HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Electrical and Communications Engineering

Elina Ahonen

Implementing a Multi-access Push to Talk System and Analysing User Experience

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Supervisor:	Prof. Raimo Kantola
Instructor:	Mikko J. Salminen, M.Sc.

Author: Elina Ahonen

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Professorship: S-38 Networking Technology

Supervisor: Prof. Raimo Kantola

Instructor: Mikko J. Salminen, M.Sc.

Abstract:

Push to Talk over Cellular (PoC) is an instant messaging type of new mobile service. It is possible to use PoC on one-to-one conversations and one-to-many conversations. The PoC service has not been as successful as predicted in Finland.

In this thesis a multi-access PoC-system was implemented and user experience was collected. The system can be accessed both with a mobile phone PoC client and a PC PoC –client. 14 testers took part in the test, which lasted 2 months. During and after the test participants were asked to answer questionnaires. Another method was to observe a moving-situation in which five of the testers participated. Also network measurements were performed to analyse the user experience.

The results of the survey show that users find PoC fun and quite easy to use. Results also show that mobility is very important, since no one actually took part in the test with a PC PoC –client. Delays, losses and some difficulties with PoC clients are still problematic. Measurements show similar delays, though they show no losses in network traffic. Even though PoC is considered easy, not so many actual use cases can be found in everyday life and the majority prefer other instant messaging. Instead the participants suggested many specific situations and occupational groups that could benefit from this type of service.

Keywords: Push to Talk over Cellular, PoC, PTT, GPRS, 3G, user experience, questionnaire, measurement

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Tiivistelmäteksti:

Pikapuhe on uusi, pikaviestin tyyppinen matkapuhelinpalvelu. Pikapuhetta voidaan käyttää kahdenkeskisiin ja ryhmäpuheluihin. Pikapuhe ei ole menestynyt odotetulla tavalla.

Tässä työssä toteutettiin moniliityntäinen pikapuhe-järjestelmä ja siitä kerättiin käyttäjäkokemuksia. Järjestelmään voitiin liittyä sekä matkapuhelimen että tietokoneen pikapuhe-sovelluksilla. Testiin osallistui 14 testaajaa ja testi kesti kaksi kuukautta. Testin aikana ja sen jälkeen osallistujat vastasivat kyselyihin. Yhtenä tutkimusmenetelmänä käytettiin myös muuttotilanteen tarkkailua. Muuttoon osallistui viisi testaajaa. Käyttäjätestin tuloksia tukemaan tehtiin myös verkkomittauksia.

Tutkimuksen tulokset osoittavat, että Pikapuhetta pidetään mukavana ja helppona. Tulokset osoittavat myös, että palveluiden liikuteltavuus on tärkeää, koska kukaan ei lopulta osallistunut testiin tietokonetta käyttäen. Viiveet, häviöt ja Pikapuhe-ohjelmien hankaluudet aiheuttavat yhä ongelmia. Myös mittauksissa todettiin viiveitä, mutta häviöitä ei tapahtunut. Vaikka Pikapuhe koettiinkin helpoksi, ei todellisia käyttötilanteita jokapäiväisestä elämästä löydetty kovinkaan paljon ja suurin osa testaajista käyttäisi mieluummin muita pikaviestimiä. Sen sijaan testin osallistujat keksivät useita erityistilanteita ja ammattiryhmiä, jotka voisivat hyötyä tällaisesta palvelusta.

Avainsanat: Pikapuhe, PTT, PoC,GPRS, 3G, käyttäjäkokemukset, kysely, mittaus

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List of Abbreviations

3GPP	3rd Generation Partnership Project
3GPP2	3rd Generation Partnership Project 2
AS	Application Server
HLR	Home Location Register
IETF	The Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IP	Internet Protocol
MSC	Mobile Switching Centre
NAT	Network Address Translation
OMA	Open Mobile Alliance
PA	Presence Agent
PMR	Public Mobile Radio
PS	Presence Server
PUA	Presence User Agent
PoC	Push to Talk over Cellular
PTT	Push to Talk
QoS	Quality of Service
RFC	Request For Comments
RTP	Realtime Transport Protocol
SIP	Session Initiation Protocol
SMS	Short Message Service
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
VoIP	Voice over IP
VLR	Visitor Location Register
WG	Working Group

1 Introduction

Push to Talk over Cellular is a walkie-talkie type of communication system integrated in new cellular mobile phones. It enables one-to-one or one-to-many half-duplex conversation. Push to Talk over Cellular–concept was introduced in 2003 and standardization work began in 2004. Contrary to expectations, Push to Talk has not gained much popularity in Finland; only one operator (Saunalahti) is offering the service. However, based on evaluation by Prisma research by the end of year 2005 there were already 200 000 Push to talk capable mobile phones in Finland. [MIN06]. For example in the USA Push to Talk has been a hit for the operator called Nextel. At the same time many kind of instant messaging services and Voice over IP solutions have gained popularity among Internet users. Push to Talk can also be seen as an instant messaging service.

The main goal of this thesis is to implement a Push to Talk (PTT) system and to combine Push to Talk over Cellular (PoC) and PC into the same system. User experience of a combined system will be collected. Some network performance measurements will also be made. The results of the measurements will be compared with user experience.

By combining PoC and a Push to Talk PC-client an instant messaging kind of system can be created. This system connects the PC or laptop users to cellular users. At the time of writing the first mobile Voice over IP (VoIP) solutions are coming to the market. These solutions mostly need Third Generation (3G) capable phones. The biggest problem in VoIP solutions in mobile phones and PC's is the incompatibility of different solutions.

This thesis has the following goals:

- Connecting Push to talk over Cellular (PoC) and Push to talk over PC (PoPC) into the same system
- Collecting user experience over PoC and PoPC in real life situations
- Determining how network performance will affect the user experience

1.1 Outline of the Thesis

This thesis is divided into two parts. The first part consists of literature study and the second part describes the test system, results of the test and conclusions and recommendations for future work.

Firstly, chapter one gives an overview of the thesis and its main ideas and structure. Chapter 2 gives an overview of IP Multimedia Subsystem and related services. Chapter 3 includes the description of Push to Talk service technology. Chapter 4 describes the theoretical framework which is related to the test setup. In chapter 5 the test system and used methodologies will be introduced. The test network characteristics will be described. In chapter 6 the results of the test are explained. Chapter 7 will be discussion about the test and the results. Finally in chapter 8 conclusions and recommendations for future work will be made.

2 IP Multimedia Subsystem, IMS

IMS is a very important concept in a discussion over PoC and therefore this chapter will describe the concept of IMS and present some of the IMS based services that are closely related to the PoC.

IP Multimedia Subsystem (IMS) is a framework to provide access to the content of the Internet and telecom services anywhere and any time with guaranteed Quality of Service and manageability. Even though most of these services can be accessed via cellular network also without IMS, the IMS can provide better Quality of Service (QoS), different charging schemes and integrate different services. [CAM06]

A packet switched network build on the IP protocol only provides a best-effort service without any guarantee of the service quality, which can quickly destroy the willingness for voice conversation or video conferencing. This was one of the main reasons for creating IMS: to provide QoS required for sensitive real-time services, e.g. Voice over IP (VoIP). Another reason for creating IMS has been charging and subscription management. With IMS the operator can provide different kinds of charging for different kinds of services. Usually charging is based on the amount of data transferred, but with IMS charging can be based on e.g. flat-rate, duration of use or type of application. A third reason for the existence of IMS is the ability to provide integrated services to the users. This means the ability of the operator to combine its own services with those offered by equipment manufacturers and third parties. The IMS defines the standard interfaces to be used by service developers. The idea is not just to create new services, but also to enable the old services to be used with any access. [CAM06]

IMS connects the 2G/3G circuit-switched domain with the 2G/3G packet-switched domain and fixed network, which enables the interworking of devices from different domains. This means that e.g. a laptop and a cellular phone can join the same videoconferencing. The concept of IMS also includes roaming. When roaming, the user should be able to use all the same services that they use in their home networks. To do this, IMS uses cellular technologies to provide access and Internet technologies to

provide services. The standardisation work for IMS is done in close co-operation by several standardisation organisations. [CAM06]

In the next sections three main IMS services that are essential from the Push to Talk point of view will be described.

2.1 Presence

Presence is a service that allows users to know about other users' reachability, availability and willingness to communicate. The presence service is able to tell whether or not the user is online, and if they are online whether or not they are idle or busy (lunch, meeting, in phone etc.). The presence service can also give details about the equipment another user has in use (audio, video etc. capabilities). [CAM06]

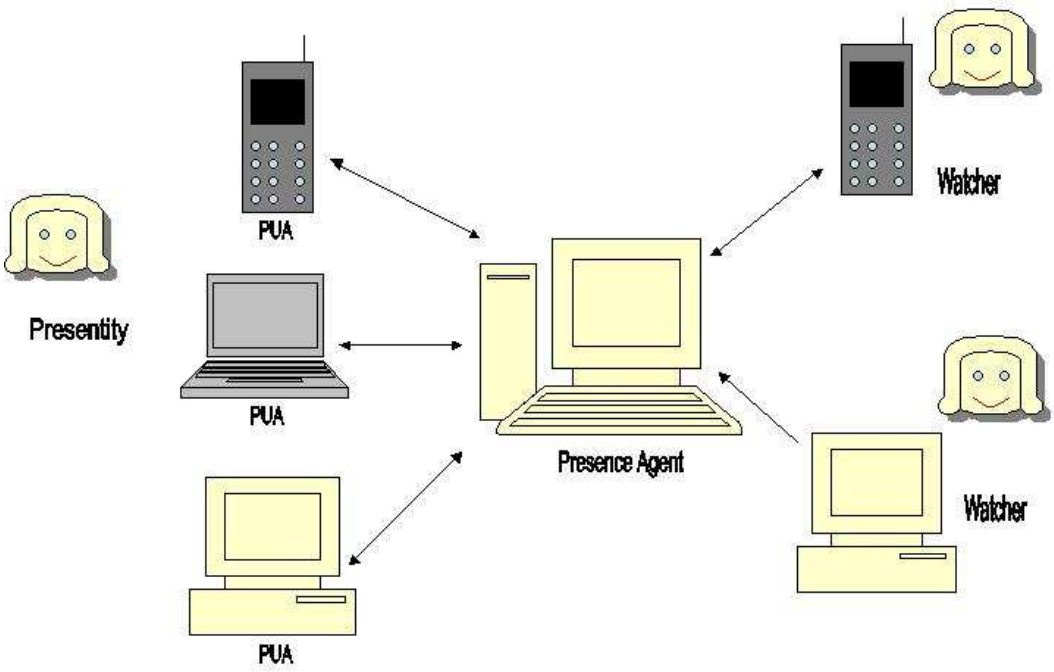

Figure 1 Roles in Presence framework

Internet Engineering Task Force, IETF, defines a presence framework that is presented in Figure 1. The framework defines many roles. The person who is providing presence

information to the presence service is called a presence entity or presentity. A given presentity can have several devices known as Presence User Agents (PUA) that provide information about his or her presence. These PUAs can be for example an IMS terminal, a laptop and a desktop computer. Each of them has a little information about the user. The laptop and desktop computers know whether or not the user is logged in. The IMS terminal knows the users registration status and whether or not the user is active or idle. PUAs could have more presence information, such as what time the user will be back from lunch or if he or she is available for videoconferencing etc. All the PUAs send their piece of information to a Presence Agent (PA). The PA gathers all the information received and gains a complete picture of the user's presence. [CAM06]

A Presence Agent can be integrated into a presence server (PS). A PS acts either as a PA or as a proxy server for presence information requests. Figure 1 also shows two watchers. A watcher is an entity that requests from the PA the presence information about presentity or watcher information about his or her watchers. There are several types of watchers. A fetcher is a watcher that retrieves the current presentity's presence information from the PA. A subscribed watcher asks to be informed about future changes in the presentity's presence information, so that the subscribed watcher has an accurate view of the presentity's presence information. Normally, applications combine the watcher and presentity functionalities together in a piece of software. This way the end-user cannot separate presence publication and presence information acquisition. [CAM06]

The presence service has already been in use in the Internet for many years with different services, mostly with instant messaging software. The presence architecture in IMS is slightly different than presence in the Internet and it has been defined by the standardisation organisation 3GPP (3rd Generation Partnership Project). The IMS terminal plays the role of both watcher and PUA. The Presence Agent (PA) is an Application Server (AS) located in the home network. In the IMS the PA is typically referred to as a Presence Server (PS), although it functions as PA. The PUA acquires the presence information from any possible source of information, such as the Home Location Register (HLR), the Mobile Switching Center/Visitor Location register (MSC/VLR) in circuit-switched networks, and the Serving GPRS Support Node

(SGSN) in GPRS networks or the Serving – Call Session Control Function (S-CSCF) through IMS registration. The watcher can subscribe to the presence information differently to his/her presentities or together to the whole of his/her presentities list. [CAM06]

In mobile phone's PoC-application, presence is bound to the profile settings (general, offline, silent, etc.). At the time of writing Online and Offline are the only possible states of Presence in PoC.

2.2 Instant messaging

Instant messaging is one of the most popular services in the Internet nowadays. The service is used to keep in touch with friends, colleagues and relatives etc. [CAM06]. There are several instant messaging applications, e.g. IRC, MSN Messenger, ICQ and AOL Messenger. Most of the instant messaging providers have special mobile software. The problem with these applications is that there is no co-operation between applications provided by different vendors. The ICQ user cannot communicate with an AOL messenger user. The prevailing instant messaging solutions on the Internet are not IMS based.

Instant messaging means a service that allows users to send messages to one another in real time. This means that messages are not stored in network nodes, as with other services, like e-mail. The content of an instant message is typically text, but can also be a picture, video clip or nearly any generic file. Instant messaging combines with the presence service, since the presence allows the information about user's status to be forwarded to other users. This way a user can know whether his or her contacts are online or not and if they are ready for communication or occupied with something else. [CAM06]

There are two modes of instant messaging: a pager-mode and a session-based mode. A pager-mode instant message is referred to as one that is a stand-alone message, not having any relation with previous or future instant messages. This model is similar to

Short Message Service (SMS) in cellular networks. A session-based instant message is referred to as one that is sent as part of an existing session, typically established with a SIP request. [CAM06]

Push to Talk can be seen as a kind of instant messaging with speech instead of text [KOI05]. Instant messaging with speech is quite different from instant messaging with text. Text messages can be read later, but speech normally comes only once and one can hear it immediately. Text messages may not interrupt as speech messages may do and they are more suitable for changing accurate information, while speech is more suitable for short and fast communication. [KAR05]

2.3 Group management

Group management is a service for creating and storing a list of group members for instant messaging applications. With group management a user can create a group of peers he or she wants to connect to. The list is saved into the server, and therefore can be accessed with any device. The list can be updated with any device and all the other devices (PC, Mobile phone, PDA) get the update. This list can be used with presence-function. That way a user can check whether or not other users in a group are online. With group management a user can create an Access Control List (ACL). An Access Control List is a list of users that the user creates as an authorization check by networks entities before a communication attempt is relayed. This means that a user can make an ACL, which allows some of the other users on the list to call him or her or to initiate a PoC session, while at the same time the user can prevent unwanted users connecting. The network will then automatically reject any communication attempts made by the barred users. Therefore ACL is actually a list defining who can take part in a conference. In PoC, this is referred to as PoC group. In Open Mobile Alliance, OMA, PoC solution, the Group Management is called the XML Document Management (XDM). The XDM specifies documents that can be shared by multiple services. One of this type is the Universal Resource Identifier (URI) list, which is a way of grouping together a number of end-users. [POI06]

3 Push to Talk

This chapter will provide a deeper understanding of the Push to Talk service and an overview of the technology behind the service. Also the PoC related standardisation organisations are presented.

Push to Talk (PTT) is a walkie-talkie type of service that allows a user to establish one-to-one calls and group calls. User can “call” someone else or a whole group just by pressing a specific Push to talk –key or a tangent. This makes it easier to make group calls because there is no need to make many different phone calls as in a conference call. The direct connection is most suitable in situations where the users need to be in connection with a certain group of people frequently over a longer period of time, such as a working day. [NOK07]

Push to Talk is a solution, which is continuously under development, standardisation and research. The standardisation work is mainly done by Open Mobile Alliance and will be further discussed in section 3.1. In cellular networks, PTT is a wireless Voice over IP (VoIP) service called Push to Talk over Cellular (PoC). [KOI05]

PTT has been used for decades in walkie-talkie terminals over different radio bands by for example military, truck drivers and hunters. Existing systems will be discussed in section 3.4. Push to Talk is widely used in Great Britain and USA in circuit-switched networks. Now that the cost of data transfer in cellular networks has decreased along with GPRS and UMTS there is a need to launch new services to packet-switched networks. However, GPRS networks are still narrow band, which means that latencies and error rates are too high for full-duplex IP telephony but enough for the half-duplex Push to Talk service [KOI05]. Full-duplex means that both parties, the caller and the callee, can talk at the same time, while half-duplex means that only one can talk at a time.

