their involvement was high and taken seriously
- they were open to discussions and opinions exchange on social issues of MobileMAN

2.5.1. Objectives of observation

The objective of this participation into the technical test sessions was to **capture the opportunities and limits that the potential "pioneers"** consider in the moment they are confronted with MobileMAN in a concrete way. Being students of engineering, these individuals are heavily confronted with technology and highly interested and attracted by this type of objects. Interesting is the fact that since they have been confronted with MobileMAN for a month (three sessions were already concluded, once per week) they might have developed an opinion on MobileMAN. Such process of opinion development needs generally some time and in this case the setting was ideal.

2.5.2. Limits and constraints

As already mentioned, there were a number of constraints that limited the amount and type of information that was to be gathered during this test session.

First of all, the aim of the testing was the quantitative and qualitative analysis of the technical solutions. Users were running scripts previously written by project engineers that instructed the machines to perform some actions, such as ping another machine in the network, or send a message to a predefined machine in the network. When a user ran the script and sent a message to machine Y, the routing algorithm sent it to the node logically nearer to the destination machine. Time, delays, packet loss and other technical metrics, such as the way information was distributed on the network nodes were measured. Since the machines were laptops, **mobility was restricted** and the entire setting of the tests was somewhat not natural, being laptop not the optimal device to be portable[20].

[20] See the concepts of micro- and macro-mobility in section 2.3.4 of this deliverable.

Anyhow, this experience was interesting since it allowed us to initiate a dialogue with individuals who have some knowledge of technical nature, are skilled but also dispose of critical eye and innovative character.

2.5.3. Outline of test observation

This test session was held at CNR in Pisa, Friday, June 17th 2005. Participants of the exercise were twenty students recruited specifically for these tests.

They already participated in three previous sessions held on the previous Saturdays; therefore they were already familiar with the procedures and objectives. The test occupied the entire day, with a lunch break spent at CNR.

At the beginning of the test session we **presented the reasons of social evaluations** in IT projects in general and the objectives of such evaluation within MobileMAN. It has to be remarked that during a previous session some participants expressed curiosity and interest in knowing more about the meaning of social evaluations of technological systems.

Among the activities of this observation of the tests we planned to give also blank sheets of paper (sketch note) to the students, on which they would have written any association or idea that came out during the testing activity. This part, however, was decided to be left out, since there was no real interaction with an application interface. In fact, the tests focused on low level architecture (routing and middleware). For this reason, it was not considered an appropriate method to gather information and was left out.

During the lunch break students were given a questionnaire to fill in. Questions were about their knowledge, opinions and personal evaluation of the mobile ad hoc paradigm. Particularly, **it was interesting to understand whether these tests sessions had brought about any change in their view about ad hoc networks and MobileMAN applications opportunities**.

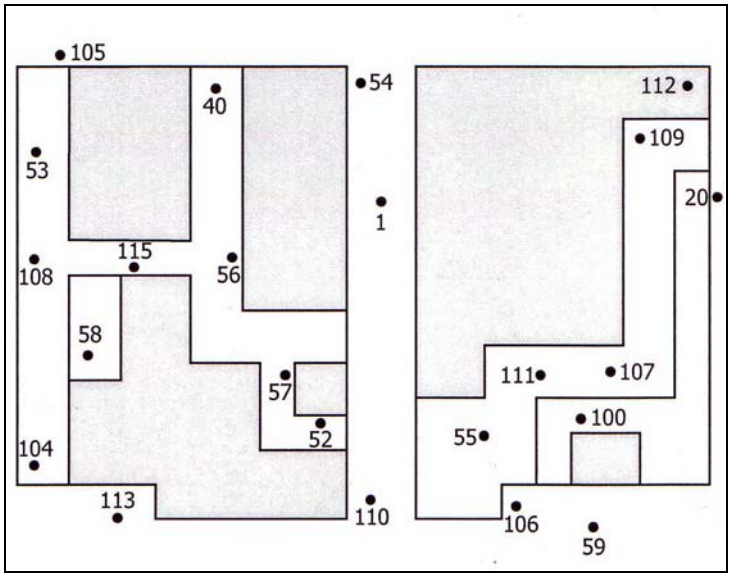

Figure 24 – Network topology of the testing session: starting position of the network nodes.

Figure 25 - Students participating in the testing session preparing for one exercise and configuring their machines.

Figure 26 – Two nodes exchange their position within the network.

2.5.4. Results from interviews and questionnaires

As already mentioned, during the day of the test we conducted a series of interviews with the students; some were one-to-one interviews another was a discussion with a group of six students. Interviews were not only focusing on ad hoc networks, but also on current mobile technologies such as mobile phones, instant messaging, PDAs, future mobile applications and so on. The idea was **not to be too narrow on the discussion subject**. In fact, we considered that discussions open to other mobile and communication technologies would have brought up interesting opinions and comments also applicable to MobileMAN.

Results from one-to-one interviews

One student expressed his **surprise** about the huge success of **ring and logos downloading for mobile phones, as well as about the expansion of video telephony**. At the question about whether he kept his mobile phone on or off during the night, he answered that he keeps it definitely switched off and that sometimes it remains off for entire days. He considers, in fact, the mobile phone as rather **invasive**, although he recognizes that it is a useful object in some occasions. **Costs** are considered as too high, and a hinder to a major use of the mobile phone. For the same reason, this student said he had no PDA and had no intention to buy one, because it is not considered "useful". New generation PDAs are being regarded as more interesting, since they have integrated the GSM module to function as phone as well.

For the future, he imagines that communication systems will **integrate all in one network** in a first phase, and secondly, the non efficient ones will disappear. This means that ad hoc networks are imagined as integrated with infrastructure-based networks. The discourse went also in the

direction of applications, and precisely on chat applications. Two students expressed their concerns about the diffusion of chat use among very young adolescents and believe that too extensive use of this means of communication can be dangerous for their personality development and the ability to interact "in the real world" with other individuals.

About the **elderly** and the possibility to develop an ad hoc network device with specific applications for them, one student expressed **doubts**. He based his opinion on the fact that in Italy, people in general are very insecure and **do not trust electronic applications, such as for example the bank withdrawal system. He expressed that mind-setting needs to be changed otherwise individuals will not accept more technology in their lives**. Especially the elderly are resistant to these types of electronic systems. This result confirms the finding of the interviews we conducted with a sample of elderly about their relationship with new technology[21].

With another student we discussed about the trend of putting more devices in one, such as PDA, photo camera and mobile phone. He doubted the usefulness of multi-function devices, based on the observation of some of his friends, who bought a multi-function device, ended up carrying laptops anyway. The reason is that **a multi-functional device often does not satisfy a need completely[22]**. He also said that for applications such as instant messaging, internet browsers and others, a PDA is not enough: one needs a laptop.[23]

Perhaps we are so used to accessing internet in the way we know it that we cannot separate it from a medium-size screen (and therefore only accessible through a conventional pc, either laptop or desktop). Consequently, we are not interested in an internet browsing application on a mobile device that does not have a screen of a minimum size. To develop novel killer applications, we might need to find something **completely new**.

Results from group interviews

Talking about innovative applications for a mobile device, we asked the students what they would think of an application like the **electronic wallet** (see iMode of NTT DoCoMo). The main comments were that people would not trust applications that deal with their money. They also pointed out that **in Italy people distrust electronic money withdrawing machines**. The surprising fact is that this distrust is not characteristic only of elderly people, but it is a **generalized phenomenon**.

An application of file-sharing that was discussed with the students makes sense for example in a university campus, where students share frequently material of courses, notes, resources and so on.

One student launched the discussion about a possible application of **ad hoc devices in cars**. In this scenario, the device communicates to the devices of the ad hoc network information such as weather conditions, road conditions, accidents and so on. This kind of application can be powerful, for two reasons:

1) It is quick and therefore can be almost instant – for example, in case of an accident, it can inform quickly on the spot about the fact, whereas now the police do inform in such situation but with a rather consistent delay of time, which is cause of difficulties.

