EVALUATION FRAMEWORK FOR A MOBILE MARKETING APPLICATION IN 3RD GENERATION NETWORKS

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Abstract: Testing of a software application serves the accomplishment of two distinct objectives: ensuring functionality and end-user acceptance. However, with an increasing desire for mobility by the society, a new context is influencing application design, programming and testing. Even though methods for designing and implementing PC-based software can be applied to mobile applications and services, testing and evaluation methods do not take the specific characteristics of mobile usage into account. Acceptance and usability issues are especially important for mobile marketing applications, since they should create a positive feedback and added value for the user. Therefore, we suggest an evaluation framework for mobile marketing applications using the newly developed application "V-Card" as an example. V-Card enhances mobile messaging by allowing users to adapt pre-produced multimedia content in a personal way with text, sound and pictures. The marketing aspect is introduced by incorporating a sponsoring model to reduce the costs for sending messages. As a result, the evaluation framework not only aims to measure the perceived added value, but in addition to this the acceptance of advertising.

1 Introduction

While telephony is still the primary use for mobile phones – unlike, for example, PDAs or laptops – the devices nevertheless have become more powerful in terms of processing power and software equipment. The latter not only encompasses the applications already installed on the mobile phone, like e-mail client, browser, multimedia player or messaging software. It also includes the ability to let the user install additional 3rd party software.

The market for mobile applications is still rather new, which makes testing all the more necessary. Products that do not meet user expectations (due to their quality or over-confident marketing) may damage the producers' reputation or even that of the entire market. One example for this is the Wireless Application Protocol (WAP), which was announced as the "Internet on mobile phones". In reality, device and network limitations only allowed for a service that did not nearly resemble the World Wide Web. Moreover, initial costs were high and service quality, such as availability and usefulness, low. As a

result, WAP services are hardly accepted by the users today, although most of the problems have been remedied and many interesting services have emerged.
In order to avoid similar miscommunication, testing a new service or application is advisable, with testing activities grouped into three categories. The first category consists of basic functionality tests, which ensure that the application is working and does not contain any errors in the business logic. Usability tests form the second category. Here, the graphical user interface (GUI) and interaction with the application are in the focus of the testing process. Finally, dedicated end-user tests make sure the application meets the demands of the market and gathers feedback for further development and enhancements.
Testing software is generally an important task, and is part of all software development models. Plan-driven software development (e. g. CMM, PSP or DoD) incorporated the concepts of verification (confirming that the product works) and validation (confirming the fitness of a product for its operational mission), whereas agile software development (e. g. XP, ASD, Crystal or Scrum) propagates test-driven development with tests carried out continuously and jointly by the developers and customers. [BT03] Furthermore, error-free software contributes to the user satisfaction, which in turn increases the quality of the application and the chance of using it again. [BD91]
While an error-free application is necessary for a successful market introduction, it is not sufficient. The second and third categories ensure that using the application satisfies the users needs and that the usage itself does not introduce additional obstacles. Identifying the users needs in an established market is easier than doing so for a new market segment. With regard to mobile applications, experiences made with 2G-application usage could be transferred to 3G networks, providing preliminary information for deciding what application to develop. The unique qualities of 3G networks (e. g. greater bandwidth, limited coverage compared to 2G networks), however, require post- and inter-development testing to see whether the application makes use of these qualities and if the initial estimates about the user needs were correct.
One possible initial estimate made from 2G could be the desire to communicate via short messages (SMS). Studies have analysed the reasons for sending SMS, finding that the main purpose was social interpersonal communication. [Dö02] [HR01] Additionally, the number of mobile messages is increasing steadily. According to figures from the Mobile Data Association MDA [MD04] an average of 58.5 million short messages were sent each day in October 2003 from users in the United Kingdom, compared to 50 million in October 2002 and 38 million in October 2001.
For the entire year 2003 MDA estimates that about 20 billion messages will have been sent. The total number of chargeable person-to-person text messages sent across UK GSM network operators O2, Orange, T-Mobile and Vodafone during the period between midnight on 31st December and midnight on 1st January, was 111 million, nearly two times the 2003 daily average and an 8% increase on the previous year.
In Germany, a study published by the VATM shows messaging contributing 14.3% to the entire revenue of all operators. This percentage is estimated to increase to 15.8% in 2003. [DV03] And according to the Swiss-German research firm Soreon, mobile data revenues (including SMS, MMS and 2G/2.5G data transmission) in Germany will reach 3.7 billion Euros during the year 2003. SMS services, ring tones and similar services are expected to generate annual revenues of 11 billion Euros in Germany by 2007. [So03]
Transferring these figures to 3G networks suggests that messaging will utilise multimedia content and that the Multimedia Messaging System MMS will replace