The advances of PoC when compared to walkie-talkies are the opportunity for roaming, text chat and multi- and unicast. The traffic in cellular networks is ciphered and with

IMS there is the opportunity of using Presence. While Walkie-talkies work only within some range, only up to approximately 5 km, PoC works wherever there is a mobile network. And because PoC is integrated in mobile phone, a user has to carry only one device with him or her. [HEL05]

PoC-service is suitable for both work and free-time situations. Examples of possible PoC user groups could be families, leisure groups, friends and businesses. Typical business users for PoC could be e.g. hotels, couriers, taxis, car rental services, airlines and airports, harbours, manufacturing, hospitals and construction companies. The concept could also interest the Land or Public Mobile Radio (LMR/PMR) users, but it must be kept in mind that PoC does not meet the strict emergency requirements of public safety organisations due to its sometimes-high latency and error rates. [NOK07]

3.1 Standardisation

Earlier there were several different proprietary PoC specifications and solutions. Because of this, a group of vendors (Ericsson, Motorola, Nokia and Siemens) started to develop an industry standard. However, industry standards and specifications were considered not to be enough for a fully featured PoC service, so Open Mobile Alliance (OMA) created a PoC working group to start working on the OMA PoC service. OMA's solution is based on IMS. [CAM06] The PoC standardisation work at OMA started in October 2003 and the first version, OMA PoC 1.0 was supposed to be ready in 2005. The work towards OMA PoC 2.0 has also been started. [NOK07] The industry standard and specifications made by a group of vendors were taken as a starting point for OMA. At the same time the IETF and 3GPP started working on some building blocks that were missing in the underlying architectures to be able to provide fully featured PoC service. [CAM06]

In the next sections the most important standardisation organisations related to PoC will be presented.

3.1.1 Open Mobile Alliance

PoC standardization work is mainly done at Open Mobile Alliance, OMA. OMA was formed in 2002 by nearly 200 organisations. Currently OMA has over 360 member companies. These organisations include the leading mobile operators, network and device vendors and information technology companies as well as content and service providers. That way the whole value chain is present at OMA. [OMA07]

OMA is the main centre of all mobile service enabler specifications, which supports the creation of interoperable end-to-end mobile services. OMA aims at service enabler architectures and open interfaces that are independent of the underlying wireless networks and platforms. OMA provides a high degree of public visibility into its specification activities through its public web site. OMA works in close co-operation with other standardisation bodies, such as ITU-T and ETSI, to establish a holistic and open standardisation blanket with no gaps or overlaps. At OMA the specifications are mostly delivered based on mobile services use case scenarios and open standards. The main focus is on improving the end-user experience by providing end-to-end interoperability. [OMA07]

In OMA the work is done in work groups. The work group concentrating on Push to talk over Cellular has the following goals [OMA04]:

- Defining a service enabling two-way form communications allowing users to engage in immediate communication with one or more users, similar to a “walkie-talkie”.
- Focusing on providing service layer support
- Using technology and identifying mechanisms of other forums to enable service

The Push to talk over Cellular (PoC) work group (WG) is supposed to develop application specifications to permit the deployment of interoperable PoC services. This WG is in close co-operation with the network defining groups (e.g. 3GPP and 3GPP2) as well as the group defining Internet environment (e.g. IETF). This close engagement is a key differentiator with other OMA WG:s that develop similar application enablers.

The initial work of the WG has been focused on the tasks required to develop specifications for an open standard to enable the adoption of PoC service over mobile networks. [OMA04]

3.1.2 IETF

The Internet Engineering Task Force (IETF) is a large open international community of network designers, operators, vendors and researchers concerned with the evolution of Internet architecture and the smooth operation of the Internet. It is open to any interested individual. IETF is a loosely self-organised group of people; it has no board of directors, members or dues. Instead, the IETF is made up of volunteers. The actual work is done in working groups, which are organised around several areas (e.g. routing, transport, security, etc.). Much of the work is done via mailing lists. The IETF has three meetings per year. The main technical documentations of IETF are the Request for Comments (RFC). The IETF is not a traditional standardisation organisation, although many specifications become standards. [IET07a] [IET07b]

The role of the IETF in PoC standardisation is to develop its Internet drafts and RFCs further to meet the requirements of OMA specifications.

3.1.3 3GPP and 3GPP2

The 3rd Generation Partnership Project (3GPP) is a collaboration agreement that was established in December 1998. It brings together a number of telecommunication's standardisation bodies, which are known as Organizational Partners. The current Organizational Partners are ARIB, CCSA, ETSI, ATIS, TTA and TTC. The original scope of 3GPP was to produce globally applicable Technical Specification and Technical Reports for a 3rd Generation Mobile System based on evolved GSM core networks and the radio access technologies that they support. The scope was subsequently amended to include the maintenance and development of the GSM

Technical Specification and Technical Reports including evolved radio access technologies. [3GP07]

The 3GPP sister project the 3rd Generation Partnership Project 2 (3GPP2) is a collaborative third generation telecommunications specification-setting project. It comprises North American and Asian interests in developing global specifications for ANSI/TIA/EIA-41 Cellular Radiotelecommunication Intersystem Operations network evolution to 3G. It comprises global specifications for the radio transmission technologies (RTTs) supported by ANSI/TIA/EIA-41. [3G207]

The main role of 3GPP and 3GPP2 in the development of PoC is to further develop the needed underlying technologies.

3.2 OMA Push to Talk over Cellular solution

The PoC-service may support one-to-one communication, one-to-many communication and a personal alert feature. The one-to-one feature, also called Private Call, is the capability of setting up a voice conversation between two users. A user initiates a private call by selecting the target mobile subscriber and pushing the PoC key on the phone. The PoC private calls are typically much shorter than a typical telephone call and the set-up is rapid (compared to telephony). Only one user can speak at a time. [OMA06]

One-to-many feature allows the user to set-up a voice communication (call) with multiple other users, but only one participant can talk at a time.
One-to-many feature has three types [OMA06]:

1. User Defined Group Call
2. Selective Dynamic Group Call
3. Private Chat Group Call

At the User Defined Group Call the participating users are selected beforehand, which means that a pre-arranged PoC group includes a predefined set of users (e.g. the user's math study group). The group has been previously created via a network provisioning action. A user creates and provisions a group. This creates a persistent group identifier that the group owner can reference from his or her contact list. The user, who creates the group, is the group owner and other members cannot change the member list unless the owner gives modification permission. [OMA06]

There is also a modification of the User Defined PoC Group that uses a special media mixing policy whereby a user (called the distinguished participant) can talk to the whole group and listen to the answers from each individual user (called ordinary participants). However, the rest of the users (the ordinary participants) cannot talk or listen to each other. They can talk and listen to the distinguished participant. This kind of pre-arranged PoC group session is called the one-to-many-to-one PoC session. This kind of scenario would be useful for example when a taxi dispatcher needs to inform all the drivers about customers waiting for a taxi, but the individual drivers answer only to the dispatcher. Drivers do not hear the answers of other drivers to the dispatcher. [CAM06]

In case of a Selective Dynamic Group Call a user selects a set of users on a handset contact list and initiates a group call. There is no need for user provisioning act on the network. Target members will be notified at setup time that this is a Selective Dynamic Group Call. Initiating Selective Dynamic Group Call is a similar process to an email, IM or SMS. [OMA06]

A Chat Group is a private group and specific users are invited to join the group. However, when a user joins a chat PoC group, no invitations are sent to other users. Conversely, when a user joins a User Defined PoC Group all the users that belong to that same PoC group are invited to the PoC session. Once users join a Chat Group, they stay attached to that group in a static fashion, whether there is discussion or not. When a user wants to leave the Chat group, it will require user action on the device to inform the network to remove him or her from that Chat group session. There is also an opportunity to create open Chat Groups, which are open to anyone to join. When the chat group is open, any participant can send an invitation to another subscriber to join

that particular chat group. However, the service provider may have set a limit on how many users can join one chat group. [OMA06]

A multiple group operation is also included in the service. This means that there is an opportunity to connect to several groups. There can be two levels of groups for a user: one of the groups may be primary group and others are secondary groups. All the groups may be secondary groups. Traffic from the primary group is prioritised; a message from the primary group supplants the messages from secondary groups. If there is no traffic in the primary group, the PoC subscriber receives traffic from secondary groups. The traffic from the primary group even overrides simultaneous traffic from the secondary groups. The user can change the position of the groups. If all the groups are secondary groups, then the user can hear the traffic from whichever starts first. The user continues to hear the same conversation until there is a period of silence long enough to indicate that the conversation is over. The user can hear messages from several groups in sequence, but then there should be means to identify which group is being received. When the user wants to talk to groups, the primary group is the default target. Target can, however, be changed. In case of just secondary groups, the selection of group may be implicit, e.g. the transmission is to the group that was most recently heard. [OMA06]

OMA PoC specification also includes the features for Mobile - Fixed inter-working. This means that users with different kinds of terminals (mobile phone, PC, etc.) could join the same PoC communication. That would require connectivity between different types of PoC-clients and Network operators with PoC Service. One example of this kind of system could be an Online Game service that has a PoC interface. This would create opportunities for service inter-working and maybe also expand the network and service providers' potential for revenue generation. [OMA06]

The third feature supported by the PoC service is the personal alert feature. The personal alert feature allows the user to politely alert another subscriber and to express the wish to communicate and request the invited user to "call back". The feature is thus called the "call-back request". It is possible to refuse to receive any personal alerts. [OMA06]

In every type of PTT connections only one person can talk at a time. Turns for talking are reserved by pushing the Push to Talk tangent. The tangent should be pushed the whole duration of talking. Some phones have a distinctive tangent for PoC; others use one of the basic tangents. PoC call is initialised by choosing the recipient from a contact list or group list and by pushing the PoC tangent. Before one can start talking, one should wait for the connection establishment sound. The PoC tangent should be pressed during talking and released after talking in order for other users to be able to talk. The right to speak is granted on first-come-first-served –basis. If someone is speaking and other users press the tangent to speak, their requests to speak are queued. [NOK07]

Normally, PoC messages are automatically delivered to participants in a group (Automatic Answer mode), and therefore there is a risk of unwanted incoming messages and spam. It is, however, possible to change the mode into Manual Answer mode, which means that a recipient has to accept all incoming messages. PoC participants can be notified of the status of on-going PoC sessions, such as arrival of new participants. There is also an opportunity to block all the messages from some users or groups. [OMA06]

PoC should not to be seen as a substitute to any existing mobile service. Instead it is a complementary service. [NOK07]

When discussing about PTT, it is important to remember that it is mostly a group forming service. As the main idea is to share ideas and talk with friends or colleagues, the service has no use without recipient or recipients. Group-forming services will be further discussed in chapter 4.3.

3.3 Technology

Push to Talk over Cellular is a Voice over IP service over cellular networks. The voice is transferred between the sender and recipient as IP-packets using the underlying data network. The packet-switched IP technology enables an efficient implementation of

PoC based on the standard IETF and 3GPP protocols via digital cellular data access. Since talk spurts can be initiated almost instantly, radio and transmission resources are reserved only for the duration of the talk bursts, rather than for the whole call session, as in a traditional telephone call. [NOK07] The service architecture is presented in Figure 2.

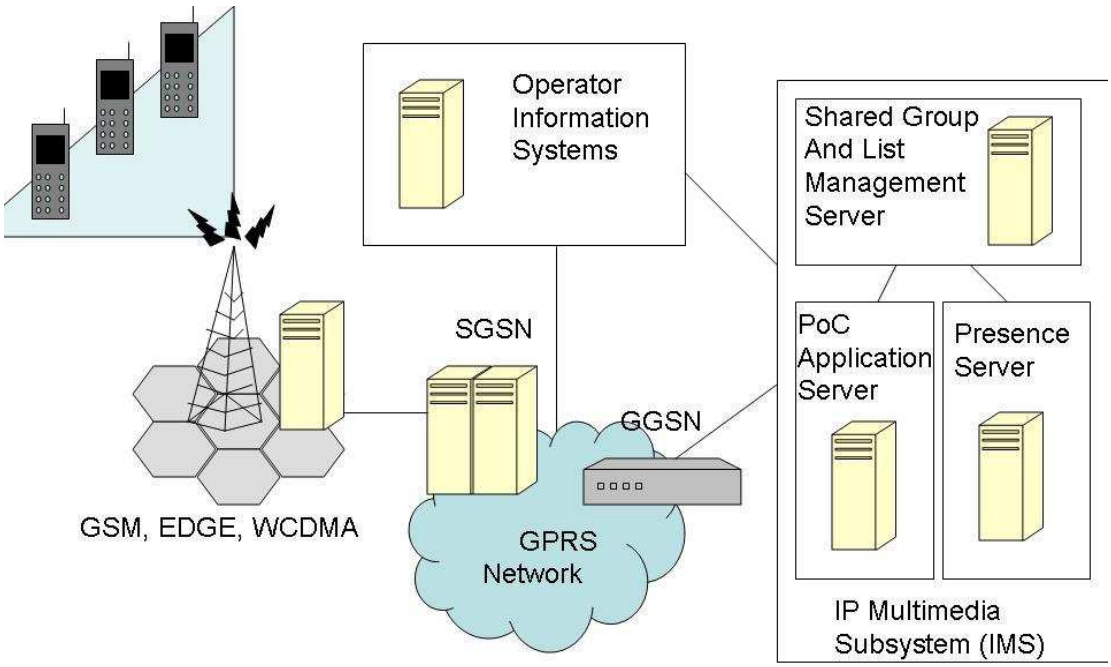

Figure 2 PoC network architecture

OMA PoC network architecture is based on a PoC application server connected to the IP multimedia subsystem, IMS. The PoC servers take care of application-specific tasks such as floor control (reserving the talk spurts for one speaker at a time). The IMS takes care of common functions, such as user authentication, call routing and generic charging based on the Session Initiation Protocol (SIP). POC servers provide interfaces to the operator's provisioning, charging and network management systems and create application-specific Call/Charging Data/Detail records (CDR). The PoC user database contains provisioned users and their service profiles. The users and talk groups can be arranged in the database in organisation-specific closed user groups to support the

security and administration capabilities needed in business applications. The PoC solution can be scaled up to multimillion user networks with several networked application servers. OMA PoC standard network architecture includes a shared Groups and List Management server for pre-defined groups. This server includes those groups that can be shared by other IMS-based applications such as games and presence. The presence server itself is a separate entity, communicating with PoC and other application servers via IMS. [NOK07]

Normal voice calls have the connection open all the time. When using PoC, the user can talk to his friends for a couple of minutes, then take for example a ten minute break and continue to talk some more. The connection is set up again every time. Instant dialogical connection cannot be guaranteed and there will most probably be delays from approximately 0 to 6 seconds depending on the operator and network utilisation. [NOK07]

In order to be able to hear all the messages, PoC uses an always-on connection. This makes it possible for users to make calls to individuals or groups with the press of a tangent. The always-on connection means that after subscribing to it a subscriber has direct access to the service without additional actions, such as dial-up. This requires that the network supports the service and is available. The users of PoC service are normally engaged in other activities but because of the always-on connection they can still stay informed by listening in to group traffic while they are busy. [NOK07] PoC calls are normally received through the phone's loudspeakers, but can also been listened through a hands free to gain more privacy [RFC4354]

SIP is an application layer signalling protocol that is used to establish sessions with one or more participants. SIP is used to create and manage sessions. Sessions may include Voice over IP phone calls, multimedia distribution and multimedia conferences. SIP is an agile, general-purpose tool for creating, modifying and terminating sessions that work independently from the underlying network. In many cases, SIP is used with close collaboration with other protocols that has been authorized for multimedia sessions, like Real time Transport Protocol (RTP). SIP does not offer any services itself; instead it offers primitives that can be used to implement different services. [RFC3261] SIP PoC

terminals can support various SIP-based communication services in addition to PoC (i.e. VoIP, Presence service). [RFC4354] At PoC SIP is used to establish the session between the participating users. RTP is used in the traffic exchange. In the beginning of the session, Session Description Protocol (SDP) is used to agree on used media attributes. The codec used for speech encoding is Adaptive Multi-Rate (AMR).

The PoC service charging can be based on several possibilities. Charging can, for example, be based on a fixed monthly or daily fee, real usage in an active talk group (talk minutes or GPRS transferred data in megabytes), active group membership (minutes of talk listened to) or other group functions such as group creation and group attachment. It is also possible to bundle PoC charging with some other cellular service. [NOK07] These options are possible because of IMS. At the time of writing, the only Finnish operator offering PoC-service is Saunalahti, which has priced its PoC-service at 2c/min/spoken time. [SAU07].

3.4 Existing solutions for PTT service

The existing mobile radio systems, which offer Push to talk service, can be divided into three categories:

1. Conventional land mobile radios
2. Trunked radio systems
3. Cellular systems.

Conventional land mobile radios operate without a special network and they use the same radio band for both transmitting and receiving radio signals. The most known devices are VHF handhelds. Their operating range is limited and depends on the frequency and antennas used. [KAR05] Conventional land mobile radios are considered spectrally inefficient because each group needs a separate channel for communication. The privacy of the conversation is also limited. [HAR00]

Trunked radio systems were developed to overcome the limitations of conventional land mobile radios. They are mostly in professional use. Trunking allows the automatic sharing of multiple radio channels. A group of channels is assigned to a group of users who then share these channels. When a user wants to make a call, the system searches for an available channel and assigns it to the call. A different radio channel may be assigned each time the customer uses the radio and it may even change during the same conversation. The customer does not know about the change. If the system is full, the user receives a busy signal or calls are queued. After the channel selection, users have private use of the channel, which reduces interference and eavesdropping. Trunked systems offer wider coverage areas through interconnection with the public switched telephone network (PSTN) and interconnection between other trunked systems. [HAR00]

Trunked radio systems generally provide one-to-many and many-to-one mobile communications. Modern trunked radio systems include data capacity and full access to the PSTN. Many systems offer integrated services, such as voice mail, data messages, faxes or data transfer. [HAR00]

To meet the growing need for advanced services and to lower system equipment costs, the land mobile radio industry is migrating to digital radio technology. Two digital mobile radio standards are being developed by association organizations in the USA and Europe. These are Terrestrial Trunked Radio, TETRA, which is developed by the European Telecommunications Standards Institute (ETSI) and APCO-25, which is under development by the U.S. Association of Public Safety Communications Officers (APCO). Private companies have developed other proprietary digital technologies. [HAR00] Two of these systems will be looked at in more detail in the next sections.