[21] See section 2.4.
[22] In fact, it may happen that a device that dispose of an integrated camera, an mp3 player, an agenda does not offer what a photo camera, an mp3 player and a PDA offer singularly and the user may end up preferring to carry separate devices that are more complete and offer complex functionalities.
[23] See results of the study on public WLANs use, section 2.3.4.

2) Being included in the car system, there would not be a problem of battery consumption. Battery consumption is one big issue in ad hoc networks, since it represents a sort of "cost" for the user: to make the system work, the user needs to keep on their device even though not using any application at the moment, to provide routing and other services for other users. This means consuming batteries "without gaining something" and could be a disincentive to collaborate.

However interesting, this scenario would raise other issues, such as, for example, **security** and problems related to the content of information. There must be a way to track the information source to prevent **false warnings or false information spreading**. Or there must be a way to guarantee that the content of information is true (see section 3.1.4 of this deliverable).

Figure 27 – Some students who participated in the group discussion.

Results from questionnaires

All the participants in the test provided a filled in questionnaire. The age of the students ranged from 21 to 31, with the great majority in the age group 21-23. The gender distribution was also rather unbalanced: 3 women and 17 men. As said, they were all students of computer engineering, of different academic years.

Almost all of them had only **basic knowledge** of the MobileMAN project: they indicated that they knew it was a project about "wireless ad hoc network", about "mobility", "infrastructure-less network". Almost all of them said they knew from the presentation before the tests.

We asked them to indicate what they thought (before the testing sessions) were the **opportunities of the MobileMAN paradigm**. It is possible to categorize their answers in the following way:

MOBILEMAN STRENGTH	NUMBER OF RESPONDENTS	%
Dynamic and adaptable	6	30
Infrastructure-less, adaptable to any condition	**9**	**45**
Adaptable to wide areas	2	10
Cost advantages	1	5
Other	2	10
Total	20	100

Figure 28 – Opportunities of MobileMAN indicated by the students. Answers were categorized in these 5 major groups.

In the same way, we asked what they thought were the limits of MobileMAN. The following table summarizes their answers:

MOBILEMAN LIMITATIONS	NUMBER OF RESPONDENTS	%
Security	4	20
Practical implementation	4	20
Quality	**6**	**30**
Dynamic network	1	5
Nothing or left blank	5	25
Total	20	100

Figure 29 – Limitations of MobileMAN indicated by the students. Answers were categorized in these 5 major groups.

Interestingly, only 20% of the respondents (4 students) have changed their opinion after the tests about the feasibility of MobileMAN. This means that they probably had a **realistic idea** at the beginning of the testing sessions. Those who have changed their opinion about the feasibility of MobileMAN indicated issues such as “limits of stability of communication”, “not appropriate for high mobility ambient”, “not functional, data loss” and “system too unstable for a bigger network” as the most problematic aspects for the realization of a functioning ad hoc network.

We asked if after this experience of testing a MobileMAN network they are **more or less optimistic** about the paradigm feasibility. It is possible to group their answers into four major groups:

ANSWER CATEGORY	FREQUENCY	%
optimistic	**8**	**40**
optimistic but with some concerns	4	20
underline importance of social behavior variables rather than technical issues	3	15
not optimistic	4	20
no answer	1	5
Total	20	100

Figure 30 – Overview table of the attitude towards MobileMAN after the testing sessions.

Another question we asked them was "What do you think is an important advantage of MobileMAN?" As the following figure shows, the great majority of the students indicated the fact that it is **infrastructure-less**.

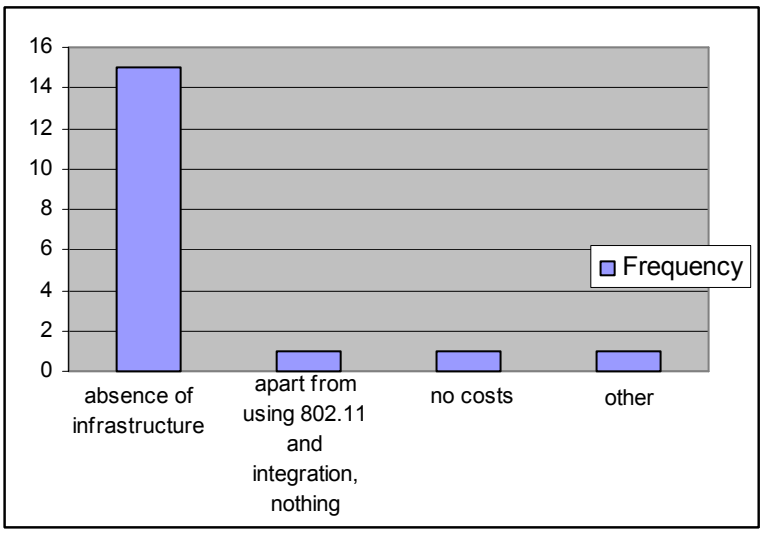

Figure 31 – Most important advantage of MobileMAN indicated by the students.

We asked the students to indicate in their opinion the **main limitations of MobileMAN as a communication means** (voice and messages). We grouped the answers in six major categories, represented in the figure below. The total number of students who provided an answer to this question was 20. As it is clearly to be seen, the major issues that limits in their opinion MobileMAN as a communication means is related to quality of service (indicated by 9 students), followed by technical challenges (links between nodes unreliable, instability of software and so on). Students provided often more than one aspect (question was open).

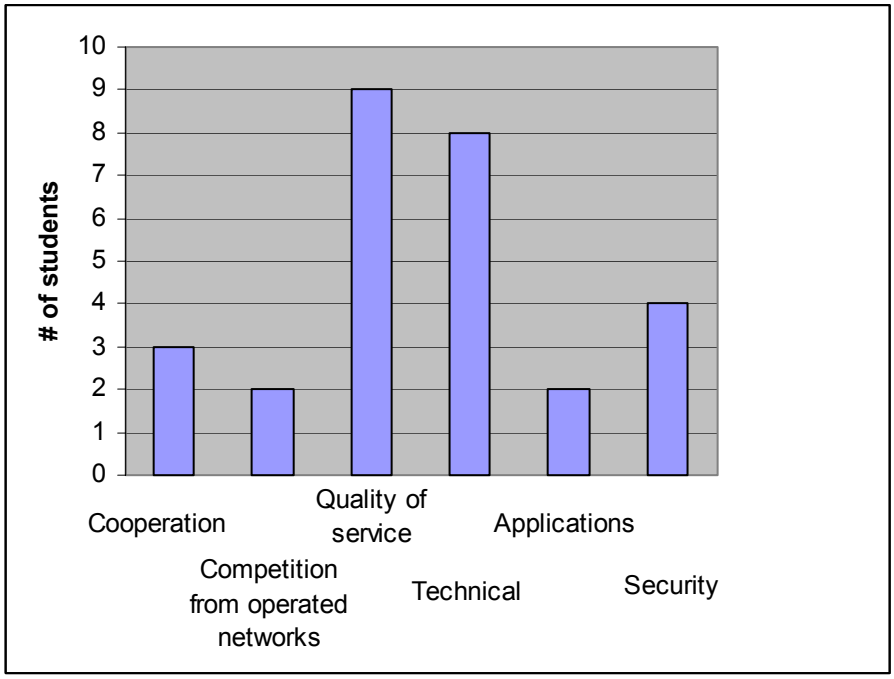

Figure 32 – Main limitations to MobileMAN as communication means, as indicated by the students. Answers were categorized in these six major groups.

The following question asked the students whether they have come across **new MobileMAN applications during this test experience** and to describe them briefly. Their responses are summarized in the figure below.