SMS. [Le03] [Lo03] Currently, MMS allows the transmission of short messages containing multimedia content, such as audio clips, short videos, pictures and formatted text. Available handsets, on the other hand, do not foster the creation of complex content. While most of the recent devices feature a built-in digital camera, most still lack the capability to play and record videos. Furthermore, the user is restrained to his current context, making it impossible to create content from other sources than the present or already visited surroundings. Hardware limitations of the devices prohibit extensive storage of content, whether self created or acquired over other sources. As a result, the user has no access to a multimedia library, which could theoretically offer him the required resources. With V-Card, the aim is to offer customers a service for customising multimedia content. By providing an extensive library of various media, these media can be easily adapted to the users wishes before sending the message to the receiver. In order to lower costs for both, the creator and the recipient of the message, a sponsoring model will be implemented. Sponsoring could be achieved by displaying a short trailer before or after the actual message or by providing content related to the sponsor (e. g. a mascot, a logo or colours associated with the sponsor). [MNK03]
To test the V-Card application, a method for measuring the user acceptance of mobile marketing applications for 3G networks is developed. The following section will discuss relevant definitions and concepts that are necessary for doing so. Drawing from the experiences related methods – described in the third section – offer, a first test scenario will be drafted in section four, taking into account the definition of the target group and the test design itself. Finally, the conclusion in section 5 will point out further research that is required and planned.

2 Concepts and Definitions

Lehner offers the following definition of a mobile application: “Mobile or also called wireless applications describe an entire spectrum of computer-supported solutions in the profit and non-profit area that distinctively uses wireless communication technologies (e. g. handheld computers or mobile phones). The term „mobile“ indicates that a user is not tied to a specific location.” [LJ02] According to this definition, a mobile application can also be a service for mobile devices that is offered by a provider, even a service that relies on other applications already installed on the mobile device. V-Card, for example, requires a device capable on sending and receiving MMS. Therefore, V-Card and the MMS client itself are both mobile applications.
V-Card is a sublimated message- and lifestyle service, offering the users an easy platform for communication. To explain the advantages of the system in contrary to simple MMS composition on the subscriber’s handset without using the system, some of the main problems faced by users of MMS-enabled handsets are addressed:

- The composition of an MMS is far more complicated on a mobile handset than the composition of an SMS. Since MMS allows text formatting, it is necessary to include different menus in the composition/editing framework. Relatively easy tasks in a word processing software on a personal computer are more difficult on a mobile handset, simply due to the lack of input devices like an alpha-numerical keyboard or a mouse. Highlighting text and changing its properties are fairly easy with a pointing device and enough space on the display for menus, but quite difficult on a tiny display, a number pad and simple cursor keys.
- Another problem mobile subscribers face today is the collecting of media with the mobile handsets. Since the memory resources of mobile phones are limited, not all pictures ever received or photographed can be stored permanently.
- One big advantage of MMS in comparison to SMS is the possibility to employ additional means of communication. MMS allows feelings or moods to be expressed by choosing the appropriate colours, sounds or pictures which are to be included in the message. This also brings with it many situations that can be visualised or expressed. Collecting media for all these would be almost impossible in terms of time and amount of data. Therefore it would be necessary to search for the appropriate media each time a new situation occurs, which has not been covered previously. This point is made even more complex by the fact that messages may incorporate continuous media (video, audio).

Figure 1 shows the V-Card core architecture and illustrates the workflow. First, the user with a mobile device requests a personalised application via the SMS Centre (SMSC) or MMS Centre (MMSC), which are part of the mobile network infrastructure. The message is passed on to the V-Card core, where the connector decides which application has been called. After the request is passed on to the appropriate application (1), it is logged in the message log. A parser receives the message (2), extracts the relevant data for customisation, and returns this data (3) – this could include the receivers phone number, the name of the sender or a message. Then, the capabilities of the receiving phone are queried from a database, which holds all relevant data (4+5) like display size, number of colours and supported video- and audio codecs.