The third category of existing Push to Talk solutions is cellular systems. Because these solutions are fairly new, most of them include advanced features, such as presence and floor control, which are missing from the older land mobile radio systems. OMA PoC is one of these newer cellular systems. There are also other cellular PoC systems, such as Fastchat from Fastmobile, Kodiak RTX (Real Time Exchange) and QChat from Qualcomm. FastChat is a completely software based solution. QChat is aimed at

CDMA2000 (Code Division Multiple Access) networks, and the Kodiak solution integrates packet-based functions with circuit-switched voice transmission to prevent unwanted delays. [KAR05]

3.4.1 TETRA

TETRA is a digital mobile radio system, which is developed by ETSI to be the only official trunked radio standard in Europe [HAR00]. The ETSI TETRA standards will continue to evolve to provide additional enhancements and technology innovations. This benefits particularly traditional Private Mobile Radio (PMR) user organizations because public networks cannot adequately provide the required RF coverage, Grade of Service (GoS) during busy periods and high levels of reliability. [TET07] The delay in TETRA networks is only 200 to 300 ms [CHA03]. Public networks are not able to provide the specialised voice services such as wide area fast call-set up, group calls, Direct Mode Operation (DMO) and high levels of secure encryption for voice and data. [TET07] Direct mode allows handsets to communicate with each other directly over a limited area. TETRA addresses the demand for clear communication, even in environments with high background noise. As part of the TETRA design, background noise is monitored and suppressed from the transmission so that only fluctuations in sound levels, such as speech, are transmitted. If the background noise changes, it will be transmitted briefly until it is recognized as an ambient sound. The PoC service does not offer this feature. [CHA03]

In Finland the Network for Authorities (Police, Military, Firemen) is called VIRVE and it is based on the TETRA standard. VIRVE was first launched in 1998 and has been in official use since the year 2000. The network serves about 30 000 users across Finland. Primary users are the authorities responsible for public safety at a national and municipal level. [BAS03]

3.4.2 iDEN

iDEN (integrated Digital Enhanced Network) is a proprietary technology developed by Motorola. iDEN offers a digital wireless telephone, two-way radio, packet data for Internet access, e-mail and text messaging and wireless modem capabilities. iDEN is based on TDMA (Time Division Multiple Access) radio technology. [IDE07] The delay in iDEN is 1 second [TET07]. Motorola licensed iDEN based Push-to-Talk technology first in the U.S. to Sprint Nextel. iDEN is also in use in Latin America, Canada, Asia and parts of the Middle East. iDEN system includes other Push-to -services in addition to Push-to-Talk, such as Push-to-Send Contacts (sharing contact information), Push-to-View (sharing images), Push-to-Smart Replies (sending short preset or custom text messages) and Push-to-Meet (sending datebook events). [IDE07]

4 Theoretical framework

In this chapter some concepts will be discussed. The understanding of these concepts is closely related to the following research. Also the user related research methods are presented.

4.1 Customer types

Individuals in a social system do not all adopt an innovation at the same time. Based on when they first begin using a new idea individuals can be classified into adopter categories. Each adopter category consists of individuals with similar degree of innovativeness. The adopter categories are Innovators, Early adopters, Early Majority, Late Majority and Laggards. [ROG03] The adopter types are presented below in Figure 3.

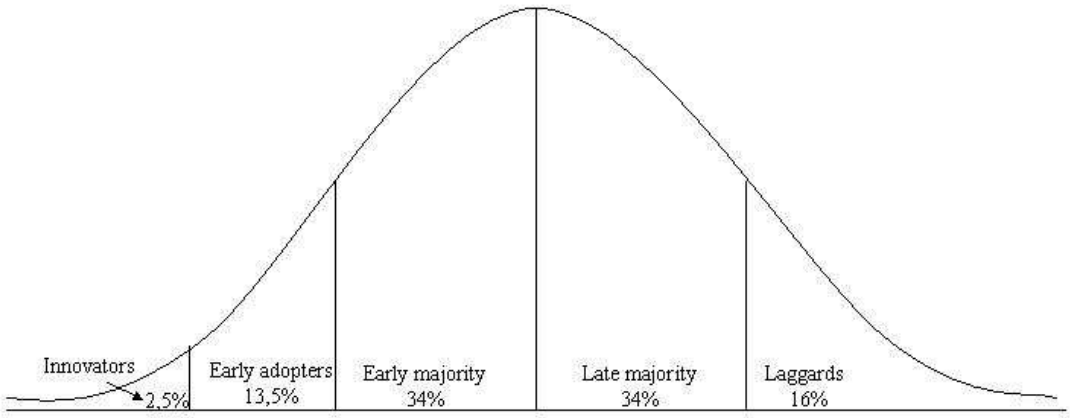

Figure 3 Adopter categories

Innovators are interested in new ideas. They normally are cosmopolites and have substantial financial resources and wide technical knowledge. [ROG03]

Early adopters are more integrated into the system than innovators, because instead of being cosmopolites, they are localities. They are respected opinion leaders, more respected than any other adopter category. Potential adopters look to early adopters for advice and information about an innovation and thus they are serving as role models for many members in a society. The early adopter is respected by his or her peers and is the embodiment of successful and discrete use of new ideas. They know that in order to maintain their central position in the communication networks of the system, they must make vice decisions. The early adopter decreases uncertainty of a new idea by adopting it, and then conveying a subjective evaluation of the innovation to near peers through interpersonal networks. [ROG03]

The early majority are deliberate and they adopt new ideas just before the average member of a system. They interact frequently with their peers but seldom hold positions of opinion leadership in a system. The early maturity is one of the biggest adopter categories, almost one third of all members of a system. [ROG03]

The late maturity is sceptical and it adopts ideas just after the average member of a system. They make up one third of a system. The late majority do not adopt until the majority in their system have already done so and the pressure from peers is necessary to motivate adoption. They may have scarce resources. [ROG03]

The laggards are the last in a social system to adopt an innovation and are the most local of all adopter categories; they mainly interact with others who also have traditional values. The point of reference for laggards is the past and decisions are done based on what has been done before. They tend to be suspicious of innovations and of change. The laggards have limited resources. [ROG03]

4.2 Product lifecycle

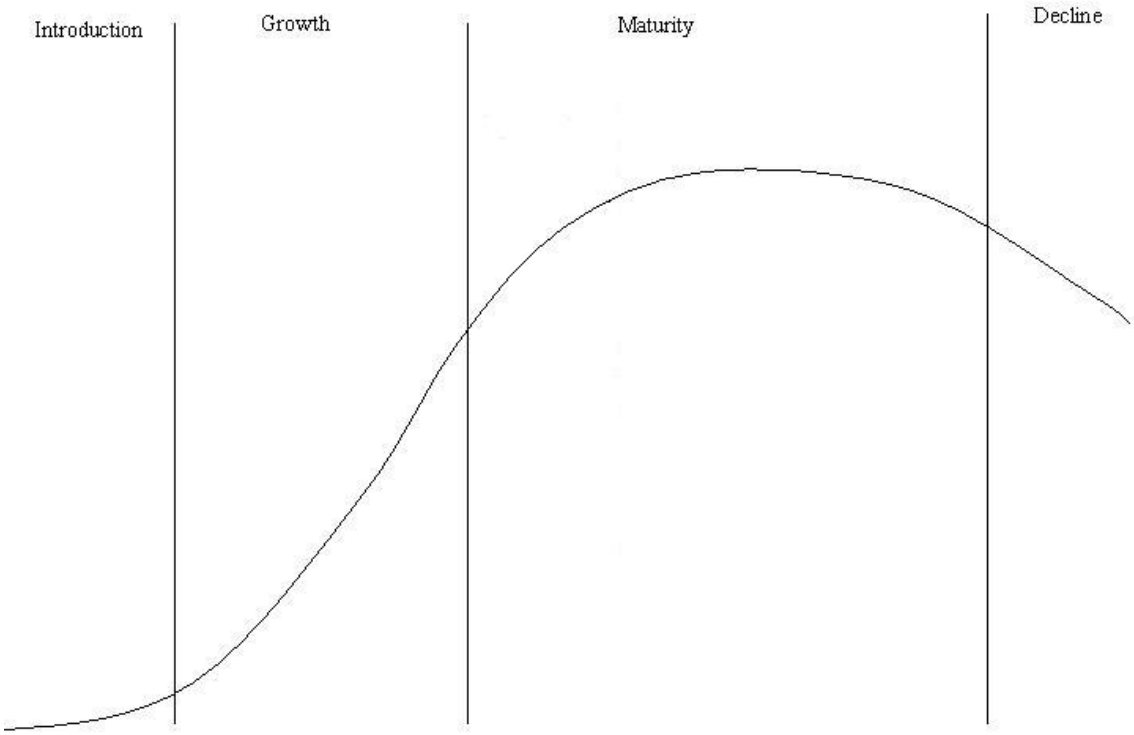

Figure 4 The product lifecycle

The product lifecycle, which is presented on Figure 4 can be divided in four stages: the introduction, growth, maturity and decline. At the introductions stage the product is brought to the market and only the early adopters are buying. Eventually more and more people are buying the product and the growth begins. When almost everyone has the product and even the late majority and the laggards are buying, the product has moved to the maturity stage. The last stage is decline, when the market is saturated and the marketing is mostly concentrated on maintain and after-sales services. [KOT06]

At the time of writing the Push to Talk over Cellular is clearly at its introduction stage in Finland. There is only one operator, Saunalahti offering the service. The service is called Pikayhteys and it is available only for Saunalahti's customers. The users are early adopters, who are mainly interested in new technology and its possibilities. At the moment, PTT is probably not one of the main criteria when customers choose the most

suitable mobile phone for themselves, even though almost all new phones have the Push to Talk –functionality. According to Prisma Research, by the end of year 2005 there were already 200 000 Push to Talk capable mobile phones in Finland [MIN06]. According to Kauppalehti, other operators are not going to provide the service in the near future, since they think that there are not enough interested customers [KAU07]. The high number of PoC capable phones may no longer be an obstacle for the service to gain public knowledge. Most likely the legalisation of bundling in Finland at May 1st 2006 has encouraged the selling of new mobile phones. One reason why PoC has not been very successful in Finland may be the fact that people in Finland are not familiar with using pagers and other portable radios [KOI05].

4.3 Group-forming services

Network effect is a notion that a network's value to its users increases with its size, since each user has access to more and more users and services. [COU03] Push to Talk is a classical example of a group forming network.

There are three kinds of services [KIL]:

1. Services that do not require other people, like remote access
2. Services connecting two people, like a telephone call
3. Services connecting a group of people, like mailing lists.

Group forming is a fundamental need for all members in any society. That is why the technical means for group forming should be available for any member in order for them to really create value. [KIL] The value of the connection is related to the amount of potential connectivity, which equals to the amount of users in a society. [REE99] The service is useful only if as many members of the group as possible are using the service. In most of the services almost everyone must be using the service in order for it to really be useful. For instance, if the daily information transfer of a group is arranged by SMS one person not having a mobile phone will significantly decrease the usefulness of the service. The penetration threshold for group forming changes with group sizes. Evidently, lower penetration for small groups seems to be enough, while large groups

require almost 100% penetration. The turning point is typically at a penetration of 80% although only 15% of the potential value of group forming is reached at this point. A high penetration of 95% is usually required to achieve the majority of the possible benefits of group forming. High service penetration, over 90%, is most easily reached via low enough prices and easy to use services. In order to achieve a sufficiently high penetration, a basic form of the service must be available for everybody with as low a fee as possible. [KIL]

4.4 Research methods

Surveys and observation are the basic research methods for user related research. Surveys can be divided in two broad categories; questionnaires and interviews [TRO07]. In this chapter these three methods will be presented.

4.4.1 Questionnaire study

In a questionnaire study the questioner and the respondent are not in direct interaction. The questionnaire is normally delivered though post or email. The amount of answers may vary even greatly. To motivate the respondents some rewards may be given. [HEI07]

In a questionnaire study the proper questions are fundamental, because there is no opportunity to ask defining questions. The questions can be open or closed. Open questions are mainly used in qualitative studies. Open questions are appropriate when the answer options are not known beforehand. Open questions are easy to make, but difficult to interpret and categorise. Open questions may bring some new ideas. Closed questions have predefined answer options. They can be called multiple choices - questions. These types of questions are suitable, when the answer options are known beforehand. The handling of closed questions is easier, and they can prevent some errors. Closed questions make it easier to give negative answers and statistical analysis is easier. However, it has to be kept in mind that the amount of options may not be too

large. Some of the options may be missing and the phrasing of the options may be misleading. To avoid misinterpretations the questions should always be tested before the real study. [HEI04]

In closed questions one of the most commonly used scales is the Likert-scale. It is usually a four or five step scale, where the tester has to choose the best option for him or her. The one end is normally ‘I agree’ (or ‘I strongly agree’) and the other end ‘I do not agree’ (or ‘I strongly do not agree’). [HEI04]

Other types of questionnaires are a group administered questionnaire and household drop-off. In a group administered questionnaire a group of respondents is gathered together and they all answer to questionnaires. A household drop-off means that the researcher goes to respondents home or business and hands the questionnaire to the respondent. The respondent is either asked to mail the questionnaire back or the researcher returns to pick it up. [TRO07]

4.4.2 Interview study

Interview study requires more time and personnel as a questionnaire study. As well as in the questionnaire study, the proper questions are crucial also in the interview study. However, interviews are more flexible; the interviewer can ask defining or follow-up questions, change the order of questions, repeat the questions and even make additional observations. Interview study can be done as a face-to-face interview or by telephone. Telephone interviews are faster and thus require fewer personnel. Telephone interviews need to be short. Face-to-face interviews are more demanding, but they allow the use of supplementary material. In a face-to-face interview the interaction between the interviewer and the interviewee is important. The interviewee decides based on the impression given by the interviewer whether or not he or she wants to answer to the questions and how he or she will answer. Also the surroundings may have an effect on the answers. In an interview people tend to give answers that they think the interviewer wants. [HEI04]

4.4.3 Observation

Observational research techniques involve the researcher or researchers making observations. Observations are usually flexible and they do not always even require a hypothesis. For instance, before actual structured research the researcher may conduct observations to form the research question. This is called descriptive research. The observational findings are considered strong in validity. However, there are problems with reliability and generalisability. The observations may not be replicated and the findings may only reflect a unique population and therefore cannot be generalised to others.

There are two types of observation: direct observation and unobtrusive observation. In direct observation, people know the researcher is watching them. The direct observation can be further divided in two types: continuous monitoring and time allocation. Continuous monitoring involves observing a subject or subjects and recording as much of their behaviour as possible. Continuous monitoring is often used in organisational settings, such as evaluating performance. Time allocation involves a researcher randomly selecting a place and time and then recording what people are doing when they are first seen and before they see the researcher. Time allocation is mostly used when researcher wants to find out the percent of time people are doing things. [OBS07]

Unobtrusive observation involves any method for studying behaviour where individuals do not know they are being observed. There is not the concern that the observer may change the subject's behaviour. When conducting unobtrusive observations, issues of validity and replication need to be considered. Especially, when looking at a particular group, which may posses unique characteristics. The main problem with unobtrusive measures, however, is ethical. Issues involving informed consent and invasion of privacy are paramount here. The unobtrusive research methods can be further divided into behaviour trace studies and disguised field observations. Behaviour trace studies involve findings things people leave behind and interpreting what they mean. In disguised field analysis the researcher pretends to join or actually is a member of a group and records data about that group. The group does not know they are being observed for research purposes. Ethically, participant-observers have the most

problems. The sensitivity of the topic and the degree of confidentiality are important issues to consider. In all, disguised field experiments are likely to yield reliable data. [OBS07]

5 Research setup

In this chapter the architecture of the test system, PC-client, participants of the test and the chosen research methods are presented.

The research time was two months. This time was chosen so that the testers would really have time to get to know the application and to find out whether or not it suits their own communication style. In two months the charm of novelty is supposed to fade away. The research was based on participants using the PoC service. Based on their experience the participants answered three questionnaires. The first questionnaire was answered before starting the test and its objective was to chart testers' previous knowledge and experience on Push to Talk or other similar kinds of systems. The second questionnaire was answered in the middle of the test, after one month. Finally, the third questionnaire was answered at the end of the test period.

The questionnaires included both open and closed questions. The questions were designed to address the users' expectations and experience over PoC. Open questions were included, since in most questions, the stick definition of answer possibilities would have been impossible before the test. It may have also narrowed the answers down. In the third questionnaire there were nine claims that are more closely defined and use the Likert-scale. Before the test, the questions were tested with two possible users and refined after that.