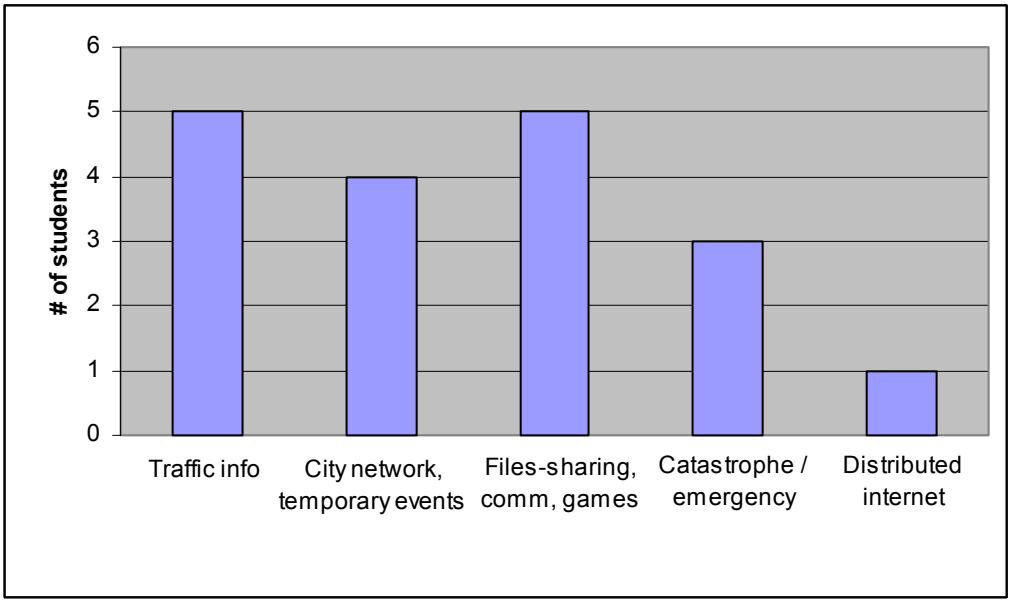

Figure 33 – Applications or use scenarios suggested by the students for MobileMAN.

Regarding applications, we asked the students to tell us one important use of MobileMAN (the most important for them). Results are summarized in Figure 33.

We provided four advantages and for disadvantages of ad hoc networks for communication between people and asked them to order them from the most important to the least important:

ADVANTAGE	MOST IMPORTANT	SECOND IMPORTANT	THIRD IMPORTANT	LEAST IMPORTANT
Democratic system	2	6	7	4
Less electro smog	0	2	5	12
Use in case of catastrophe	10	4	3	2
No cost of use	7	7	4	1

Figure 34 – Table overview of the ranking of advantages of MobileMAN and ad hoc networks.

As it is possible to see, electro smog issues are perceived as not important, whereas the most important for this group of individuals is –surprisingly – the opportunity to function in case of catastrophe (10 students indicated this advantage as the most important), and the second most important is the cost advantage.

DISADVANTAGE	MOST IMPORTANT	SECOND IMPORTANT	THIRD IMPORTANT	LEAST IMPORTANT
Less quality of service	3	10	6	1
Battery issues	1	2	7	10
No control on information / communication	3	4	5	8
Contingent upon cooperation	13	4	2	1

Figure 35 - Table overview of the ranking of disadvantages of MobileMAN and ad hoc networks.

The most important disadvantage of ad hoc networks was indicated by this group as being the contingency upon cooperation (13 individuals indicated it as the most important disadvantage and 4 as the second most important one). Battery issues were perceived as least problematic. Quality of service issues were indicated as most important drawback by 3 respondents and as second most important by 10.

The last question we posed to the students was **if they would accept a lower quality of service to communicate free on an ad hoc network**. The following figure shows how they answered:

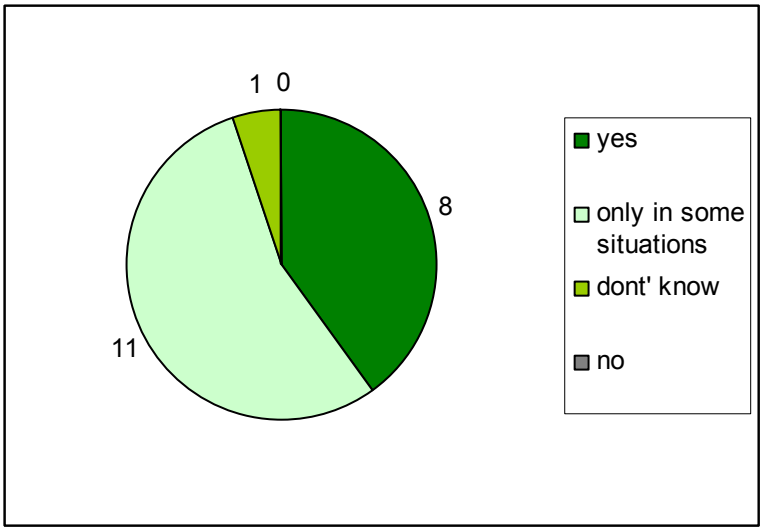

Figure 36 – Overview of the answers to the question of whether they would trade quality of service to communicate free over an ad hoc network.

Again, as already stated elsewhere in this deliverable, the answer pattern to this question underlines the insecurity about trying a new device that would not give all the benefits that an already existing system gives (reliability of the network existence, quality of service). 8 students responded they would accept the compromise, whereas 12 are somehow not sure.

2.5.5. Conclusions

The discussion about distrust in electronic services is very interesting, and we could investigate the reasons of such distrust. It is also thinkable that such attitude would be a hinder to cooperation for an ad hoc network. At the IEEE REALMAN workshop in Santorini (July 14th 2005) we presented a paper[24] for a poster session that covered the topics of modern social networks dynamics, communication applications and new needs. We talked about the **role of trust and reputation** in our modern society, dominated by great deals of uncertainty. Cooperation is certainly higher when there is trust between individuals. For a system like MobileMAN that relies deeply on cooperation to function, this aspect of distrust in new technology is crucial and needs to be seriously taken into account.

The observation of the testing session in Pisa was very useful to discuss about mobile technology and ad hoc networks with individuals that are highly motivated in this kind of talks. However, **applications that were suggested are still of traditional type**. We have already pointed out how

[24] "Social networks, novel communication applications and needs in mobile contexts". The extended version of the article can be found at: http://mobileman.projects.supsi.ch/MMDocuments.html

difficult it is to imagine an innovative applications or use of MobileMAN. In any case, we believe that it was an interesting experience for two reasons:

1. Engineering students were introduced to the social aspects of IT projects and the importance of taking human factors in account when designing new products and systems;
2. We had the opportunity to see a real ad hoc network functioning and to interview users that were practically confronted with MobileMAN.

Opinion exchange with engineers and IT experts has always been very useful and very stimulating for us. This opportunity to encounter other people, who are outside the project but have some knowledge of it and of technology has given us the chance to reflect and discuss not only MobileMAN and ad hoc networks, but also other mobile technology, applications and what are the benefits and the problematic aspects of it.

3. SOCIAL THEORETICAL CONSIDERATIONS ON AD HOC AND MOBILEMAN

3.1. Cooperation and network existence of ad hoc networks

3.1.1. The key aspect of cooperation

In all the activities that composed the social evaluation of MobileMAN and ad hoc networks, we required the collaboration of the relative group of people and regularly, **this cooperation was not automatic**. In many cases the results of our studies were limited by the **scarce participation** of individuals. In some other case (the study on the use of mobile phones) we rewarded participation with some cash. This aspect confirms what we already said in theory about collaboration and about the problematic aspect of individuals not collaborating when there is not enough rewarding in one of the forms, such as money, image, reputation or other indirect advantage for the person who chooses to collaborate. For a system like MobileMAN that is contingent upon cooperation of the users, otherwise the network does not exist or does not function properly, considerations about spontaneous cooperation is essential. The fact that people do not spontaneously cooperate (unless in particular circumstances) is of extreme importance. Without a sufficient number of nodes that are active and guarantee the network functioning, the quality of service is dramatically low and makes the entire system useless. In the report "MobileUK – Mobile Phones and Everyday Life", the authors write: "people are now used to acting in certain ways". This means that technology that allows users to do the same things as with another previous system will hardly get any success. People are used to being able to talk or send messages almost from everywhere, since the mobile phone network covers the great majority of the territory. The user therefore takes as granted two things:

- that the network **exists and is functioning**;
- that the **quality** of the service is **at least acceptable**