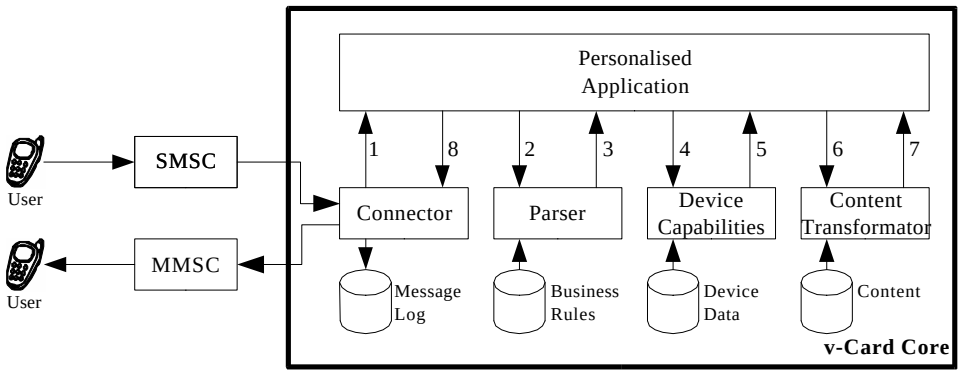

Figure 1: V-Card Architecture

A main drawback with the device data is, that the sender has to know which mobile phone the receiver is using. To prevent this, a possible solution is to allow only registered user to receive a message. During registration, the user has to specify the device he is using. After that, the sender only needs to transmit the receiving persons user identification, the system automatically looks up the needed device parameter.
Finally, the application transmits all the data gathered to the content transformator. Here, the pre-produced content is tailored with the input delivered by the user according to the capabilities of the device (6+7). The result is then sent via the connector (8) to the receiving user. Since the personalised applications and the data are separated, new applications can be easily created. Basically, all that needs to be added are business rules for the parser and additional content, if so required. The database for devices only needs to be updated if a new device becomes available or if a new user registers for the service.
Content transformation is the essential part of the V-Card core. Basically, this could be transforming text, pictures, audio or video – or any combination thereof. While the modification of text is rather simple (by filling in the data from the parser into a template), transforming pictures is more difficult, depending on the type of picture. Rendering text to fit into the theme of the picture is relatively easy to achieve. Embedding a face into a picture is a little more complex and depends on the quality of the material delivered by the user. Due to the small size of the display, artefacts will be less noticeable though.
Since V-Card also has the ability to transmit personalised J2ME applications via MMS, it surpasses the capabilities of pure MMS messages creating added value for the user, which normally do not have the possibility to create or modify Java programs. One example is a sliding puzzle where, after solving the puzzle, a user may use the digital camera of the mobile device to change the picture of the puzzle. After the modification, the new puzzle can then be send via V-Card to other receivers. Still, as mentioned above, V-Card requires a MMS client. It can therefore be regarded as an enhancement or improvement for MMS communication and is as such a competitor to the “normal” MMS. Hence, the evaluation framework should be usable to measure the acceptance of both “normal” MMS messaging and “enhanced” V-Card messaging, creating results that can be compared with each other to determine the actual effect of the added value hoped to be achieved with V-Card.
The next section discusses approaches to evaluate customer acceptance of newly designed applications. While extensive research exists regarding PC-based software, mobile applications currently lack comprehensive methods for creating such evaluations.

3 Related Work

Amberg et al suggest a concept for measuring customer satisfaction. [AHW03] They have identified four major items that are queried before and after the use of a mobile service (perceived usefulness, usability, cost and mobility), where each item is an aggregation of several acceptance criteria. This way, the perceived values of a potential customer, who has no previous experience with the service, can be obtained as well as the actual values that occur after or while using the service. By plotting the results in a star diagram, with better result values closer to the centre of the diagram, different services can be compared and problems become identifiable. Figure 2, for example, shows the result for the Short Message Service. The users rated both usability and costs for the ser-

vice higher before actually using the service. After sending and receiving several messages, however, costs accumulated and usability was rated lower, indicating issues that could be improved.