To support the results from questionnaires, observation was selected as one of the research methods. In this case, the unobtrusive observation, or more precisely, the disguised field observation was chosen. This method was chosen because of the nature of the study and observation situation, it was assumed that no ethical restrictions occur. The method was chosen to provide most valid data without the researcher interference. After the observation the participants of moving house were asked a permission to use the data in the study.

Allison Woodruff and Paul M. Aoki have carried out a similar type of test in the USA in 2003. In their study, they observed and interviewed seven young people and their use of Push to Talk cellular radio.

5.1 Architecture of the tested system

One of the goals for the test was to connect a PoC mobile phone application and a PC PTT Client into the same system. In order to be able to do this, a PoC server was needed. With own server it was possible to connect subscribers of different operators. This server could be accessed both from mobile and fixed networks.

The PoC server software was installed in a PC, which was located in the basement of The Student Union of Helsinki University of Technology –building in Otaniemi, Espoo. The PC had Windows XP Professional (version 2002) as the operating system. The server had AMD Athlon™ MP Processor 1800+ 1,53Ghz and 512MB. The server was connected to the Internet via a Local Area Network. The server could be accessed through GPRS, UMTS and LAN networks with both mobile phone and PC PoC applications. Nokia provided the server software, the "Duck server", which was used. Duck is a single box stand-alone SIP/PoC server, developed for testing purposes. It can be run on one computer and it needs only an IP-connection. The Duck-server has a so-called Mini-IMS within it, so it is possible to use services provided with IMS, such as Presence.

5.2 Mobile phone PoC-application

Most new mobile phones have a PoC-client already installed. The figures below show the functions of the client. Figures are taken from Nokia E60 mobile phone.

Figure 5 View of the PoC client

The main window of the PC client is shown in Figure 5. The client is connected to two channels called Testi and Channel. Testi is the primary channel and a participant called E60 is talking to the channel. The order of the channels can be changed by choosing Swap. The menu from Options is presented in Figure 6.

Figure 6 PoC client menu

The PoC application has the opportunity to check active members on a channel, to send invitations to join the channel and to disconnect from the channel. A list of PTT contacts and channels can also be viewed. The received callback requests can be found on Callback inbox. Callback requests can be sent by choosing PTT contacts and choosing the contact.

5.3 PC-client

The PC-client that was used was from the Spanish company Genaker. “Genaker 4010” is presented in figures below. The client is not yet available for public. The PC-client has the same functions as mobile phone PoC-applications. Both the PC-client and mobile phone users can join the same group. However, the PC-client also has the opportunity for text chat in addition to voice communication. Text messages are delivered only to other PC-clients of the same group, not to the mobile phone users who participate in the same conversation.

Figure 7 PC-client login screen

Figure 7 shows the Genaker PC-client login screen and the basic start-up outlook of the program.

Figure 8 Tabs of Genaker PC-client

Figure 8 shows the functions of the Genaker PC-client. The first figure in the upper left corner shows the Start-tab, which shows the Amounts of active sessions, calls and messages. The second tab in the upper right corner is Contacts view, which shows the

stored PoC contacts. Here new contacts can be added. The third tab in the lower left corner in figure 8 shows groups. The group called ‘test’ is set as primary group and it has only one user. The other group, called ‘testi’, is a so-called secondary group and it has 2 users. The fourth tab shows message and call history.

Figure 9 Group communication view

Figure 9 shows the communication window in “Genaker 4010”. The turn for speaking is taken by choosing the PTT-button. The upper box shows the participants of the group and the lower box is for text chat.

PC Client has one major problem: it does not easily work with Network Address Translation (NAT). NAT is commonly used in home and office routers providing sharing of IP addresses among multiple users. SIP and RTP protocols, which are used in

real-time communications, are not fully compatible with NAT. This also causes problems with PoC. Because of this, most of the users in this test were unable to use the Genaker PC-client. The NAT problem could have been overcome with static IP-addresses and re-configurating the ADSL- and WLAN-routers. However, the test was supposed to simulate the real situation and thus it was not possible to configure the routers of participants, since they were not able to configure them themselves.

5.4 Participants

The participants of the research were groups of students or graduates. The test groups were gathered by advertisements in Helsinki University of Technology's newsgroups and on the university's notice boards. The advertisement is presented in appendix A. The main idea was to reach the so-called early adopters who are interested in new technology and its possibilities. The students of a technical university were considered to be more likely to be early adopters than other young people. And because PoC is for the most part a group-forming service, young people are, according to studies more likely to belong to the most active group than older people [KIL]. Young adults use much time to social communication and value it highly [WOO05].

The participants were recruited as groups, because as stated before, PoC is a group-forming service and in order to get information on normal use and needs, the test groups were asked to communicate with their own peers in normal everyday situations. This would not have been possible with predefined tasks and with unfamiliar peers. The users participated using their own mobile phones. The participants formed two two-person groups, one three-person group and two five-person groups. Only two people from the other five-person group answered the research questions. Testers were given movie tickets (3-6, depending on tester activity) as thanks for their participation. Two mobile phones, Nokia N95, were raffled to the participants. Nokia sponsored the mobile phones and movie tickets.

The testers were mainly from 20 to 27 years old; one of the testers was 47. Four of the participants were students, five were working and three were both studying and

working. The participants were also asked to evaluate their own behaviour when considering the purchase of new technological equipments: “On a scale from one to five, when do you purchase new technical equipments? (1= Immediately after the launch to the market, 2= Quite soon after the launch and then I like to introduce it to my friends, 3= A bit later, when someone has shared and praised the product to me, 4= Not until most of my friends already have one, 5= Not until almost everyone else has one). One user answered 1, three users answered 2 and five users answered 3. Four users could not choose between the five options. Their purchase behaviour varies from 1 to 4, depending on the prices and need. None of the participants chose option number five.

6 Results

This chapter will introduce the test results. The results of each three questionnaires, observation and measurements are presented in own sections.

First of all, even before the test could be started, there were several problems. We found out, that SIP and RTP –traffic, which is used to connect the PoC client to the server, are not allowed in some operators' networks. There were also problems in getting different types of mobile phone's PoC applications to work. At the time of writing there are several different types of mobile phones on the market and some of the PoC-clients in those mobile phones are designed and manufactured by the prevailing industry standard (prior to OMA solution) and few of them are made based on the OMA PoC standard. None of the tested mobile phones' PoC applications are based on OMA PoC standard since Nokia does not have any OMA standard based PoC capable mobile phones on the market yet [LUU07]. This caused some problems, since almost every phone had a different kind of menu. In this research, there was no opportunity to use automatic settings delivery, which is normally used when a user subscribes to a service through a mobile operator. Since no single operator provided this test, this was not possible. Because the automatic delivery of settings could not be used, the participants were given a lot of instructions to help them get started. These instructions can be found in Appendix B. The questionnaires can be found in Appendix C.

The subscribers of one mobile operator could not be accepted to participate in the test, since their network did not accept SIP and RTP –traffic, and they were not willing to participate to allow the traffic for the time of testing.

In the next sections, the results of the three questionnaires will be presented.
The results are presented in figures, when possible. The figures have been drawn using Excel-spreadsheet (2003) –application.

6.1 First questionnaire

The first questionnaire is presented in Appendix B. It included eight questions, which explore whether the user is familiar with the PoC or other similar type of concepts. The use of instant messaging applications was also asked. In this section the results of each question will be presented.

The first question was *"Do you use Instant messaging applications (MSN Messenger, ICQ, IRC etc.) and VoIP applications (Skype etc.)?"* The results are presented in Figure 10.

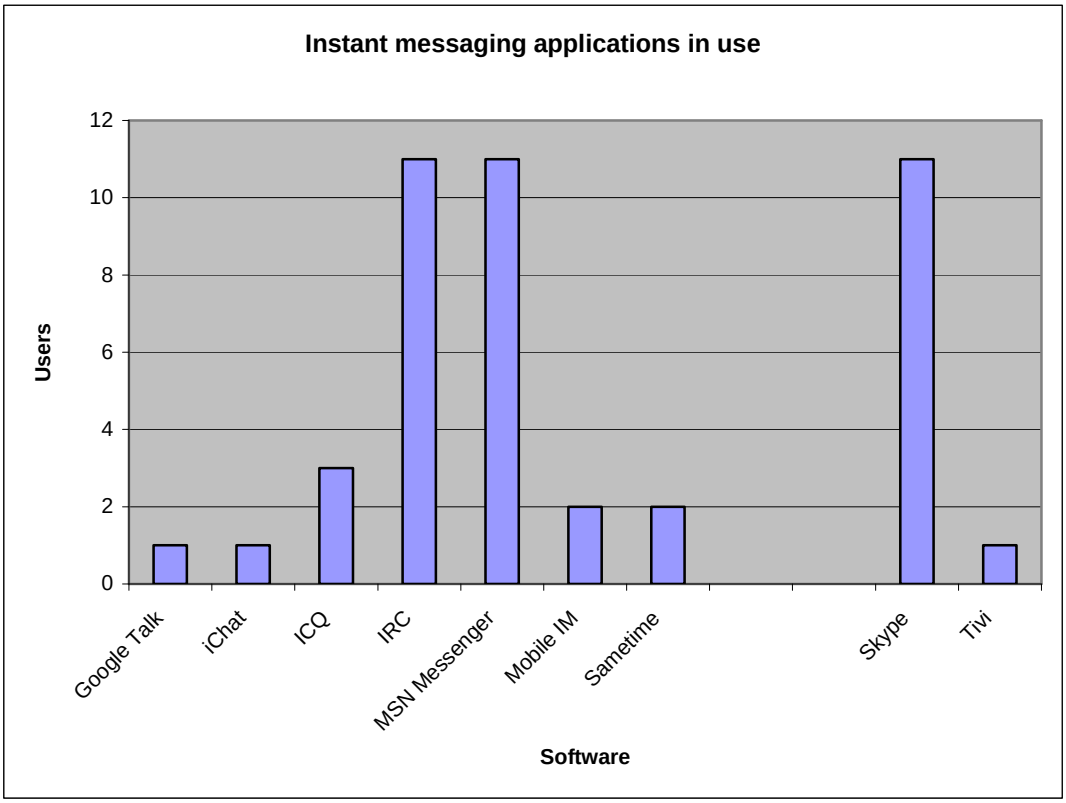

Figure 10 Instant messaging applications in use

Every respondent used at least one Instant messaging or VoIP application. MSN Messenger and IRC were the most popular Instant Messaging applications; both have 11 users. ICQ was the third popular Instant messaging software; it had 3 users. Sametime had 2 users and Google Talk, AOL Instant Messaging and iChat each had one

user. Trillian, which is an application to connect several Instant messaging applications to one application, was mentioned in one answer. Skype and Tivi were the only VoIP-applications that were mentioned. Skype had 11 users and Tivi one. Two respondents mentioned mobile Instant Messaging. One of them was using the Mig33-application, which is similar to Trillian, but for mobile phones, and the other user had MSN Messenger.

The second question was "*How often do you use Instant Messaging? a) several times a day, b) once a day, c)once a week, d) once a month, e)less frequently"*. The results are shown in Figure 11.

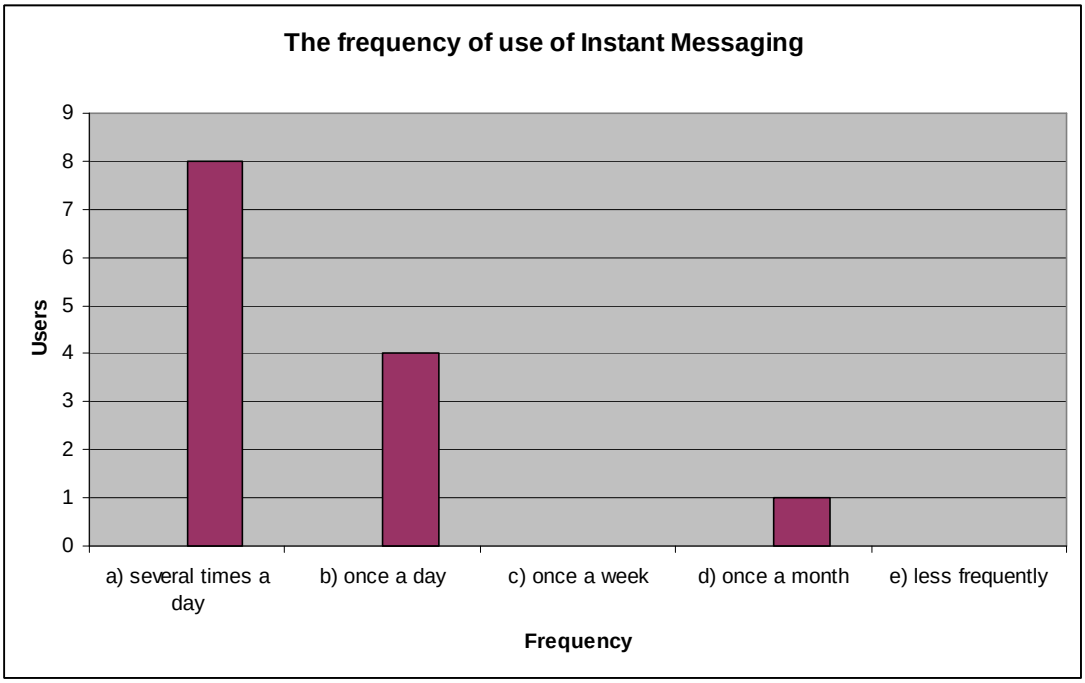

Figure 11 Frequency of use of Instant Messaging

Eight respondents used Instant Messaging several times a day, four users once a day and one user only once a month. One user specified her usage more closely; she uses Sametime once a day, Skype once a week and Trillian less frequently. One user also mentioned that even though he uses other types of Instant Messaging almost all the time, Tivi, iChat and Skype he uses less frequently.

The third and fourth questions were about the respondents' familiarity with PMR-radio systems and PTT. The third question was *"Are you familiar with PMR (Walkie-talkie)? Where have you used them?"* Four of the respondents have been using PMR-systems during their military service, two respondents during hunting. Truck driving, peace steward–duties, agility and driving school were also mentioned. One user has been using Marine VHF. Four respondents were not familiar with PMR-systems. In addition to this, the familiarity of PTT-system was asked. The fourth question was *"Are you already familiar with PTT? How?"* Seven of the respondents were not familiar at all with PTT. No one has actually used PoC, according to question five *"Have you used earlier some PoC-service (for example Pikayhteys by Saunalahti)?"*. Instead, PoC was familiar from advertisements, news or demos or even from their own mobile phone's menus. One respondent mentioned that he had even purchased a particular mobile phone model to have a PoC-cabability and that he had thought about switching to another operator in order to be able to use the functionality.

The respondents were also asked about their expectations on PoC; question six was *"In which kinds of situations do you think that PoC-service is most useful? In what kinds of situations you presume you would be likely to use PoC?"*. The answers of all the participants are presented as a list below as they were given.

- In work to invite co-workers to meetings and when several people need to answer a question quickly.
- Whenever one only needs a quick yes/no/maybe – answer.
- To agree the exact place, when meeting a friend in town.
- In a store to contact a friend, who is still shopping and to ask to bring something that was not remembered earlier.
- In work, if one needs to contact a colleague frequently.
- In any call, if it is cheaper than normal call. Easy to invite fellow students to lunch. It could also be used in many ways in dog hobby.
- To ask someone to call.
- Between cars when driving, during online gaming if there is no opportunity to text chat. To quick notes, like "could you throw the keys from the window? Or if the doorbell is broken; can you come and open the door?"

- In university campus area to replace "Where are you?" -calls
- In online gaming, if everyone does not have a microphone on computer. Could probably be used to replace normal calls, since it is cheaper. In everyday negotiation (who is bringing and what to a gathering).
- In a big house or yard to invite family members to dinner without calling or shouting to everyone differently. PoC could certainly be used to stay in touch during fetes.
- When going to a trip with friends and you move separately. With PoC it could be easy to agree where to go to dinner etc. Also people in different cars could be connected via PoC.
- In a store to call the wife and to ask shopping list. No need to call a proper phone call every time. To other quick notes, e.g. to ask to throw the keys from the balcony. And to ask a friend to have lunch in campus area.
- At work: to organize events, when there are more than 2 people involved in organisation. There is an opportunity to get comments from many people, no need to call to just certain people. Guidance at construction site.
- During free time: To contact family and friends during downhill skiing (used in USA). Boaters could use instead of Marine VHF (not many users any more), to create unofficial discussion channels. The system could be developed to regional channels, so that the server would acknowledge the cell of origin and would then re-send the message to proper recipients.
- For example among a group of people, in some shared event or internal communication of some occupational group, e.g. construction workers.

The last question in the first questionnaire was *"Are you a radio amateur?"* According to answers none of respondents was a radio amateur.

6.2 Second questionnaire

The second questionnaire was answered in the middle of the test, one month after the beginning of the test. 13 of the 14 testers answered the questionnaire, which had eight questions. The main purpose of the second questionnaire was to remind the testers about the test. Two months was chosen to be the test time, in order for the testers to be able to get over the charm of novelty and to find out whether they would use PoC in normal everyday situations. However, two months is quite a long time and therefore this second questionnaire asked about the problems in the beginning and the usage so far. By the end of the test the testers may have already forgotten the problems they faced in the beginning.