If MobileMAN cannot provide any new and innovative service and application, even though the user might find the system attractive because they need not to pay any fee to a network operator, **the fact that the two granted aspects of an infrastructure-based network are not guaranteed in an ad hoc network might prevent potential end users from accepting it and continue with the mobile phones of 3G**. This calls for an application or a set of applications that are "killer" and that justify the adoption of MobileMAN in the first place. In this view, the requisite of cooperation must appear to the user as a small "price" to pay for a unique service. This application must be one that is not available in new generation mobile phones, since the competition would certainly be won by the already established mobile phone network system – it must be totally innovative and must exploit

3.1.2. Is it possible to obtain spontaneous cooperation?

This question is a challenging issue. As we have written in the contribution to deliverable D10, cooperation from individuals is not to be taken for granted. **Fragmentation of the modern society has resulted also in a lower tendency to cooperation**. The trading between benefits and cooperation costs has changed and personal benefits have become more important in the individual's decision of whether to accept to cooperate or not. Certainly, it has to be underlined that different situations determine different behaviors and generalization can lead to wrong conclusions. **An individual decides to cooperate with other individuals depending on a number of factors**. In the specific situation of MobileMAN we can make the following considerations:

- The application types that were thought for MobileMAN include for instance voice communication and files-sharing. It is possible to classify voice communication (phone calls) as an important instrument to interact with others to arrange meetings, coordinate social activities and so on, whereas files-sharing can be put in the category of entertainment[25]. A user that makes use of MobileMAN for phone calls both of personal and business type might not appreciate that their device's resources are consumed by a teenager who wants to download an mp3 file or a videoclip. This fact can be a hinder to cooperative behavior by users who **consider the ad hoc network for different purposes**. This drawback can be perhaps solved by providing applications of a completely different nature than the ones that we dispose of on mobile phones for instance.
- Battery life can be decisive: to be usable, a device needs to be able to have a **battery life** of at least one day at a medium usage: it would not be thinkable to have an ad hoc device that runs with a battery that discharges in less time. Individuals are often out of home for the entire day, and may be able to charge the device battery in the evening, when at home. It has also to be remembered that MobileMAN wishes to enhance mobility of the end users, and not limit it. Reliability of battery power is in this vision an important factor to take into consideration.
- An ad hoc network follows the **Metcalfe's law**, that is, "the value of a network equals approximately the square of the number of users of the system (n^2)". This means also that an ad hoc needs a minimum of users (nodes) to function satisfactorily for the users. A network that is made of only a few nodes that are scattered over a large area will dramatically lower the value and loose nodes. If MobileMAN were an ad hoc network that interfaces with other existing networks, users could see a major incentive in trying/adopting the technology. According to Metcalfe's law, the value of such network (interfacing with another existing network) would be higher than if not, since the number of nodes would increase. Users could therefore see an advantage and be more willing to cooperate to make up the network and make it work.

In any case, being cooperation of the users a fundamental factor for the functioning of the network and the entire system, we need to take in great consideration the human response to this requirement.

[25] This categorization is not rigid: in fact, files-sharing can also be an essential tool for working purposes, but over the internet peer-to-peer software is mainly used for sharing entertainment content (videos, photos, music). It is possible to think that the use of such applications in mobile contexts would be similar.

3.1.3. Pure ad hoc networks vs. mixed types of networks

Users need to be certain that the network they would like to use to communicate or exchange files does exist and will function. For this reason, it can be very difficult for a totally ad hoc network that theoretically could disappear any moment, to be perceived as interesting by potential and users. For this reason, MobileMAN cannot be an isolated ad hoc network, with no bridges to other networks. **More than one user has expressed doubts about such solution**. A completely separate network would require that to communicate two individuals must have the devices otherwise it would not be possible to communicate. If A has such device and B does not, than communication between A and B over the ad hoc network would not be possible. Another important aspect is that to appear appealing MobileMAN needs to offer applications that are not available on mobile phones and that are very innovative. If this does not happen, users would not see any advantage in adopting technology such MobileMAN. **Individuals are very subject to routine and hardly switch to a different system that offers the same advantages as the one they are used to**. In our studies, we asked whether they would be interested in trying a device that runs on an ad hoc network, that allows them to communicate free (messages and voice calls) but with less quality. They responded that they would consider it if the ad hoc device and the mobile phone were a sort of "two devices in one", with the option to easily switch from GSM phone mode to ad hoc mode depending on the situation. Therefore, providing a device that acts both as mobile phone and as ad hoc device might be a way to guarantee that there are a sufficient number of nodes to make the ad hoc network function.

3.1.4. Information quality over ad hoc networks

A potential use of ad hoc networks can be a sort of '**broadcasting information**' to all nodes of the network. Ideally, this way to reach information reflects the 'word of mouth' principle and is a very quick way to spread information that needs to reach all nodes.

Information delivery in an ad hoc network has the advantage of being potentially broadcasted instantly, because any node in the network can broadcast a message to the nearest nodes. The consequence is that whenever an event happens the node (A) that is geographically near to it can broadcast to the entire network (with a cascading process) the information (info Z), so that all nodes are almost instantly reached by the message. In the example of a **car accident or an emergency**, this would be very useful, since traffic could be redirected with a far greater efficiency and in less time.

In the scheme below, the node A witnesses a car crash and starts spreading the info Z to the entire network, while each node that is reached by the info message starts doing the same. In this way, any node that is connected to the network is reached by the message.

This scenario poses also questions: for example, if a node is passing by and receives the message and then leaves the network, being out of reach, what should it do when it connects to a second ad hoc network? Broadcast the message as well or not? There must be parameters to limit the broadcasting option or if the information turns out to be a false alarm, there must be a way to take control of the message spreading. This way is, in fact, very quick, both in positive and negative situations.

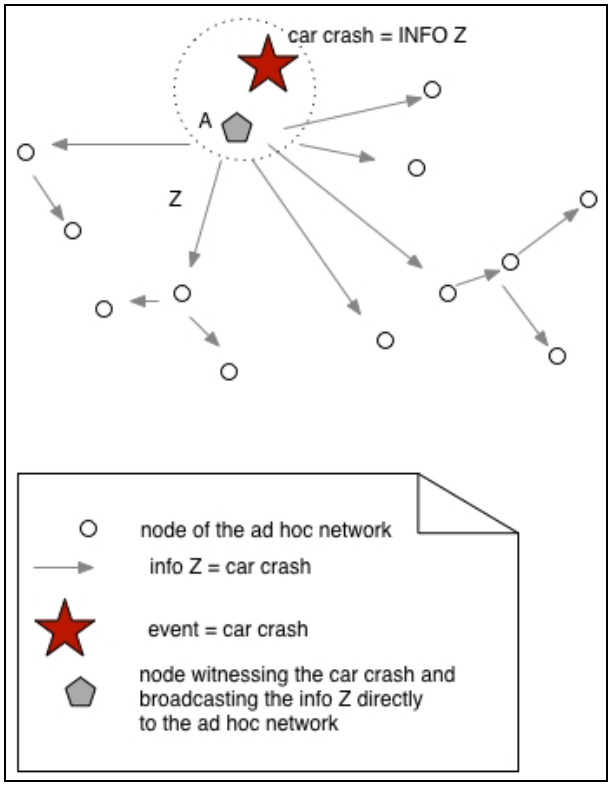

Figure 37 – Situation of ad hoc network with nodes able to broadcast information without control of information.

Information Z would not undergo any control about its truth or correctness, **generating chaos and useless actions if false**. This aspect is very problematic, since it trades between **timely information and reliability**. In case that anyone can broadcast information to the network nodes, there has to be a mechanism to ensure that broadcasted information is of "good quality" or that the source can be tracked back so that information control is available in case of misuse of the option to broadcast to the network.