The first question concerned the beginning of the test; *"Was it easy or difficult to get the application to work properly? If it was difficult, what kinds of problems did you have?"*. Nine testers, the majority, found the beginning easy or quite easy. They mentioned that the instructions were good enough. And even though some of them had some problems, they still felt they were not that dramatic. Four people found the beginning difficult. They had problems with the settings, because the menus were different in different kinds of mobile phone models. One respondent mentioned that it took about 30 minutes to get the system to work. There was one special problem with Elisa customers, who had to in addition to PoC-settings, also configure their Internet-settings. The users of Elisa cellular network needed to use a special Access Point Name (APN), which is designed for testing purposes. This APN allowed the needed SIP and RTP –traffic. The APNs that are normally used in Elisa or Kolumbus subscription do not allow this type of traffic.

The second question was *"Have you been using the system with your mobile phone or with PC?"* Everyone had been using the service with their mobile phone. Only one respondent had shortly tested PoC with PC. In the beginning of the test there were three testers, who were interested in testing the PC-client, but the PC-client did not work with their home network configuration and they had to drop out. The PC-client that was tested is presented in section 6.3.

The third question was *"In what kind of situations have you used PoC?"*. The most popular use situation was moving house; five respondents had participated moving house. Five respondents had just tested the system and two of them had also used the system to change quick notes, e.g. to set a place for lunch. Two participants had used PoC when playing an online game with each other. They had also used the system in normal communication.

The fourth, fifth and sixth question asked about the use of PoC more closely. The fourth question was *"With whom have you used PoC ?"*, fifth question *"Have you used one to one or one to many conversations?*" And the sixth question, *"If you have used the one to many feature, how many people participated your group and how did you get the information about the group? (Did you send invitations yourself or who did?)"* Three participants had been using the system with their families and the other ten with their friends. Five users had used only one to one feature, four users one to many feature and four users had used both. The group size had varied quite a lot. Some users had used group functionality only with two people in total, and two users mentioned that the size of the group had been almost ten people. The most common group size was five people. The source of group information was not very clear. In family communication the group information came from the father. The group who had participated in the moving had the group information already stored into their phones and in the beginning of the moving house they decided together to use the system for communicating. There was no mention of where the group information in the beginning had come. One participant replied that he and his friend agreed to use of PoC beforehand using some other medium, like IM.

The seventh question inquired about the problem the participants had had with PoC this far. Six users had not had any problems. Four users had had problems with losses, all the messages had not been delivered to the recipients and some of the messages had been disturbed so much that it had been impossible to understand the message. Three participants mentioned that delay had caused some problems and that it had made the conversation too slow. One participant had found out that if users are too near to each other when using PoC the delay and loss are greater than when the users are far away from each other. The sudden loss of connection was also mentioned. Three participants

had also had problems with mobile phones. One of them found out that the tangents were not suitable for the type of communication where they had to be pressed all the time. Another user had to switch his phone off and on again to be able to receive messages. This had happened a couple of times. The third user mentioned that his phone, Nokia 6131, did not receive any messages from a group channel when it had the cover closed. This problem did not occur in one-to-one conversations. Two users mentioned that the system had to be on all the time to be able to receive messages. The group members may not always remember to turn their application on and this makes it impossible to use the system.

The eighth question was free for respondents to restate any ideas they have. These statements are presented as a list below:

- The system is probably most suitable for “virtual meetings”, to decide where to meet in the evening
- The application has to be turned on all the time and you may not be able to hear all the messages if the surroundings are not peaceful and quiet.
- It seems that there is no use for this kind of system in normal life
- Does a hands-free work with this? It would be great, so everyone could not hear the conversations.
- Quite a fancy function to use with a group of friends.

6.3 Third questionnaire

The third questionnaire was the longest and the most informative of all three questionnaires. The questionnaire was created to find all the problems and opportunities there had been during the test. Some overall opinions were also asked. The questionnaire included 27 questions in total. Three of these 27 questions were background information. All the 14 testers answered the questions.

The first question dealt with the overall feelings about the use of PoC: *“How did you feel using the PoC?”*. The answers were mainly positive. Ten respondents said that

using PoC was interesting and even fun and the application seems to be useful at least when communicating with a bigger group. But not all opinions were that positive. One respondent answered that the usage was inconvenient. Three respondents regarded PoC as impractical when compared to normal GSM-calls and to e.g. Skype.

The second question inquired about the convenience of use. *"On a scale from 1 to 5 (1= inconvenient, 2= quite inconvenient, 3= not inconvenient, nor convenient, 4= quite convenient, 5=convenient) evaluate the convenience of the PoC use."* The results are presented in Figure 12.

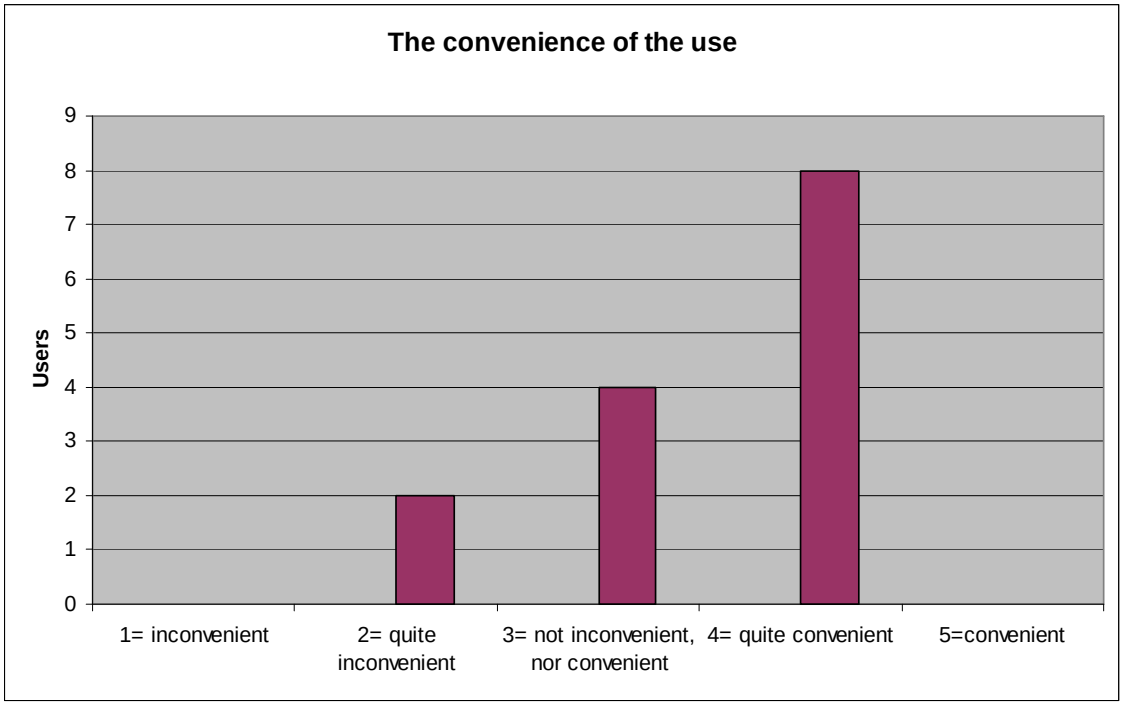

Figure 12 Convenience of the PoC use

As can be seen, eight respondents answered 4; the use of PoC is quite convenient. Four testers thought that the use was neither inconvenient nor convenient and two testers said that the use was quite inconvenient.

The third question was the same as the third question in the second questionnaire; *"In what kind of situations have you used PoC?"* Four users had used PoC for short conversations, like asking friends for lunch. Three users mentioned participating in a moving house. Four users mentioned pure testing purposes. Family, Internet-gaming,

group-situations and winter vacation (skiing and downhill skiing) each had two users. One respondent mentioned that he is going to use PoC in the future during teaching for motorbike driver's licence.

The fourth question, "*With whom have you used PoC?"* was also asked in the second questionnaire. Ten users had used the PoC with friends and four users with family. The fifth question was "*Have you used PoC on one-to-one or group -communication?"* Six users had used PoC on both one-to-one and group –communication. Four users had used only one-to-one –communication and four users group-communication. The sixth question *"If you have used the one to many feature, how many participants were in your group and how you did got the information about the group? (Did you send invitations yourself or who did?)"* was also asked in the second questionnaire. The responses were quite similar in this third questionnaire. The group size had varied from only two people to almost ten people. The average group size was five people. Even those people, who took part in the same moving situation, were not sure about the group size. Two participants had used group-communication with family and eight participants with friends. Only one tester mentioned that he had himself invited the others to join the group, other respondents just mentioned that someone else had invited through the PoC-application, by e-mail or just by asking to join before starting the use.

The seventh question inquired about the distance of participants in PoC-conversations: *"How far away from each other were the participants during conversations?"*. Four participants had used the system inside a house and thus the distance between participants was only a few meters. Five of the testers answered "a few kilometres" or "several kilometres". Two mentioned slightly more accurate distances: three or five kilometres. Distances from tens of meters to dozens of kilometres were also mentioned. One respondent mentioned even a distance of 400km.

The eighth and ninth questions dealt with the opportunity to check whether or not a member of the users contact list or some group is online. The eighth question was: *"Did you use the opportunity to check the availability (online-offline-busy etc.) of a member in your contact list or a group?"* Twelve testers had used the opportunity and only two testers had not used the opportunity. Ninth question was: *"How useful on a scale from*

one to five (1=completely useless, 2=quite useless 3=neither useless, not useful, 4=quite useful, 5=very useful), do you think that this kind of opportunity to check your friends' availability is? Give reasons" The results are presented in Figure 13.

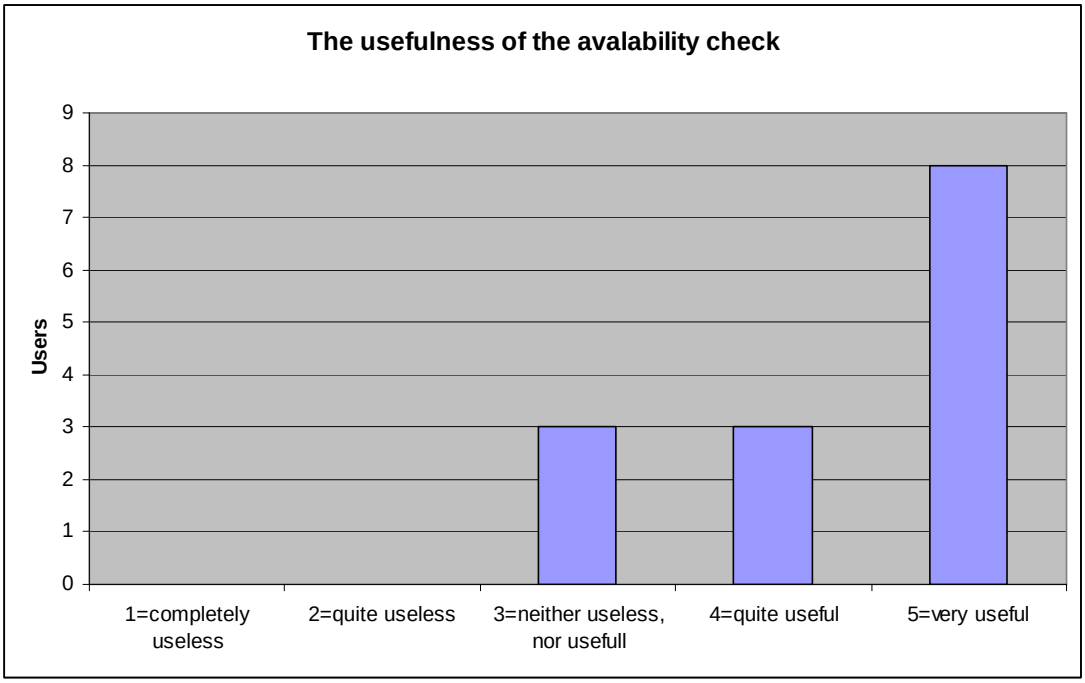

Figure 13 Usefulness of the availability check

The users clearly felt very positive towards the opportunity to check the availability of friends and members in their groups. Three were indifferent about its usefulness, but three answered that the function is quite useful. Eight participants found the opportunity very useful. The reasons were quite congruent; "with this opportunity to check availability you know who is going to hear your message" or "you know whether to send PTT message or contact otherwise". One user hoped that using the availability check could be made easier.

The tenth and eleventh questions dealt with the opportunity to send a call back request; Question 10: *"Did you use the opportunity to send call back request?"* and question 11*:"On a scale from one to five (1=completely useless, 2=quite useless 3=neither useless, not useful, 4=quite useful, 5=very useful), how useful do you think the call back request is?"*. Only five testers had used the call back request; nine users had not used the functionality. The answers to question 11 can be seen in Figure 14.

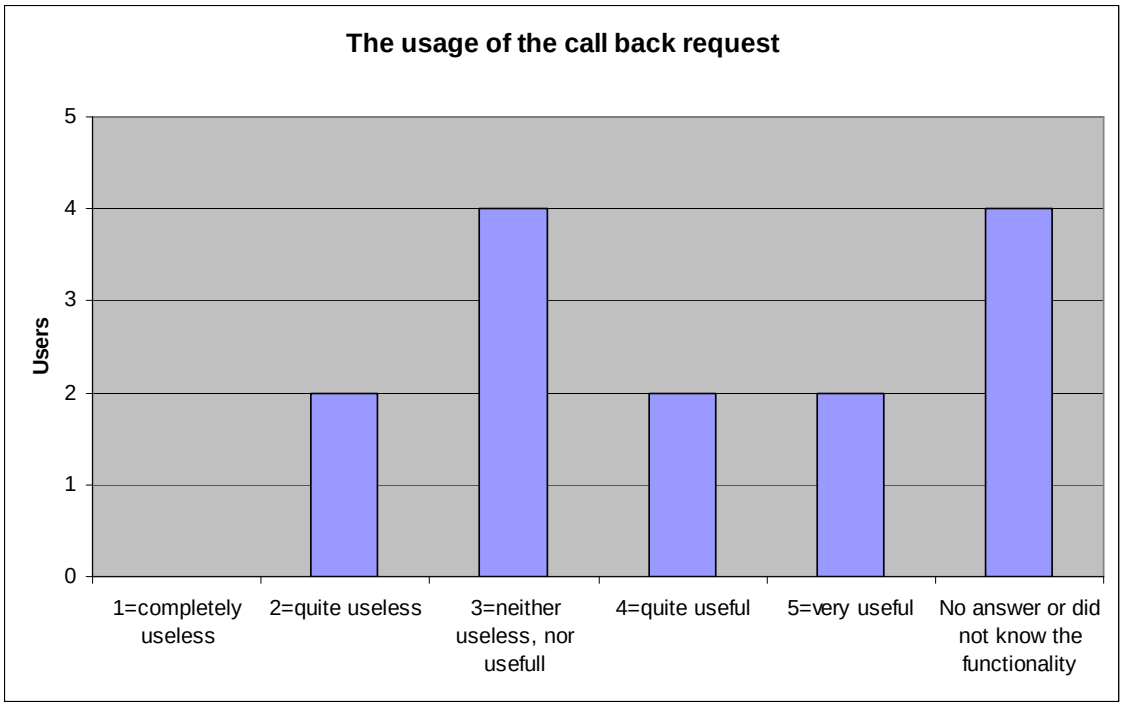

Figure 14 Usage of the call back request

Two users thought that the call back request –functionality is quite useless, four users found the functionality neither useless nor useful, two users found it quite useful and two users very useful. Four users answered that they have no opinion, since they did not know about the functionality. The two users, who answered that the call back request is quite useless, had not used the functionality during testing. Five of the users gave reasons for their answers. One of them did not find the call back request useful (answer=2), since he thought that the functionality did not suite the definition of PoC to be a quick way for communication. The other commentators had found the functionality quite useful or very useful. They said that the call back request makes it possible to use PoC more as a "normal" phone and it expands the possibilities of use, when the recipient is not available at the moment. One user, who had found it very useful, even though she had not actually used it, explained that she did not try the call back request, because she was not sure how the recipient would receive the request. She had thought that it might disturb e.g. a meeting.

The next question was *"How did PoC suite the situations in which you used it"?* Three users answered that they had difficulties finding any potential situations in which to use

PoC. Three users answered that PoC was moderately suitable. Eight users found the PoC quite or very suitable. Especially moving house and downhill skiing situations were mentioned.

The thirteenth question, *"Did you have problems with PoC?"*, was also asked in the second questionnaire in the middle of the test. The answers were not quite the same. Only one user now answered, that he did not have any problems, while in the middle of the test six testers had not had any problems. The problems in the beginning with settings were mentioned in eight answers. Five respondents mentioned that the PoC application had automatically lost its connection to the network many times. Four users had experienced some loss in messages; not every message was delivered, which made it sometimes difficult to follow the conversation. The need to ask the other participants to repeat many times was mentioned. One user mentioned delay. One user thought that the volume of the mobile phone's loudspeaker was too low. Some mobile phone models had caused problems. One user found the tangent of his mobile phone not suitable for PoC.

The fourteenth question asked about the participants' willingness to use PoC in the future*: "On a scale from 1 to 5 (1=I definitely would not use, 2= I probably would not use, 3= I do not know, 4= I probable would use, 5= I definitely would use), how possible it is that you would use PoC in the future? Give reasons! "* The results are presented in Figure 15.