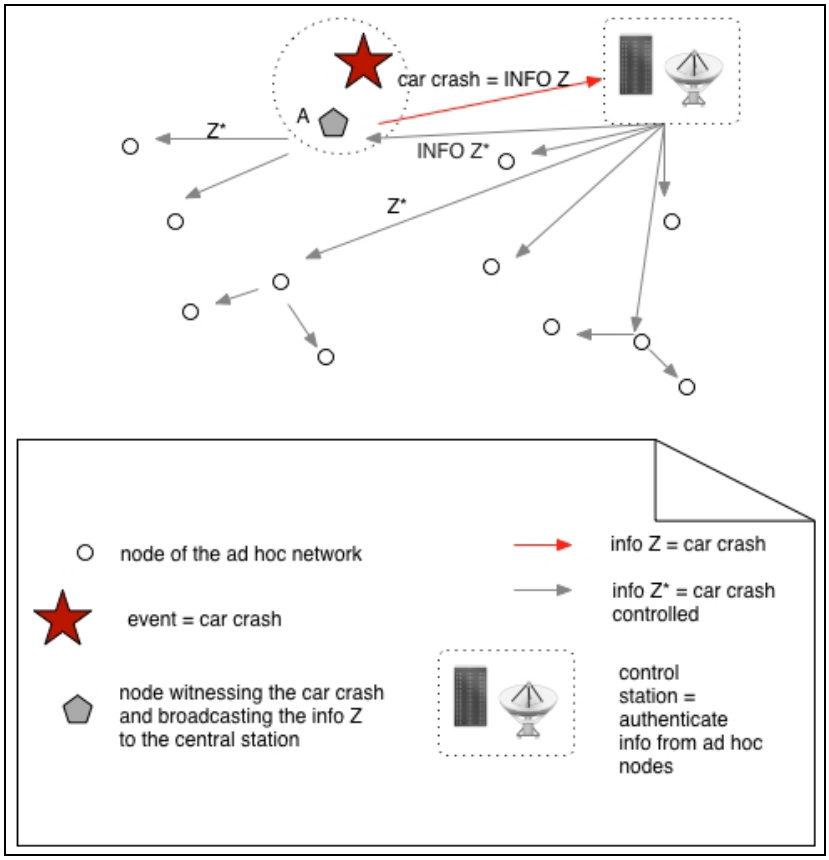

Figure 38 – Situation of ad hoc network with nodes only able to broadcast information after an authority has controlled the truth and validity of information sent by one of the network's nodes.

In this second case, the node A sends the event info Z to the control station that controls the reliability and truth of the information and once it has been checked, it broadcasts the information Z* back to the node and the ad hoc network. This process, however, requires some time and is not efficient.

The issue about the reliability of information sources is not new: with the explosion of Internet, and the ease with which it is possible to set up a website or a blog anyone can publish whatever they wish. Costs of publishing are very near to 0. On one side, this is a positive opportunity, since it allows multiple information sources, discussions on opinions and ideas, and ultimately is very democratic. On the other side, however, this raises the issue about the reliability of the sources of information and calls for the capacity to judge content of information with a critical eye.

3.1.5. Conclusions

On concluding aspect that we can say is that the scenario where users cooperate to make an ad hoc function is at the moment rather unrealistic. Cooperation is – as we have seen – not an automatic behavior by individuals. In our opinion, this is a frame of mind that is very strong and that conditions human behavior heavily. Our way of thinking should be more oriented to the group-benefits than to the individual-benefits. If it was less egoistic, then cooperation to make an ad hoc function would be certain.

Another important question is 'in what situation is ad hoc showing the advantages of its nature?'. Ad hoc is not indicated for situations where there is the need to coordinate nodes or people: in these situations, a leader is required, otherwise chaos would be the result.

If we had given to someone a mobile phone fifteen years ago asked them "What would you do with it?", they probably would have thought it was useless. This is because the actual result of the meaning of any object (therefore, also of the mobile phone) is not only individual, but also (and mostly) **social**. Individuals alone would act differently if isolated, than they behave when as part of a social group. For this reason, it becomes very difficult to predict users' behavior towards a certain system. It has also to be said that nowadays a key role in the process of adoption of a system or product by users is played by marketing activities. In any case, an unfulfilled **need** is always the starting point.

3.2. Ad hoc networks and social networks

As we have seen in this report, a technology like MobileMAN needs to offer a brand new type of applications. It cannot just give the user already established communication functions such as voice and text (like SMS) communication. As it resulted from our studies, the fact that MobileMAN would allow users to communicate with each other and exchange files at no use cost is not enough for a number of reasons. Either MobileMAN chooses to interface with existing infrastructure networks (such as the mobile operated networks) or it offers to the potential end-users completely new applications that empower them to perform actions that otherwise are not available.

The next section will present two scenarios in which MobileMAN could bring specific advantages.

3.2.1. Neighbourhood resource sharing

The starting point for this scenario is the observation that in our cities, when we travel by car, we are very often alone, even though the car can potentially carry up to 4 or 5 people. Theoretically, if we were able to load each car with at least 3 people, we could gain significant results:

- Reduction in costs (fuel, perhaps even minor number of cars)
- Reduction in pollution
- Reduction of traffic, with better fluent roads in the cities
- Better integration of neighbors, which means overcoming the isolation barriers typical of life in cities

A better integration of neighbors would also **foster a sense of community and as a consequence we can believe that cooperation among community members would increase**. In such a scenario, MobileMAN could function, since we have reasons to think that users would cooperate to make it work and would be a useful tool to coordinate resource-sharing among members of the same community. It is possible to imagine shared shopping list so that the person who goes to the shopping centre could buy items that other people have put in the shared list and save time. Coordination would be easier. This organization would also potentially be a mean to decrease the sense of loneliness that we can encounter in the cities, where traditional relationship and extended family structures are absent.

This community creation would be a way to strengthen and extend the social networks of an individual, and more precisely the **network of the local ties**. Perhaps this would be more interesting to types of individuals such the elderly, who are more interested in “real relationships” than virtual ones. Moreover, since they might experience mobility difficulties, to be able to count on the real help of someone living in the neighborhood would be of great benefit to them. In this scenario, MobileMAN is not the community-maker, but it is a tool that allows the management, organization and communication among community members. Crabtree et al. (2003) say that “services that exploit social network effects are [also] likely to be popular”. Applications that support interaction and communication among members of the same neighborhood could be important tools that can end up in allowing people to encounter their neighbors in the real world. This aspect is very important to the elderly, who have often expressed that they are not interested in any relationship or network ‘that is not real’.

Basically, this scenario reproduces the same concept of the sharing of resources available through the internet: projects such as SETI@home and others make use of spare computer resources of registered users who agree to cooperate to create a sort of "supercomputer" with a huge computing capability.

3.2.2. Information around the city

An interesting type of application is presented by the team that work on the Socialight project. Socialight is a platform that allows the user to leave for example **virtual messages or notes around the city**. The concept is that a message is attached to a specific location. In this way, it is possible to leave virtual notes for the user themselves as reminder or messages for a person when they enter in the proximity to the location where the notes has been left. With a little creativity this could lead to a sort of game, such as a hunting game with hints that help to reach the next hint. Technically, this type of virtual notes would be easier for devices of an operated network, so that they can remain stored in a database of the cell (location) until the recipient will have received the note or the note will have expired its validity. However, this is an example of game that combines real environment and technological supporting devices. It could also be a way to display tailored information about exhibitions, events, conferences or meetings taking place in a specific area that could be addressed to all users who have a specific profile.

3.3. Other important considerations

3.3.1. Social evaluation in IT projects

Doing social evaluation of potential impacts of technology is getting more and more important, because technology is becoming more and more important in our everyday life. Many people say that they cannot live without their mobile phone, their laptop, their iPod, or a broadband internet connection. In fact, our life is becoming so intertwined with technology that it may be unthinkable to go back to ten years ago and consider that we used to live without all this devices and instruments. Is this invasion good or bad? Neither of the two. It is always the use that defines whether technology is positive or negative, never the object itself. Doing social evaluation of technology within a design and development project means recognizing that technology "makers" have real responsibility when designing technology. As already pointed out by many organisms and authorities, including anyone in the "information society" and providing real access is essential for a society that has the will to eliminate or at least lower inequalities and wants to grow as a whole.

3.3.2. Lessons learnt from MobileMAN

Participating in the MobileMAN project as a unit responsible for the social evaluation of the technology has been both a very challenging and rewarding experience. Interacting with a group of system developers has not always been easy due to the differences in the backgrounds of the persons and the technical language that inevitably is necessary to design and develop a new network system. However, keeping an eye on both worlds, the technical and the socio-economic ones has allowed us to get a more complete picture of the technology.

Taking into consideration the needs and requirements of the potential end-users is not an easy task. However, we believe that it is the way to create and develop a system that will better help individuals to organize their life, their communication and information. In short: a system that will enhance people's quality of life. MobileMAN has given us the opportunity to initiate to look at new communication technology in a deeper way, investigating uses that individuals make of the instruments they have at disposal.

We were very optimistic about the cooperation aspect: we had to change our idea when systematically it was very difficult to involve individuals to participate in our studies. Unfortunately, we could eventually count on limited groups of people for our studies for the MobileMAN social evaluation. This has limited us in the process of generalization of our results. Data analysis would have been more interesting with bigger samples: in fact cross tables between variables were impossible with so few data. We realized only when it was late that it could have been interesting to develop the questionnaires for the data gathering in our various studies in a way that a set of questions were the same: this would have given us the opportunity to confront the various trends among different communities or groups of potential end-users.

However, from a qualitative point of view, we were able to bring to the surface several elements that we believe will be helpful for a successive step in the development of ad hoc networks or other mobile communication technology.

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ANNEXES – QUESTIONNAIRES

1. Study on mobile phones
2. Study on use of public hotspots
3. Questionnaire about wiki exercise at HUT
4. Questionnaire about test session at CNR

Scuola Universitaria Professionale
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SUPSI
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Scienze
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QUESTIONARIO SULL'USO DEL TELEFONO CELLULARE

COMPLEMENTO ALL'ATTIVITÀ DI RECORD DELLE ATTIVITÀ SVOLTE COL TELEFONO CELLULARE

Sesso
1 □ maschile
2 □ femminile

Età: _____

Professione: _____

Stato civile:
1 □ nubile / celibe
2 □ coniugato/a
3 □ separato/a
4 □ divorziato/a
5 □ altro

1. **Che tipo di cellulare possiedi? (marca e modello)**
   _____

2. **Da quanto tempo hai <u>il tuo attuale</u> cellulare?**
   1 □ meno di un anno
   2 □ tra uno e due anni
   3 □ tra due e tre anni
   4 □ più di tre anni

3. **Da quanto tempo utilizzi un telefono cellulare?**
   1 □ meno di un anno
   2 □ tra uno e tre anni
   3 □ tra tre e cinque anni
   4 □ più di cinque anni

4. **Hai una carta prepagata o un abbonamento mensile?**
   1 □ carta prepagata
   2 □ abbonamento mensile

5. **Indicativamente a quanto ammonta la spesa media mensile legata all'uso del cellulare?**
   1 □ meno di 50 franchi
   2 □ tra 51 e 80 franchi
   3 □ tra 81 e 120 franchi
   4 □ più di 120 franchi

6. **Quali funzioni del tuo telefono utilizzi <u>regolarmente</u>?**
   1 □ sms
   2 □ mms
   3 □ comunicazione a voce
   4 □ agenda
   5 □ macchina fotografica integrata
   6 □ calcolatrice
   7 □ ora, cronometro, sveglia
   8 □ e-mail
   9 □ browser
   10 □ elenco dei numeri di telefono
   11 □ giochi
   12 □ altro, pf specificare _____

7. **Di notte il tuo cellulare è:**
   1 □ spento
   2 □ acceso
   3 □ di solito spento ma lo tengo acceso in casi particolari
   4 □ di solito acceso ma qualche volta lo spengo

8. **Se il tuo telefono ha la funzione GPRS (General Racket Radio Service) per il trasferimento di dati, la usi?**
   1 □ si
   2 □ no

9. **Usi un e-mail client per leggere e mandare mail da tuo cellulare?**
   1 □ si
   2 □ no

10. **Dai il tuo numero di cellulare facilmente ad altre persone?**
    1 □ non ho problemi a darlo a persone appena conosciute
    2 □ do il numero solo a persone che conosco bene
    3 □ do il numero solo agli amici e parenti più intimi

11. **Accetteresti messaggi pubblicitari inviati a te se questo abbassasse il costo dei servizi a tuo carico?**
    1 □ no
    2 □ non saprei
    3 □ solo se non fossero più di 5 al giorno
    4 □ solo se non fossero più di 10 al giorno

5 □ si, in ogni caso

12. **Pensi che gli sms inviati vengano memorizzati in banche dati dagli operatori di telefonia per motivi di sicurezza?**
1 □ si
2 □ no
3 □ non saprei

13. **Ritieni che il tuo cellulare abbia delle applicazioni inutili?**
1 □ no
2 □ si, quali _____

14. **Ci sono delle applicazioni che vorresti il tuo cellulare avesse ma non ha?**
1 □ no
2 □ si, quali _____

15. **Ritieni che i cellulari al momento siano**
1 □ piccoli
2 □ grandi
3 □ di grandezza giusta

16. **Se il cellulare fosse un animale, sarebbe:** _____

17. **Valuta le seguenti affermazioni:**
Il cellulare mi permette di estendere la mia rete sociale di conoscenze e amicizie.
1 □ sono molto d'accordo
2 □ sono in parte d'accordo
3 □ sono parzialmente in disaccordo
4 □ sono totalmente in disaccordo

Il cellulare mi permette di essere più vicino alle persone che già fanno parte della mia rete sociale (amici, colleghi, conoscenti, parenti).
1 □ sono molto d'accordo
2 □ sono in parte d'accordo
3 □ sono parzialmente in disaccordo
4 □ sono totalmente in disaccordo

18. **Come consideri l'idea di usare il cellulare per pagare al supermercato, all'edicola, al cinema tramite addebitamento sulla carta SIM?**
1 □ la trovo una buona idea
2 □ la trova una idea non interessante
3 □ non ho opinioni in merito

19. **Possiedi un'agenda elettronica (palmare)?**
1 □ si
2 □ no

20. **Hai già utilizzato servizi di chat via sms?**
    1 □ si
    2 □ no

21. **Se sì, che opinione hai di questi servizi? (se no, lasciare in bianco)**
    1 □ sono divertenti
    2 □ permettono di fare nuove conoscenze
    3 □ sono inutili
    4 □ sono scomodi
    5 □ sono cari
    6 □ altro, specificare _____

22. **Ti sei già abbonato a servizi che forniscono news via sms (per esempio, notizie Teletext)?**
    1 □ si, regolarmente
    2 □ si, di tanto in tanto
    3 □ si, in casi particolari
    4 □ no

23. **Se si, di che categoria? (se no, lasciare in bianco)**
    1 □ sport
    2 □ traffico
    3 □ meteo
    4 □ notizie esteri
    5 □ notizie regionali
    6 □ notizie mercati finanziari
    7 □ altro, specificare _____

24. **Il tuo telefono cellulare ha personalizzato:**
    1 □ il logo sul display
    2 □ la suoneria
    3 □ il cover
    4 □ niente

25. **Se hai personalizzato qualcosa del tuo cellulare, modifichi regolarmente questi aspetti?**
    1 □ si settimanalmente modifico qualcosa
    2 □ mensilmente
    3 □ quando capita ma non spesso
    4 □ non mi interessa personalizzare il mio telefono

26. **Conosci il concetto delle reti ad hoc?**
    1 □ si
    2 □ no

27. **Una rete ad hoc richiede che gli utenti collaborino per garantire le funzioni di routing e di inoltro delle informazioni. Questo significa che gli utenti dovrebbero tenere i**

propri apparecchi accesi anche se non li utilizzano, consumando quindi batteria. Coopereresti?