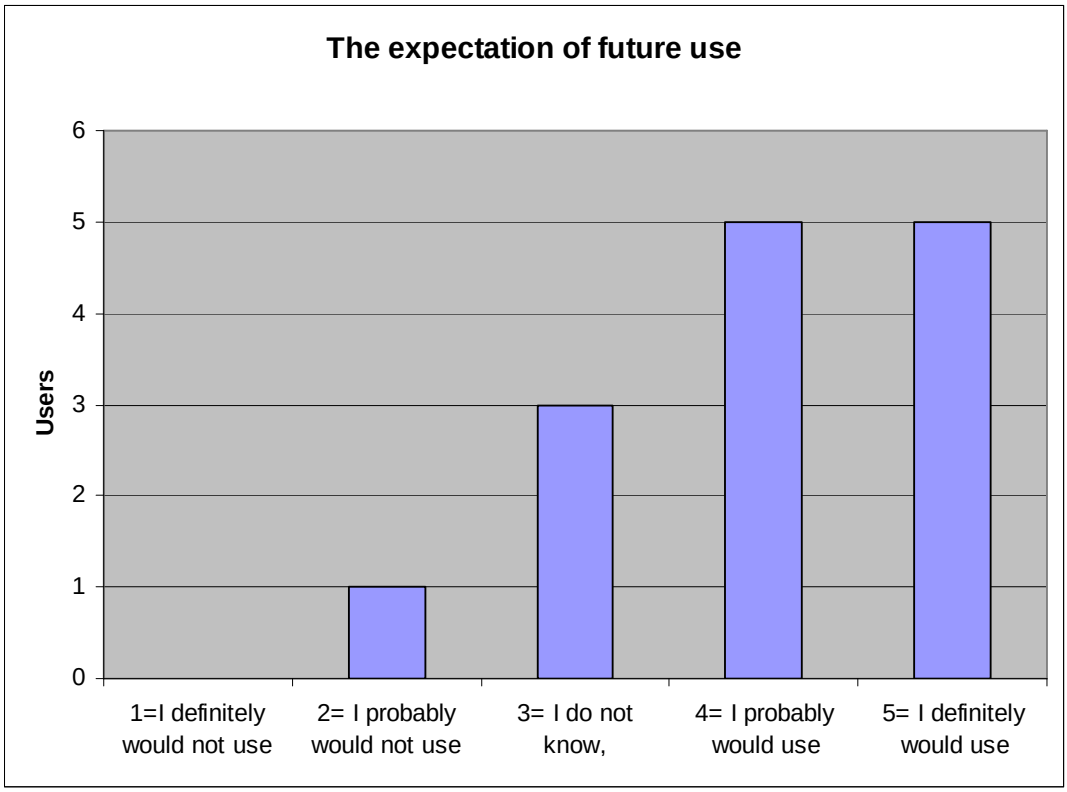

Figure 15 The expectation of future use of PoC

The majority, ten testers would probably or definitely use PoC also in the future. Three of the testers did not know whether or not they want to use PoC in the future and one participant though that he would probably not use it. The reasons for possible use are given below as a list. After each reason, the answer choice is marked.

- I would not remember to turn the application on and if I would I think the messages would disturb at a bad moment. (answered 2)
- At the time PoC seems to be quite useless for me, Mobile Skype is better. Maybe, if the mobile phone's loudspeaker was any better, PoC would be an opportunity to replace radio phones, now it does not have enough power if there is any background noise. (answered 3)
- Yes, if my friends would also be active users. (answered 4)
- I would use it in group situations or when giving advice to someone. Of course, the other person should also have the opportunity to use PoC. (answered 4)
- I would use PoC to organise events (answered 4)

- PoC would be useful if many of my friend would use it. Then we could arrange get-togethers via PoC, which is easier than SMS (answered 4)
- Both parties should agree beforehand to use PoC if they want to use PoC in one to one conversation. This can probably not be used to replace normal phone calls, which is the problem of all IM applications (answered 4)
- I would use PoC in group situations, but it might be too expensive. I would use it if it would be free of charge, or if just the data transfer was charged. (answered 5)
- I would use it when it becomes available. I would use it with family and friends and at work, to organise events (answered 5)
- I would use PoC as radiophones, e.g. on long journeys with many cars and hiking. (answered 5)
- At home or family cottage (answered 5)
- To inform some quick things. In order for me to choose PoC over a normal phone I would need to be sure that the other user is actively listening, not just idling. (answered 5)

The fifteenth question asked respondents to evaluate three aspects of PoC: usefulness, usability and functionality. The results are presented on figures below.

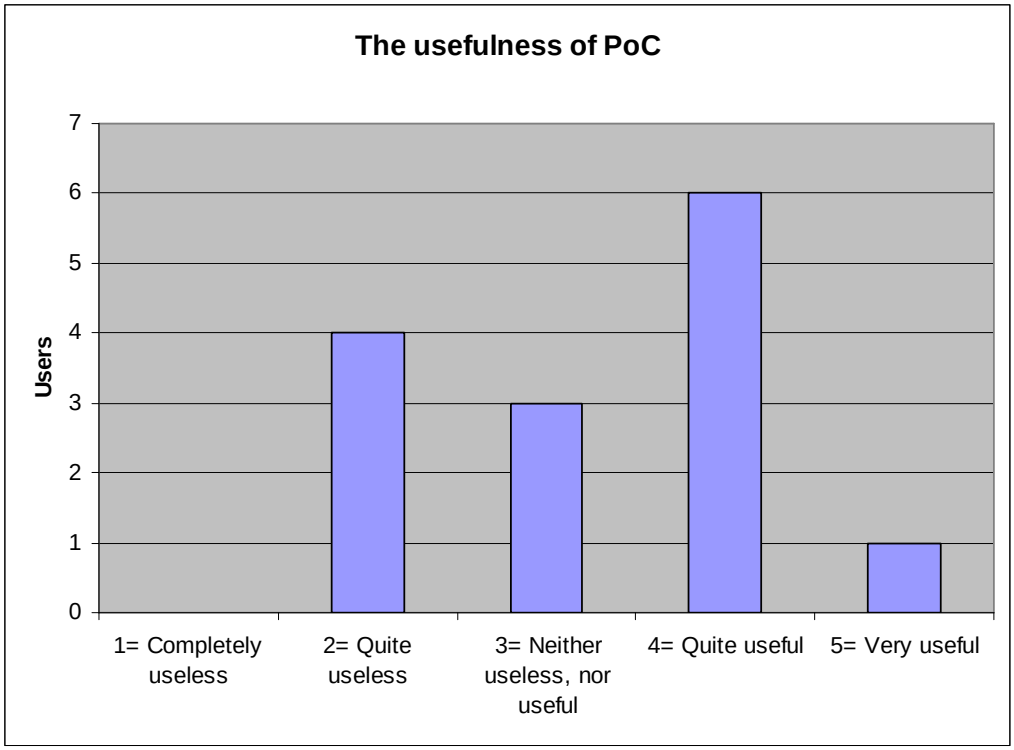

Figure 16 Usefulness of PoC

The testers' opinions about the usefulness of the PoC-system varied quite much. The results are shown in Figure 16. Four users found PoC quite useless, three users neither useless nor useful, four users quite useful and one user very useful.

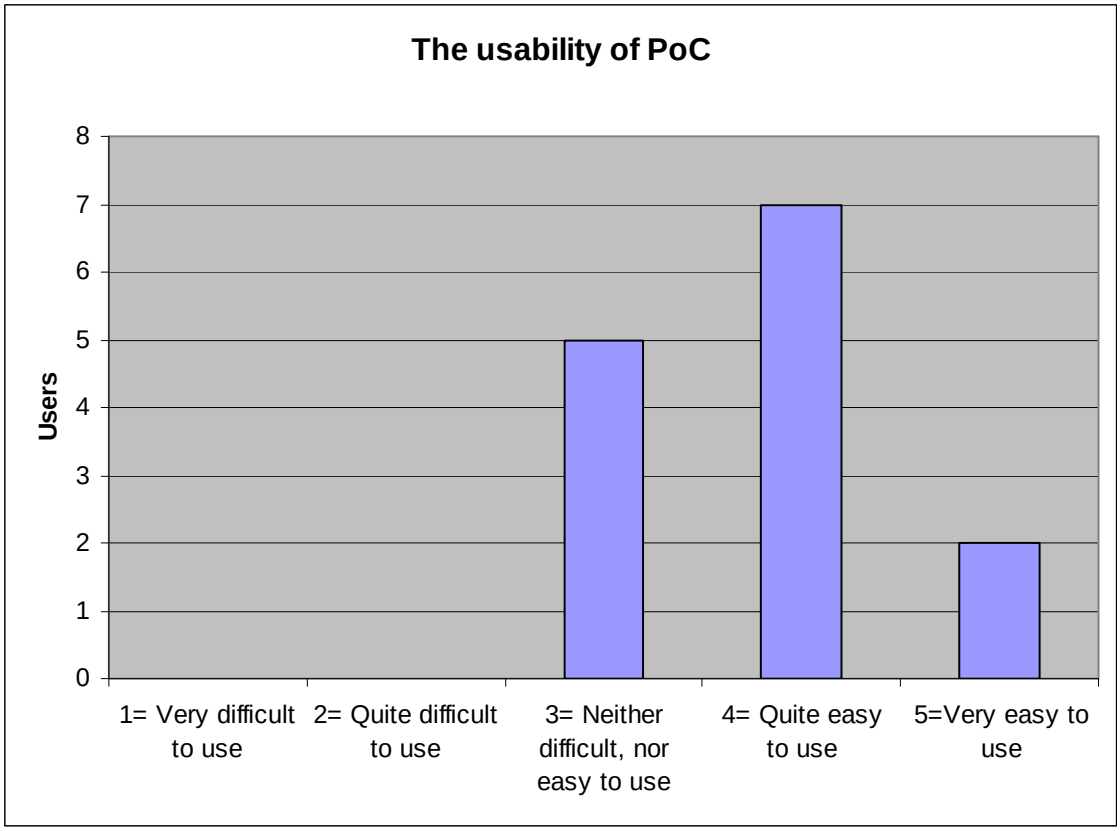

Figure 17 Usability of PoC

The results of the usability of the PoC –question can be seen in Figure 17. Five users were indifferent about the usability of the PoC and answered that the use was neither difficult nor easy. The other respondents thought the use was easy, seven users answered quite easy and two users answered very easy to use.

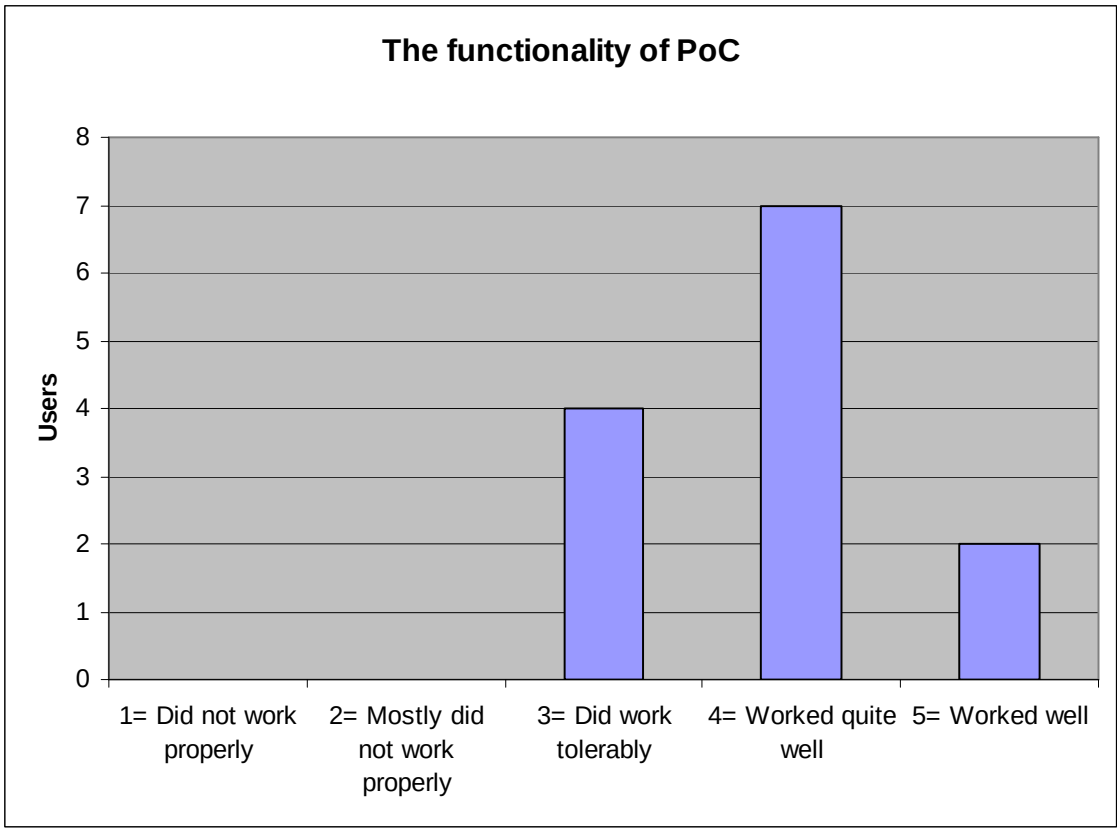

Figure 18 Functionality of PoC

The opinions about the functionality of PoC were quite positive as can be seen on Figure 18. Four users answered that PoC did work tolerably well, seven testers answered that it worked quite well and two users answered that PoC worked well.

Question sixteen asked respondents to give examples of people to whom PoC would be most suitable. Three users answered, “To those, who need radiophones in their work or hobbies.” Two users mentioned some companies and occupational groups in particular, construction workers, moving company workers and event organisers. One user thought that PoC is not suitable for business use and would be best for hobbies. The most popular answer, though, was groups of friends. One tester assumed that PoC would be most suitable for 16-18-year-old people or for students, who want to talk about what to do in the evening. PoC was mentioned to replace SMS-conversations. Active families with outdoor hobbies were also mentioned.

Questions seventeen and eighteen dealed with the price of the PoC-service: *"Did it make any difference to you how much PoC-messages cost?"* And *"How much would you be ready to pay for PoC-service?"*. The results of question seventeen are presented on Figure 19.

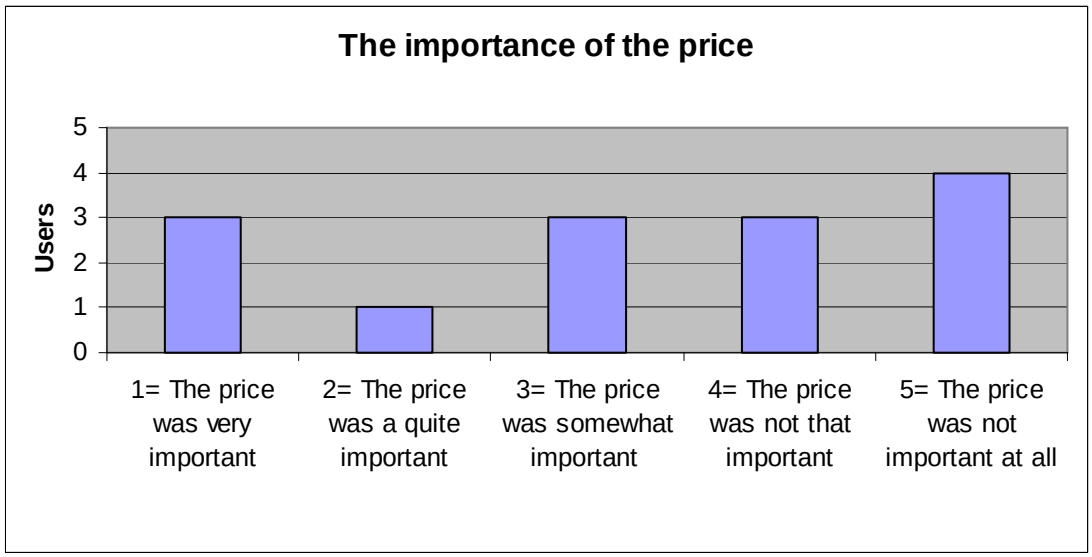

Figure 19 Importance of the price

The importance of the price varied much between the testers. To three users the price was very important and to one user quite important. Three users thought that the price was somewhat important. The price was not that important to three testers and the price was not important at all to four respondents. Two users answered that the usage of PoC should be free of charge, because they do not actually need the PoC and there are free services that are more suitable to them. Six respondents were ready to pay the normal data transfer fee, but no additional fee for the actual service. One user was ready to pay even double the data transfer fee. Nevertheless, he thought that the price of the data transfer is difficult to understand, because it is not clear how much data is actually transferred. Therefore it would be better to charge the use of PoC by minutes and he would be ready to pay double the price of a normal phone call. Two users proposed a monthly fee, approximately 3-5€/month in addition to the data transfer fee. One of these respondents said that a minute based fee would be suitable, if it was charged only by the minutes of sent speech, not by the received minutes. One user would be ready to pay the

same price as she pays for normal phone calls. Two users did not mention any particular price.

Questions nineteen and twenty asked how much does the data transfer cost at users' own mobile subscription and do the users pay their own mobile phone bills. Four users did not know the price of the data transfer at their mobile phone subscription, two of these testers did not pay the bills themselves; their employers pay the bills. Five users pay 4 €/25MB and five users have a fixed monthly fee of 10€/month for data transfer. Altogether eleven users pay their bills themselves and three users have their bills paid by employers. This question did not seem to have any clear correlation with the question, "How much would you pay for PoC-service?"