1 □ si
2 □ no
3 □ non saprei
4 □ dipende dalle situazioni

28. **Di seguito sono elencati i vantaggi delle reti ad hoc: ordinali dal più importante al meno importante per te:**

1 □ assenza di operatore, democrazia totale del sistema
2 □ assenza di antenne, elettro smog molto minore
3 □ possibilità di funzionare anche in caso di catastrofe (non c'è infrastruttura)
4 □ non essendoci nessun operatore non esiste il costo di un abbonamento o del servizio

29. **Di seguito sono elencati gli svantaggi delle reti ad hoc: ordinali dal più importante al meno importante per te:**

1 □ impossibilità di garantire una certa qualità del servizio (non c'è operatore)
2 □ problemi legati al consumo di batteria
3 □ assenza di controllo dell'informazione / contenuto della comunicazione
4 □ il sistema dipende dalla cooperazione spontanea degli utenti (l'esistenza della rete non è garantita)

30. **Saresti disposto a rinunciare a una certa qualità del servizio per poter comunicare gratuitamente?**

1 □ si senza condizioni
2 □ si ma fino a un certo punto
3 □ no, meglio pagare per avere un servizio di qualità
4 □ sarei disposto se in ogni momento potessi scegliere tra i due modi di comunicazione e fosse facile optare per l'uno o per l'altro

31. **Come consideri l'opzione di usare un PDA (agenda elettronica, palmare) ad esempio per comunicazioni voce o messaggi e file sharing usando una rete ad hoc (quindi gratuita ma con una minore qualità di servizio)?**

1 □ interessante – sarei disposto/a a dovermi portare appresso un telefono cellulare e un PDA con funzionalità ad hoc da usare in situazioni diverse
2 □ non interessante – i telefoni cellulari forniscono già queste funzionalità a costi ragionevoli e con una buona qualità (sms, mms, voce)
3 □ sarebbe interessante se l'utente potesse scegliere tra le due modalità (gratuito ma di qualità minore – a pagamento ma con qualità del servizio) presenti nello stesso apparecchio

Grazie per la tua collaborazione!

STUDY ON THE USE OF PUBLIC HOTSPOTS

Thank you for participating in this survey. Our objective is to understand the current uses of public WLAN hotspots and whether these change the way people manage their time and interact with other people, while being mobile.

The questionnaire is anonymous and consists of about 35 multiple choice questions. It will require only a few minutes.

Thank you again for your kind participation. Should you have questions or comments, please feel free to contact: claudia.brazzola[at]supsi.ch

QUEST2

How often do you use public WLAN hotspots?

- ○ daily
- ○ more times in a week
- ○ about once per week
- ○ occasionally
- ○ never

QUEST2A

You use public hotspots when travelling:

- ☐ for personal reasons (holiday, free time)
- ☐ for working purposes

QUEST3

Where do you use public hotspots?

- ☐ at the airports
- ☐ in hotels
- ☐ in bars or cafes
- ☐ in other places : _____

QUEST4

Would you like to be able to connect to the internet while travelling by train?

- ○ yes
- ○ no
- ○ indifferent

QUEST5

What device(s) do you use to connect to a public hotspot?

- ☐ laptop
- ☐ personal digital assistant (PDA)
- ☐ smartphone

QUEST7

What do you like (in case you do) about public hotspots?

- ☐ the possibility of filling in empty time slots (e.g. waiting at the airport)
- ☐ the opportunity to be online at any time and "anywhere" (virtually)
- ☐ other aspects : _____
- ☐ I don't like hotspots
- ☐ I neither like nor dislike hotspots

QUEST8

Which of these applications do you use in a public hotspot?

- ☐ send and receive emails
- ☐ instant messaging
- ☐ chat
- ☐ discussion in forum
- ☐ information search
- ☐ web surf
- ☐ file-sharing
- ☐ e-commerce or e-banking transactions
- ☐ voice over IP (telephony via internet)
- ☐ other : _____

QUEST9

Are you concerned about privacy intrusions in wireless environments (lower security)?

- ○ not at all
- ○ not particularly
- ○ yes, to some extent
- ○ yes, very much

QUEST10

What type(s) of hotspots have you already used?

- ☐ free of charge hotspots
- ☐ hotspots subject to a fee

QUEST11

On average, fee-subject hotspots are, in your opinion:

- ○ expensive

- right in the fee amount
- cheap
- no opinion

QUEST12

Use of hotspots subject to a fee is paid by your company when you travel for work?

- yes
- no, it is not paid by the company
- I have never used fee-subject hotspots

QUEST13

If the use of a public hotspot were not paid by your company, would you be concerned about the cost?

- yes completely: I would not use it
- yes, to some extent: I would use it but limit the time of use to the necessary
- not at all, I would pay to be able to use it

QUEST14

Are you concerned about the costs, given that your company does not pay for hotspots use?

- yes, I only use it when I really need it
- no, I use it without being concerned

QUEST18

Considering usability and portability, you think that:

- laptops are better than PDAs, since they allow a full use of connectivity
- PDAs are better than laptops, since they are more portable
- both are good to carry around and use hotspots
- both are not ideal either for weight, use interface, etc
- I have no opinion

QUEST20

Have you ever checked your emails through your mobile phone?

- yes, regularly
- yes, sometimes
- yes, when I have no other option to check my emails
- no

Mobile ad hoc networks are infrastructure-less networks, made only by users' devices. In this kind of network, there is no operator to whom the user needs to pay for the use of services (such as for example with mobile phone

networks). Users' devices act both as providers for other network users and as users, requesting services (routing of messages, download of shared material). These networks are easy to deploy because there is no infrastructure and would allow users to communicate and sending messages at no use cost, providing that a sufficient number of users choose to collaborate to make the network function.

QUEST25

Being ad hoc networks not run by any operator, these networks are a totally democratic system. How important is this advantage?

- very important
- quite important
- indifferent
- unimportant
- I consider this aspect more as a disadvantage

QUEST26

How important is the advantage of the absence of antennas in ad hoc networks?

- very important
- quite important
- indifferent
- unimportant

QUEST27

How do you consider the absence of fees to pay to use an ad hoc network?

- very important
- quite important
- indifferent
- unimportant
- I consider this aspect more as a disadvantage

QUEST28

An ad hoc network presents the disadvantage that quality of service is not guaranteed, since there is no operator. How do you rate this drawback?

- very problematic
- problematic to some extent
- indifferent
- problematic in some situations but not in others
- not problematic at all

QUEST29

One key characteristic of an ad hoc network is its contingency upon spontaneous cooperation of users, which is uncertain. The infrastructure is made of users' devices who provide services. How do you rate this uncertainty of networks functioning?

- ○ very problematic
- ○ problematic to some extent
- ○ indifferent
- ○ not problematic

QUEST30

Would you cooperate to make such network function, even though it may cost you in the form of battery power?

- ○ yes
- ○ not sure
- ○ depends on the situation
- ○ no

QUEST31

Consider the following scenario:
You have a PDA (electronic agenda) that works both as mobile phone (GSM network) and as ad hoc device (not using any operator). GSM network is subject to a fee payment and provide good quality, whereas ad hoc is free but the quality of service is variable and not guaranteed. You can switch easily from GSM to ad hoc and viceversa on your device. You consider this option:

- ○ not interesting, I don't bother paying for calling and sending messages
- ○ not interesting, it's too complicted to switch from one mode to the other
- ○ interesting: I would use ad hoc when possible and and I don't need to have two separate devices
- ○ interesting, however I would try it even if the devices were separated (mobile phone - ad hoc PDA)

QUEST32

Please, provide your age range:

- ○ < 26
- ○ 26 < 35
- ○ 36 < 45
- ○ 46 < 55
- ○ > 55

QUEST33

Your gender is:

- ○ female
- ○ male

QUEST35

Your education title:

- ○ PhD or Master
- ○ University degree
- ○ University of applied sciences or equivalent
- ○ High school
- ○ Secondary school
- ○ Other : _____

QUEST36

Amount of job mobility (% or working time outside the office, on average):

- ○ less than 20% monthly
- ○ between 21 % and 40% monthly
- ○ between 41% and 55% monthly
- ○ more than 55% monthly

QUEST38

In your free time, how often do you use a computer (for private use)?

- ○ daily
- ○ a few times a week
- ○ once in a while (not regularly)
- ○ I only use my pc at home for working purposes
- ○ I don't have a computer at home

QUESTIONNAIRE – SCENARIOS/APPLICATIONS BUILDING ACTIVITY

Dear Student

Thank you for your participation into the Wiki exercise of the MobileMAN project. This questionnaire is the last step of this exercise and will conclude it.
Although we ask you to provide your name, we wish to point out that this is just for controlling purposes and the data will be treated anonymously. We remind that this questionnaire is required in order to receive the bonus points that this exercise will get you.

Thank you very much!

Part I – Personal details

1. Name: _____
2. Age group: □ 20-25 □ 26-30 □ 31-35 □ over 36
3. Sex: □ male □ female
4. Studies: _____
5. Professional history (if applicable): _____
6. Marital status: □ single □ married □ separated/divorced □ other
7. Children: □ yes □ no

Part II – Questions about the scenarios/applications building exercise

8. Total number of people in your group:
□ did not work in group
□ 2 people
□ 3 people
□ 4 people

9. Type of medium used for the exercise:
□ used only offline (paper)
□ used only online (wiki)
□ tried wiki but too complicated and changed to paper
□ used both easily

10. Title of created scenario(s): _____

11. How did you find this activity:
□ it was easy to imagine applications and/or scenarios
□ it was of medium difficulty
□ it was difficult to imagine something about the future
Could you add some comments:

_____
_____
_____

12. Your opinion about the task given (tick all you feel appropriated):
□ nonsense
□ fun
□ interesting
□ stimulating
□other: _____

If you used wiki as medium, please answer to questions 13 to 16 (if not, just leave them blank):

13. Would you continue to use this wiki after the exercise is over?
□ yes, certain, because: _____
□ maybe
□ no, because: _____

14. Had you already used a wiki website before this activity?
□ yes. Which one? _____
□ no, never

15. Did you find the wiki interface complex to use?
□ yes
□ a little
□ no
□ no opinion
Could you add some comments?

_____
_____
_____

16. Do you think that wiki was an appropriate medium for this kind of activity?
□ yes, because _____
□ no, because _____
□ no opinion

If you used paper (offline) as medium, please answer to questions 17 to 18 (if not, just leave them out):

17. How did you organize your group-work?

_____
_____
_____
_____
_____
_____

18. Did you find that paper was an appropriate medium for this kind of activity?

□ yes, because _____
□ no, because _____
□ no opinion

Part III – Questions about MobileMAN

19. Please, write three adjectives that come into your mind when thinking about MobileMAN:

1. _____
2. _____
3. _____

20. To what kind of groups/communities do you think MobileMAN would bring particular benefits?

_____
_____
_____
_____
_____
_____

21. Do you think that innovative MobileMAN services that are tailored to the user might be harmful for the rights to privacy?

□ yes, because: _____
□ no, because: _____
□ no opinion

22. Do you think that the website section explaining the MobileMAN project and technology was clear enough?

□ did not look at it
□ yes
□ no, because:

_____
_____
_____

Part IV – Questions about technology in general

23. Are you concerned with the idea of privacy and security issues of new technologies (user profiling, storage of information about citizens and so on)?
□ yes, because _____
□ no, because _____
□ never thought about this

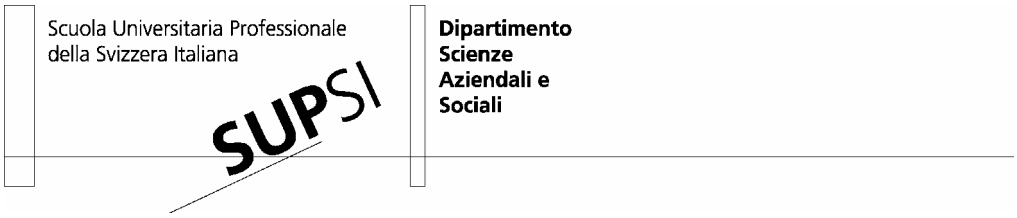
24. Do you think that a network that integrates all networks (telephone, power, tv, internet, radio,…) would be too dangerous because of its vulnerability to attacks?
□ yes
□ no
□ no opinion
Could you add some comments?
_____
_____
_____
_____

25. Do you think that we might become too dependent on technologies?
□ yes
□ no
□ no opinion
Could you add some comments?
_____
_____
_____
_____

26. Do you think that ad hoc networks will replace infrastructure-based networks or rather support them?
□ totally replacement of infrastructure-based by ad hoc
□ they will complement each other
□ ad hoc is not going to be the network format of the future
□ they will compete
□ I have no idea
□ other_____

Comments or suggestions: _____
_____
_____
_____

Thank you very much for your collaboration!



MOBILEMAN – TEST RETE AD HOC, PISA 17 GIUGNO 2005

SEZIONE I: INFORMAZIONI GENERALI

1.1 Età:

_____

1.2 Sesso:
□ femminile
□ maschile

1.3 Studio / indirizzo di studio:

_____

1.4 Anno di studio frequentato:

_____

1.5 Nell'ambito dei tuoi studi, cosa ti interessa maggiormente?

_____
_____
_____
_____

1.6 Intendi seguire una specializzazione? Se sì, in che cosa?

_____
_____

1.7 Eventuali esperienze precedenti o attuali di lavoro:
Cosa:

_____

Dove:

_____

Quando (da… a…):

_____

_____
_____

SEZIONE II: CONOSCENZE E OPINIONI INERENTI A MOBILEMAN

2.1 Cosa sapevi del paradigma di MobileMAN prima di partecipare a questi test?

_____
_____
_____
_____

2.2 Quali pensavi che fossero le opportunità e i limiti di questo paradigma?

_____
_____
_____
_____

2.3 Dopo queste giornate di test hai cambiato opinione su questo paradigma?
□ si
□ no

2.4. Nel caso affermativo, rispetto a cosa hai cambiato opinione?

_____
_____
_____
_____

2.5 Per ciò che riguarda la fattibilità di MobileMAN, dopo questa esperienza sei più o meno ottimista?

_____
_____
_____
_____

2.6 Quale ritieni che sia un importante vantaggio di MobileMAN dopo questa esperienza?

_____
_____
_____
_____

2.7 Quale ritieni che sia il più grosso limite a una diffusione di MobileMAN come mezzo di comunicazione (voce, messaggeria)?

_____
_____
_____
_____

2.8 Hai incontrato delle difficoltà durante questi test?
□ si
□ no

Se sì, quali?

_____
_____
_____
_____

2.9 Come le hai risolte?

_____
_____
_____
_____

2.10 Queste eventuali difficoltà ti hanno fatto dubitare della fattibilità di questa tecnologia?
□ si
□ no

Perché?

_____
_____
_____
_____

SEZIONE III – APPLICAZIONI E SCENARI PER MOBILEMAN

3.1 Durante questi test, ti sono venute in mente delle applicazioni possibili a cui non avevi pensato prima? Se sì, quali?

_____
_____
_____
_____

3.2 Descrivi una situazione in cui usare MobileMAN

_____
_____
_____
_____

3.3 Quale potrebbe essere per te un'applicazione importante per MobileMAN?

_____
_____
_____
_____

3.4 Di seguito ci sono alcuni dei vantaggi di una rete ad hoc – mettili in ordine di importanza per te, assegnando un numero dall'1 (più importante) al 4 (meno importante):
a) assenza di operatore, democrazia totale del sistema _____
b) assenza di antenne, elettro smog minore _____
c) possibilità di funzionare anche in caso di catastrofe (non c'è infrastruttura) _____
d) nessun costo di utilizzo _____

3.5 Di seguito trovi alcuni degli svantaggi di una rete ad hoc – mettili in ordine di importanza per te: assegnando un numero dall'1 (più importante) al 4 (meno importante):
a) impossibilità di garantire una certa qualità del servizio (non c'è operatore) _____
b) problemi legati al consumo di batteria _____
c) assenza di controllo dell'informazione / contenuto della comunicazione _____
d) il sistema dipende dalla cooperazione spontanea degli utenti (l'esistenza della rete non è garantita) _____

3.6 Paragonando costi e qualità di servizio, saresti disposto a rinunciare ad una certa qualità per comunicare a costo "zero"?
□ si
□ no
□ solo in alcune situazioni
□ non saprei

GRAZIE PER LA TUA COLLABORAZIONE!