The next two questions asked what the testers found best and worst about PoC. The users had most liked the easiness of communication, especially group communication. There is no need to call everyone separately and everyone gets the same message quickly. Users liked the sound that informed about an incoming message. The charm of novelty was mentioned in three responses.

On the other hand the users did not like to configure the settings. They did not always know whether or not the service was on, and whether or not the communication parties were available to receive messages. The network capacity and reliability was not always enough; the users had not liked the delays and losses in the messages. The connection between the PoC-client (mobile phone application) and PoC-server was sometimes broken. One user mentioned that he did not like the fact that only one user could speak at a time. Three users were disappointed about not being able to use PoC with a hands-free. They said that a hands-free tangent should work as the PoC tangent. One user mentioned that he would have liked to test the PC-client, but it did not work because of the NAT.

The 23rd question asked testers to suggest improvements. The suggestions followed mostly the list of problems and features that users had not liked. The suggestions are listed below.

- Full-duplex speech
- The opportunity to use all kinds of hand-free gadgets with PoC
- The opportunity to use a hands-free tangent as the PoC tangent
- Easier introduction
- A designated PoC-tangent to each phone
- The opportunity to use PC-client also with NAT
- The opportunity to add pictures to the messages (at least on one-to-one communication)
- The application could tell who of those people that the user has in his or her address book has the opportunity to use PoC
- The availability of the service should be clearly shown
- To improve the usability of the application's user interface

One user hoped that a user could be on a channel but could change his or her status so, that he or she could not receive any messages. When a user changes his/her status, which is connected to the change of mobile phone's profile (offline, silent, in a meeting etc.), he or she leaves the channel and is not available for any messages, not even one-to-one messages. A user, who tries to send a one-to-one message to another user who is not available, he or she gets a notification "The user is either busy or using silent-profile". When the user again becomes online he or she automatically rejoins the channels, which he or she had active when first changing the profile.

Question 24 asked about the use of PoC compared to the use of Instant Messaging; *"If you use Instant Messaging applications (ICQ, MSN Messenger etc.), how usable do you think PoC is, when compared to Instant Messaging applications? Evaluate on a scale from 1 to 5 (1= I would rather use IM applications, 2= I would mostly rather use IM applications, 3= Both are equally usable, 4= I would mostly rather use PoC, 5= I would rather use PoC) Give reasons!"*. The results are presented in Figure 20

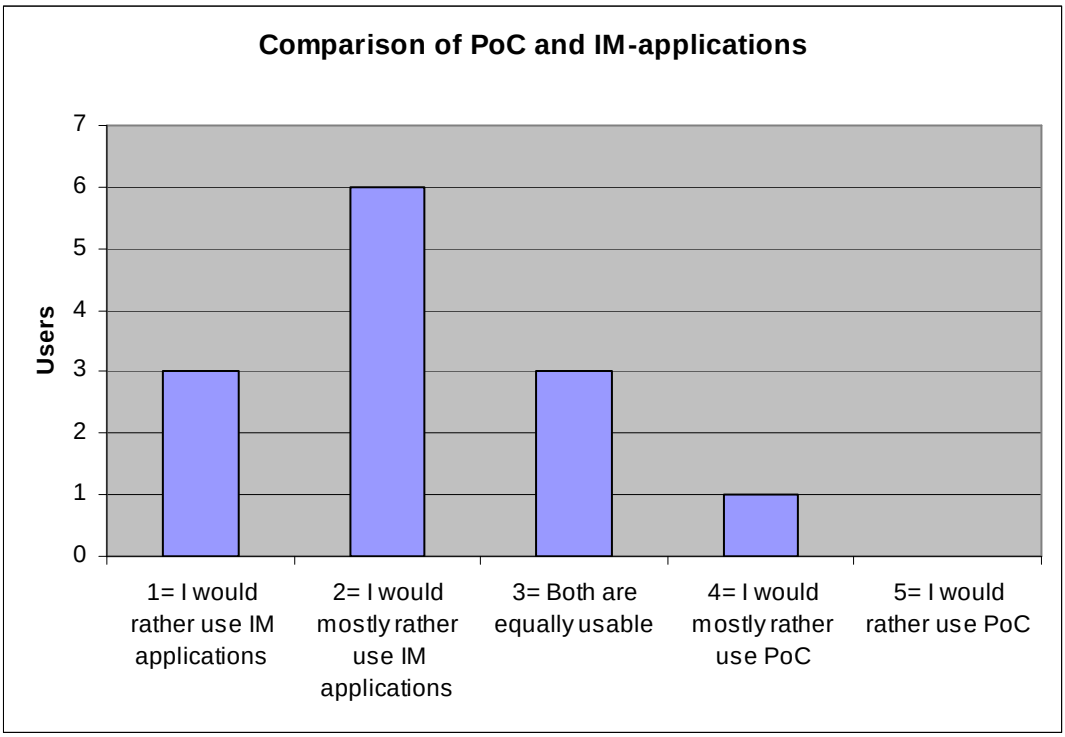

Figure 20 Comparison of PoC and IM-applications

Three respondents answered they would rather use IM applications and six users would mostly rather use IM applications. Three users thought that both PoC and IM applications are equally usable and only one user would mostly rather use PoC. One user did not answer, since he did not use IM applications. The reasons that the testers gave are presented below as a list. The option that the respondent had chosen is presented after every point.

- Text is "saved" all the time, you don't have to answer immediately (answered 1)
- IRC-channel has a solid status of communication in a group of friends, it is also possible to talk privately with only one person (answered 1)
- IM applications are free and easier. (answered 2)
- PoC and IM are suitable for different kinds of situations. IM is better for longer conversations and PoC is better for short conversations that are addressed to many people. People normally have their mobile phone closer and it also announces an incoming message better. (answered 2)
- Thoughts are better transferred through speech than text. It is more natural. That's why the concept of PoC would be worth 4 or 5. However, the usability of

PoC is defined by the amount of mobile phone users, who take the service in use. (answered 2)

- I have Agile Messenger to connect different IM application in my phone and Fring-software to take care of Skype-calls; they are more suitable for me. (answered 2)
- It would be better if these could be combined. (answered 3)
- Both have their own advantages; text is handy, you can read it also later. PoC is more suitable when you are on move, talking is then easier than writing. (answered 3)

The last actual question of the third questionnaire asked the respondents to innovate three groups (i.e. work, hobby related), which could find PoC useful. The suggestions are presented as a list below.

- Stewards
- Construction workers
- Police
- People who travel with many cars
- Groups of friends
- Scientists
- Truck drivers
- Taxi drivers
- Guides
- Driving schools
- Event-, fair- and competition organizers, judges
- Conductors
- Army forces
- Real estate care takers
- Stock brokers
- Different kind of hobby groups: airsoft- and paintball-players, hunters, agility trainers, orienteerers, golfers, berry or mushroom pickers, scouts and hikers

6.4 Observation – Moving house

One of the main assumptions for the usage of PoC was, that it is at its best in group communication, where there is a need to connect occasionally but quickly. The method to test this assumption was an observation of a user situation. In this user case, a married couple was moving. The distance between the old and new house was 19,5 kilometres. 14 people took part in the change of residence. Three people stayed at the old residence to clean, one person was at the new residence to receive the furniture and other articles and the others were in several cars moving the articles. There were all together five groups, each of which had one or two PoC-capable mobile phones in use.

As predicted PoC was used to exchange information about where each group was at what time. But the system was also used to communicate otherwise during sitting in the car, not just to change important messages, but to report what was seen on the way and to tell jokes. This can be an effect of the new system and charm of novelty. The participants were not yet familiar with using PoC in communication and wanted to test how it worked and how others heard the messages. There were several “Hello, this is John speaking! Can you all hear me” -type of messages in the beginning of the observation. The moving took about five hours and after that everyone gathered to the new residence. The users told that they had found PoC nice to use and even useful during moving. Those, who also took part in the questionnaire, mentioned the moving as the most useful situations for PoC use.

One of the notifications in Woodroff and Aoki’s study was that the feedback in PoC conversations was reduced. Because of the half-duplex nature of the channel the level of spontaneity was decreased. For example, reactions to jokes are more artificial than in full-duplex communication. Even fake laughter appeared. [WOO05] This was very clear also in moving house -observation. The responses to jokes and funny anecdotes that were transmitted to other groups during driving were quite vague. It seemed like people wanted to answer something, so that the originator could know that his or her message was heard, but real laughter was too late.

6.5 Measurements

In the beginning of the study it was predicted that the GPRS and 3G networks would cause some delay and losses to the PoC traffic. This also came up in the responses; the testers mentioned that there was occasionally even so much loss that they were unable to understand some of the messages. To study this, some measurements were made. All the measurements were done using the Elisa cellular network. All the testers used Elisa radio network, even though they had different operators (Saunalahti, Kolumbus and Elisa).

The measurements were done with two laptops, both with Windows XP. The computers were connected to the Internet with two Nokia E60 mobile phones. This way the GPRS and 3G networks could be used for testing. Before the measurements the clocks of both computers were synchronised with Windows Internet-time –function. The timeserver that was used was time1.mikes.fi, which belongs to the Centre of Metrology and Accreditation. The measurements were done in two ways. First, the used bandwidth was explored with a test measurement. The bandwidth was 8 kbit/s, which is one of the eight possible bandwidths with AMR-codec. The first actual test was done using the Iperf-measurement tool. This tool was used to make one laptop send, and the other to receive a constant flow of UDP-packets. The size of UDP-packets was 122 B and the bandwidth 8 kbit/s. Second, a more practical test was made with Genaker PoC PC-client. A one-minute discussion between two parties was made and the packets were measured. Both of the tests were done in GPRS, 3G and fixed network. All the packets in both of the tests were gathered using Ethereal network analyser and then analysed with Tcpdump, and the statistics were made with Microsoft Excel-spreadsheet (2003). The results of the measurements are presented below in Table 1.

Table 1 The results of the network measurements

	GPRS		3G		Fixed network	
	Delay, s	Loss, %	Delay, s	Loss, %	Delay, s	Loss, %
Iperf	2,3486	0	1,3352	0	0,494918	0
PC-client	2,0272	0,0037	1,0366	0	0,47582	0

As can be seen, the delay with GPRS and 3G networks is quite big. However, the delay of the GPRS network is mentioned to be from two to three seconds [CHA03]. This is aligned with the test results. The needed bandwidth is only 8 kbit/s, which is lower than the capacity of GPRS or 3G. The theoretical capacity of Elisa GPRS network is 53,6 kbit/s and in practise 40 kbit/s at it's best [ELI07]. The theoretical capacity of 3G networks is 384 kbit/s [ELI07]. The delay in fixed network is significantly lower than the delay in mobile networks.

These measurements do not show any losses. As well as delays, losses are highly dependent on the utilisation rate of the network. Surprisingly, the results show that the delay with PC-client is shorter, even though it also includes the delay of the PoC server. All the results also include the delay of the connection between mobile phones and PCs (USB cable). However, this is very small when compared to the overall delay. The delay of the Iperf-test is presumably bigger, since it is a constant stream of packets and thus the processing takes more time. PC-client packet stream is more spacious.

7 Discussion

In this chapter the results of the test and measurements will be discussed.

The main goals of the test were to connect PoC and PoC PC client to the same system and to gather user experience. In the beginning of the test PoC was predicted to be most useful in group communication, to occasionally exchange quick notes. The goals were not totally reached, since none of the testers actually used the PC client, even though it was possible. However, a lot of important information was gathered.

According to the results of the first questionnaire the testers seemed to feel positive towards PoC, even thought none of them had actually tried it before the test. The concept, thought, was familiar to most of the testers.

In the end of third questionnaire the testers answered a question that inquired about their behaviour with new technology. This was asked to find out whether the early adopters were reached or not. According to the answers, we may not have reached the early adopters after all. However, none of the respondents did answer to be a laggard or late majority.

The users had problems mostly with settings in the beginning. These problems were expected, since it was not possible to use automatic settings delivery. If PoC-service was ordered from some operator, they would most definitely deliver settings automatically. This would make the beginning much easier for the user.

The unwillingness to use the system with PC states that mobility is important to people when considering a PoC service. Most of the users use Instant Messaging with their PC, but PoC is seen as a mobile system, which is at its best when the user has it with him or her all the time he or she wants to be reachable. One user answered to the last question of the third questionnaire that it would be best, if PoC and IM could be connected together. The PC-client could solve this problem, since it also has the opportunity to exchange written messages, like IM. At the time these messages are not delivered to

mobile phones, which is a clear shortcoming. The use of PoC PC-client as IM-application would require that all the participants have a similar kind of PC-clients. At the moment, MSN Messenger and ICQ are the dominating applications at the IM-market. The growth of PoC PC-client users would need the application to be free of charge. At the time of writing the PC-client that was used in the test is not yet available for public.

The third questionnaire was designed to ask the overall feelings about PoC. It clarified problems and possibilities of PoC. As can be seen from the answers, the users most liked the easiness of group communication, as predicted. The testers had used PoC mainly with friends, but also with family. Most of the testers said that the use was quite easy, even though there were some problems. It can be seen from the results that most of the opportunities of the PoC were not very clear to the users.

Some of the testers were worried that they would disturb the other participants during something important. This was also noticed in the Woodruff and Aoki's study, they even mentioned that some of their testers found the messages disturbing while at the same time some found the messages to be a mark of popularity. [WOO05]

As in Woodruff and Aoki's study, testers in this thesis study also seemed to find PoC fun. The participants were quite enthusiastic to use PoC in the future; only 14,3% of the users answered that they would probably not use PoC in the future. However, 64,3% of the users would still prefer IM to PoC. One of the reasons for IMS' popularity is the use without payment. The willingness to pay for PoC seemed to divide opinions between the testers. Those participants, who liked the PoC the most, were also willing to pay for the service the most. The right pricing is one of the key components in a way to make PoC successful.

Mobile phones still seem to have many PoC related problems. The introduction of the service is very different in different kinds of mobile phones that have different kinds of menus. Even with the opportunity of automatic settings delivery, the menus should be clear and congruent. During the test, one of the testers reported problems with one Nokia model 6131 in particular. He was not able to receive one-to-one messages when

the cover of the phone was closed. The problems with tangents in hands-free -equipments and in phones were also reported.

In the designing phase of the test some other problems were also discovered. It was not possible to create a new group by using an appropriate menu in Nokia E60. The phone responded with message: “Impossible to register a group”, even though it did not even contact the server. It was, however, possible to create a new group by choosing ‘join a group’ and then adding the requested information. This was possible even when there was no such group beforehand. Sometimes the phone even switched itself into using the phone’s own earphone, even thought there was no opportunity to choose it on the menus. Normally, the voice was transmitted through the mobile phone’s loudspeaker.

Some of the mobile phone related problems may be related to the pre-standard applications. At the time of writing Nokia does not yet have any OMA standard based PoC mobile phones at the market. However, the PoC servers, which are available at the market, are based on OMA standard. [LUU07]

The answers show that the use of PoC client in a mobile phone is not yet as easy as it could be. The users did not all know about the opportunity to send Call back request or to check the availability of their contacts. One user mentioned that she prefers IRC to PoC, because IRC offers an opportunity to talk privately to another user. This is also possible on PoC with one-to-one conversation. In the PoC application, the group-conversation is a clear option and the opportunity to one-to-one conversation is not so clearly pointed out. The initiation of one-to-one communication is more difficult than the initiation of a group communication. A user needs to save specific PoC contacts to his or her mobile phone. This should be made easier.

The users mentioned that there were sometimes quite much losses and delays. To test this some measurements were made, but no losses appeared at the measurements. The delays were quite long, even over two seconds. However, both delays and losses are highly dependant on the overall state of the network, which can vary greatly. Users must remember to push the PoC tangent the whole time of talking. The mobile phone indicates the right to speak with a “beep”-sound. In the beginning of the use, this may

be difficult to remember and thus the users may even experience significant losses. The tangent must also be pressed long enough.

Only 14 people took part in the test. Therefore, even though quite much data was collected, the results may not be totally generalisable. However, a similar type of test done by Woodruff and Aoki in the USA had only 7 participants.

8 Conclusion and future work

Based on the test results it can be said that the average user may not have much use for the PoC-service in everyday life. The service was found quite easy and fun to use, but not so many actual use situations could be found. PoC clearly is a group forming service and in order to be able to get the best value of the service the penetration should be reasonably high. This on the other hand would require that other operators in addition to Saunalahti would also offer the service. Co-operation between operators would be needed. Even thought PoC has been successful in the USA with Nextel, in Finland it is certainly in the introduction phase. Only early adopters are using the service. Nevertheless, the testers did suggest many professional groups that could benefit from this type of communication.

In the future a similar kind of study should be done with some suitable occupational group, e.g. construction workers.

At the time of writing further development of the PoC has already begun. OMA is working on the specification for PoC 2.0. The next phase will include other content than just voice and will be called Push-to-X. X could be pictures, video, data, and other multimedia. [TEL06]

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APPENDIX A

Osallistu Pikapuhe-tutkimukseen!

Etsimme Pikapuhe-palvelun hyödyntämisestä tehtävää diplomityötutkimusta varten työ-, harraste- tai kaveriryhmiä (2-1000 henkeä), joiden jäsenistä mahdollisimman monella on Pikapuhe-sovelluksen (Push to talk) sisältävä matkapuhelin (luettelo sivun alalaidassa) tai käyttävät aktiivisesti PCtä. Tutkimuksessa käytetään testaajan omaa matkapuhelinta tai PCtä ja testaajia pyydetään vastaamaan 3 kyselyyn. PCssä tulee olla mikrofoni ja kaiuttimet tai kuulokkeet. **Tutkimukseen osallistuvat saavat palkkioksi 3-6 elokuvalippua aktiivisuudesta riippuen. Sen lisäksi käyttäjien kesken arvotaan 2 kpl Nokia N93 tai N95 puhelinta.**

Tutkimukseen voivat matkapuhelimella osallistua Saunalahden, DNA:n ja Elisan/Kolumbuksen asiakkaat. Ainoana vaatimuksena on Pikapuhe -sovelluksen sisältävä puhelin ja liittymä, jossa on datasiirtomahdollisuus (GPRS, EGPRS tai 3G GPRS).

Pikapuhe on radiopuhelintyyppinen matkapuhelinpalvelu, joka mahdollistaa lähes reaaliaikaiset kahdenkeskiset ja ryhmäkeskustelut. Useimmissa uusissa matkapuhelimissa (kts. sivun alalaita) tämä toiminto on jo integroituna, mutta myös muihin S60 sarjan puhelimiin sovellus on asennettavissa.

Yhteys on yksisuuntainen ja se muodostetaan Pikapuhe-näppäintä painamalla ja pitämällä näppäin pohjassa puheen ajan. Kun näppäin vapautetaan voi toinen henkilö ottaa puheenvuoron. Viestin vastaanottaminen ei edellytä mitään toimintoa, vaan viesti kuuluu kaiuttimen tai handsfree:n kautta, kunhan Pikapuhe-toiminto vain on päällä.

Testi alkaa tammikuussa ja kestää 2-3 kuukautta. Jos olet kiinnostunut, ota yhteyttä pian! Ilmoittautuessasi kerro nimesi, osastosi ja matkapuhelimesi tyyppi sekä operaattori. Kerro myös haluaisitko käyttää sovellusta puhelimellasi vai PC:llä.

Pieni käyttöesimerkki:

Porukan voi kutsua koolle Pikapuhetta käyttäen. Kaikki saavat viestin yhtä aikaa,

vastaamatta puhelimeen.

Lisätietoja: Elina Ahonen, elina.ahonen@tkk.fi

Push to talk toimii seuraavissa Nokian puhelimissa: 5140, 6260, 6170, 7270, 6020, 6021, 3230, 6230i, N90, N70, 6101, 5140i, 6111, 6270, 6280, N91, 3250, E60, E61, E70, 7360, N71, N80, N92, 6233, 6103, 6125, 6136, 6131, 6070, N72, N73, N93, 5500 Sport, 6080, 6151

APPENDIX B

Pikayhteys
Valitse Valikko > Yhteydet > Pikayhteys.

Asetukset:
Pikayhteyden käyttäjätunnus/käyttäjänimi: oma puhelinnumero muodossa +35850xxxxxxx
Oletuslempinimi: Käyttäjän mukaan
Salasana: ei tarvitse asettaa
Toimialue: poctesti.fi
Palvelimen osoite: 130.233.16.32
Yhteysasetukset oman operaattorin mukaan, Elisan ja Kolumbuksen asiakkaiden täytyy valita yhteysosoitteeksi rlgeelab.radiolinja.fi

HUOM! Jos sinulla on www.nokia.fi-sivustolta ladattu sovellus huomioi nämä:
-Salasana-kohtaan tulee asettaa jotain
-Käyttäjätunnukseen saattaa tarvita laittaa eteen sip:

Uuden kanavan (ryhmän) luominen

S60 puhelimet: Jostain syystä uutta kanavaa ei pysty luomaan valinnalla Pikayhteyskanavat->Uusi kanava->Luo Uusi. Sen sijaan käyttämällä Pikayhteyskanavat->Uusi kanava->Lisää olemassaoleva voi luoda myös uuden kanavan. Tällöin kirjoitetaan vain haluttu kanavan nimi sille varattuun kohtaan ja osoite kohtaan kanavannimi@poctesti.fi->valmis. Lisäksi tulee valita muodosta yhteys kanavaan. Kutsuja liittyä ryhmään voidaan lähettää valitsemalla lähetä kutsu ja sieltä valitsemalla henkilöt, joille kutsu halutaan lähettää.

S40 puhelimet: Lisää ryhmä->opastettu. S40 puhelimet oletusarvoisesti lisäävät ryhmännimen perään & -merkin ja käyttäjätunnuksen, jolla ryhmä on luotu. Tämä tulee

huomioida, jos toisella puhelimella halutaan liittyä ryhmään "käsin", eli ilman liittymiskutsua. Liittymiskutsu voidaan lähettää valinnalla ryhmälista->valinnat >lähetä kutsu->tekstiviestinä. Kutsun lähetys infrapunalla onnistuu myös toiseen S40 puhelimeen.

Puhelimessa voi olla avoinna useita pikayhteys kanavia (ryhmiä). Yksi näistä on "oletus", eli kanava, jolle puhe menee, kun painetaan erillistä Push-to-talk-näppäintä (ei kaikissa puhelinmalleissa), tai tavallista soittonäppäintä. Muita kanavia voi kuitenkin kuunnella samaan aikaan. Oletuskanavaa voi vaihtaa vaihda-valinnalla (S60) tai valitsemalla ryhmälistasta jonkin toisen oletukseksi (S40). Pikayhteys palvelun voi jättää taustalle avoimeksi, jolloin haluamiaan kanavia voi kuunnella, vaikkei itse juuri silloin osallistuisikaan. Kannattaa kuitenkin huomata, että mikäli kanavalla ei ole pitkään aikaan aktiivisuutta, saattaa ns. pudota pois. Valikossa näkyy tällöin muodosta yhteys kanavaan, mutta tämän valitsemalla ei kuitenkaan mitään tapahdu, eivätkä viestit kulje. Tällöin kannattaa käynnistää koko sovellus uudelleen. Palvelimella on olemassa testi@poctesti.fi -kanava, jolle voi huudella, jos haluaa testailla, eikä ole kaveria saatavilla. Siellä yleensä on joku, joka vastailee, jos vaan kuulee.

Pikayhteys-liikenne välitetään data-liikenteenä. Yhdessä viestissä siirtyy n.10 100kB. Pikapuheen käytön hinta siis määräytyy oman liittymän datahinnoittelun mukaan.

Kannattaa huomioida myös, että kahdenvälistenpuheluiden soittaminen pikayhteystietoluettelon kautta, onnistuu vain, jos puhelinnumero/pikayhteystieto on tallennettu samassa muodossa kuin kyseinen käyttäjä on rekisteröitynyt palvelimelle. Eli kun käyttäjätunnukset nyt ovat muotoa +35850xxxxxxx, niin myös puhelimeen tallennettujen numeroiden muoto tulisi olla tämä sama. Näin ollen voi pikayhteystietovalikosta soittaa kahdenvälisiä pikayhteyspuheluita, lähettää soittopyyntöjä, sekä katsoa, onko kyseinen hlö kirjautuneena sisään.

Alla lisätietoja sovelluksen käyttöön liittyen:

Käyttäjän asetukset valikossa voit asettaa lempinimesi ja muita pikayhteyteen liittyviä asetuksia, mm. ääniä jne.

Pikayhteyspalveluun kirjautuminen Jos olet asettanut Sovelluksen käynnistys toiminnon käyttöön Käyttäjäasetukset -valikossa, pikayhteystoiminto kirjautuu automaattisesti pikayhteyspalveluun, kun se käynnistetään. Muussa tapauksessa sinun pitää kirjautua palveluun käsin.

Kun laitteen Soittoäänityyppi-asetukseksi on valittu Piippaus tai Äänetön tai tavallinen puhelu on käynnissä, pikayhteyspuheluja ei voi soittaa eikä vastaanottaa.

Yhteystietonäkymä: Jos haluat tarkastella, lisätä, muuttaa tai poistaa yhteystietoja tai soittaa kyseisille henkilöille, valitse Valinnat > Pikayhteystiedot. Näyttöön tulee laitteen Osoitekirja-sovelluksen nimiluettelo, jossa henkilöiden kirjautumistiedot näkyvät. Jos haluat soittaa valitulle henkilölle, valitse Valinnat > Henkilökoht. puhelu. Jos haluat soittaa ryhmäpuhelun, valitse Valinnat > Soita py-ryhmäpuhelu.

Jos haluat lähettää henkilölle soittopyynnön, valitse Valinnat > Lähetä soittopyyntö. Kun kirjaudut pikayhteyspalveluun, pikayhteyssovellus muodostaa automaattisesti yhteyden kanaville, jotka olivat aktiivisia, kun sovellus viimeksi suljettiin.

Jos haluat muokata kanavan tietoja, valitse Valinnat > Muokkaa.

Kanavan jäseneksi liittyminen Jos haluat liittyä kanavan jäseneksi, valitse Valinnat > Pikayhteyskanavat. Valitse kanava, jolla haluat keskustella, ja paina ääninäppäintä. Muista pitää laitetta edessäsi pikayhteyspuhelun aikana, jotta näet näytön sisällön. Näyttöön tulee ilmoitus, kun on sinun vuorosi puhua. Puhu mikrofoniin äläkä peitä kaiutinta käsillä. Pidä ääninäppäintä alhaalla niin kauan kun puhut. Kun lopetat puhumisen, vapauta ääninäppäin.

Jos haluat siirtyä pikayhteyskanavien välillä, valitse Vaihda. Aktiivinen kanava näkyy korostettuna. Jos haluat nähdä kanavan aktiiviset jäsenet, valitse Valinnat > Aktiiviset jäsenet. Jos haluat kutsua jäsenen kanavalle, valitse Valinnat > Lähetä kutsu.

Pikayhteysloki

Jos haluat avata pikayhteyslokin, valitse Valinnat > Pikayht.loki. Lokissa näkyy pikayhteyspuhelujen päivämäärä, kellonaika, kesto ja muut tiedot.

Pikayhteyden katkaiseminen

Valitse Valinnat > Poistu. Kirjaudu ulos palvelusta ja lopeta pikayhteys valitsemalla Kyllä. Paina Ei, jos haluat jättää sovelluksen käyntiin taustalle.

APPENDIX C

Alkukysymykset:

1. Käytätkö pikaviestinohjelmia ja VoIP -sovelluksia (MSN Messenger, IRC, Skype yms.)? Jos käytät, mitä?

2. Kuinka usein käytät pikaviestimiä? a) useita kertoja päivässä b) kerran päivässä c) kerran viikossa d) kerran kuussa e) harvemmin

3. Onko PMR (Walkie-Talkie) radiopuhelin sinulle tuttu jostain yhteydestä? Mistä?

4. Onko Pikapuhe (Push to talk) sinulle aiemmin tuttu jostain yhteydestä? Mistä?

5. Oletko ennemmin käyttänyt jotakin Pikapuhe -palvelua (esim. Saunalahden Pikayhteys -palvelua)?

6. Millaisissa tilanteissa olettaisit Pikapuhe -palvelusta olevan hyötyä? Millaisissa tilanteissa olettaisit käyttäväsi
Pikapuhe-sovellusta?

7. Oletko radioamatööri?

8. Muuta?

Välikysymykset:

1. Oliko palvelun käyttöönotto helppoa vai vaikeaa? Jos vaikeaa niin millaisia ongelmia ilmeni?
2. Oletko käyttänyt matkapuhelimella vai PC:llä?
3. Millaisissa tilanteissa olet käyttänyt Pikapuhe-palvelua?

4. Kenen kanssa olet käyttänyt Pikapuhe-palvelua?
5. Oletko käyttänyt Pikapuhepalvelua kahdenkeskisiin ja/tai ryhmäpuheluihin?
6. Jos olet käyttänyt ryhmäpuheluihin, niin kuinka isoja ryhmät olivat, kenestä ne muodostuivat (ystävät, työkaverit jne) ja mistä
ryhmäinformaatio tuli (kutsuitko itse ryhmän koolle, kutsuiko joku muu, kuinka sait tiedon)
7. Onko Pikapuheen käytössä ollut hankaluuksia?
8. Muuta mieleen tulevaa?

Loppukysymykset:

1. Miltä tuntui käyttää Pikapuhetta?

2. Asteikolla 1-5 (1=epämukava, 2=melko epämukava, 3=ei epämukava, eikä mukava, 4=melko mukava, 5=mukava), arvioi palvelun käyttömukavuutta.

3. Millaisissa tilanteissa käytit Pikapuhetta?

4. Kenen kanssa olet käyttänyt Pikapuhe-palvelua?

5. Oletko käyttänyt Pikapuhepalvelua kahden keskisiin ja/tai ryhmäpuheluihin?

6. Jos olet käyttänyt ryhmäpuheluihin, niin kuinka suuria ryhmät olivat, kenestä ne muodostuivat (ystävät, työkaverit jne) ja mistä ryhmäinformaatio tuli (kutsuitko itse ryhmän koolle, kutsuiko joku muu,
kuinka sait tiedon)

7. Kuinka kaukana vastaanottaja/ryhmän jäsenet olivat?

8. Käytitkö toimintoa, jolla on mahdollisuus tarkastella yhteystietoluettolosi/ryhmän jäsenten tilaa (online, offline jne.)?

9. Kuinka hyödyllisenä pidät mahdollisuutta tarkastella yhteystietoluettelosi jäsenten tilaa? 1=täysin hyödytön, 2=melko hyödytön, 3=ei hyödytön, eikä hyödyllinen, 4=melko hyödyllinen, 5=erittäin hyödyllinen, perustele

10. Käytitkö mahdollisuutta lähettää soittopyyntö (call back request)?

11. Kuinka hyödyllisenä pidät mahdollisuutta lähettää soittopyyntö? 1=täysin hyödytön, 2=melko hyödytön, 3=ei hyödytön, eikä hyödyllinen, 4=melko hyödyllinen, 5=erittäin hyödyllinen, perustele

12. Kuinka Pikapuhe sopi käyttämiisi tilanteisiin?

13. Oliko Pikapuheen käytössä hankaluuksia?

14. Arvioi asteikolla 1-5 käyttäisitkö Pikapuhetta jatkossa (1=varmasti en käyttäisi, 2=todennäköisesti en käyttäisi, 3=en osaa sanoa, 4=mahdollisesti käyttäisin, 5= varmasti käytän)? Miksi/miksi et? Jos käyttäisit, niin millaisissa tilanteissa?

15. Arvioi Pikapuhe-palvelua asteikolla 1-5 seuraavista näkökulmista:

Hyödyllisyys: 1=täysin hyödytön, 2=melko hyödytön, 3=ei hyödytön, eikä hyödyllinen, 4=melko hyödyllinen, 5=erittäin hyödyllinen

Käytettävyys: 1=erittäin hankala käyttää, 2=melko hankala käyttää, 3=ei vaikea, eikä helppo käyttää, 4=melko helppo käyttää, 5=helppo käyttää

Toiminta: 1=ei toiminut kunnolla, 2=useimmiten ei toiminut kunnolla, 3=toimi kohtalaisesti, 4=toimi melko hyvin, 5=toimi hyvin

16. Kenelle arvioisit Pikapuhe-palvelusta olevan eniten hyötyä?

17. Oliko käytön hinnalla sinulle merkitystä? 1=oli paljon merkitystä, 2=oli melko paljon merkitystä, 3=oli vähän merkitystä, 4=ei juurikaan merkitystä, 5=ei ollut merkitystä

18. Paljonko olisit valmis maksamaan palvelun käytöstä?

19. Millainen liittymätyyppi sinulla on, minkä hintaista datasiirto liittymässäsi on?

20. Maksatko puhelinlaskusi itse vai maksaako joku muu?

21. Mistä pidit erityisesti?

22. Mistä et pitänyt?

23. Parannusehdotuksia?

24. Jos käytät muita pikaviestimiä (MSN Messenger, IRC, ICQ yms.), niin kuinka käyttökelpoisena pidät Pikapuhetta näihin verrattuna? 1=käytän mieluummin Pikaviestimiä, 2=käytän useimmiten mieluummin pikaviestiä, 3=yhtä käyttökelpoisia, 4=käyttäisin useimmiten mieluummin Pikayhteys-palvelua, 5=käyttäisin aina mieluummin Pikayhteyspalvelua, perustele!

25. Innovoi: Keksi 3 eri käyttäjäryhmää/ammattikuntaa/harrasteryhmää, jotka mielestäsi voisivat hyötyä tällaisesta palvelusta.

26. Muuta?

Lopuksi muutamia taustatietoja:

27. Ikäsi?

28. Oletko opiskelija vai työssäkäyvä?

29. Oletko kiinnostunut uudesta tekniikasta, ostatko uusia teknisiä laitteita/otatko uusia teknisiä toimintoja käyttöön

a) heti niiden ilmestyttyä

b) melko pian laitteen ilmestyttyä ja sen jälkeen esittelet tuotetta muillekin

c) vähän myöhemmin, kun joku on kehunut niitä sinulle

d) Vasta kun useimmat tuttavistasi ovat hankkineet kyseisen laitteen

e) vasta kun kaikilla/lähes kaikilla muillakin on