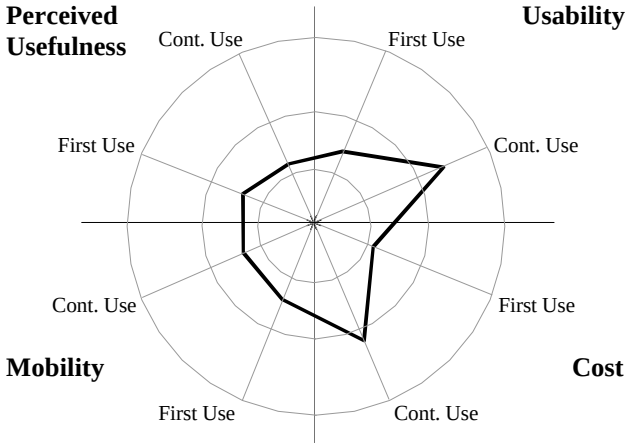

Figure 2: Evaluation of the Short Message Service [AHW03]

Other evaluation methods are less focused on mobile applications or services, but address the acceptance of software on a more general basis. Examples include the concept of perceived usefulness and perceived ease of use by Davis and the Task-Technology Fit concept by Goodhue. [Da89] [Go95] [GT95] Although the perceived ease of use most likely has an impact on the usage of the application, the perceived usefulness could generally be considered low with marketing applications: Döring [Dö02] notes that creating a SMS is mainly found to be a positive activation from boredom by the user.

In the study, five different communicative functions were extracted. Dominating with 54% of all text segments is the contact function that focuses on the relation between sender and receiver. 40% of all SMS contained information about the current location or were asking for such information. The second most common function is about the exchange of facts - the informative function. These types contain messages offering information or asking about the current situation, which were normally not communicated before the advent of mobile telecommunication. Third, the appeal function asks the receiver for specific support. Fourth, the obligation function contains an element that creates a self-commitment.

Mostly, the identified functions were aimed at inter-personal communication that does not correlate well to the definition of “usefulness” or “goal-directed individual tasks” which both aim at the benefits of new IT systems for the users work. Therefore, neither Davis’ nor Goodhue’s approach are directly applicable for evaluating a mobile marketing application, although for the method developed, some items were re-used (esp. items to measure the perceived ease of use).

4 An Evaluation Framework

The evaluation framework described below can be split into two segments. In the first segment, the target group for evaluating mobile marketing applications is being defined. The composition of the test group is determined either by the intended audience of the application, or, if such specifications do not exist, by projecting the current user demographics of 2G mobile networks onto the initial uptake of 3G networks. While the predefined audience for an application varies and cannot be generalised, such a case will not be discussed here. Instead, the initial demographic of the first 3G users are projected.
The second segment discusses the actual evaluation procedure, which consists of an implementation of use cases [Co00] and a questionnaire. With the use cases, typical situation should be modelled without restraining the user too much. Therefore, the use cases are formulated in an unspecific way and allow the user to be flexible and creative. The questionnaire on the other hand is intended to collect statistically analysable data, which helps to compare different applications in a more objective manner.
All the use cases discussed below are specifically targeted at the V-Card application and MMS messaging. If another type of application is subject to testing, other use cases that cover typical usage need to be created and applied. Such modifications are not necessary for the questionnaire. It can be applied to mobile marketing application and possibly to mobile applications in general, although this should be subject for further research.

4.1 Definition of Target Group

Based on a survey of the Internet Business Group FORIT [Fo00] in 2000, the general mobile user profile can be determined by a few key factors. As the mobile communication market was already well developed in 2000, the following figures are regarded as being relatively stable. The group of mobile users, primarily mobile phone users, is composed of 63% men and 37% women. The younger generation between 21 and 30 (24%) and the adults between 31 and 40 years (32%) dominate the profile. The FORIT survey also shows that 34% of mobile phone users possess their phone for more than 3 years. Based on this and the statement that the average monthly phone bill will increase with the time the users own their mobile phones, FORIT identified 9% of the population as "M-Commerce Early Birds". This segment is probably the most attractive for future mobile commerce applications. These Early Birds are part of the first generation mobile phone users and will most likely also be first in using their device for new mobile services. This segment contains 24% women and 55% of the segment is between 21 and 40 years old.
Another survey in 2001 among students of the University of Regensburg describes similar results. 5-18% of the mobile device owners can be identified as so-called "Mobile Pioneers" which have experience in this field for three years or longer. Men dominate this segment and its members are also more open towards mobile marketing and sponsoring to lower costs. Because students comprised the basic population, the average age can be defined between 20 and 28 years. The survey also revealed that there is a medium intense correlation between the gender of the respondents and their actual experience with the WAP technology.

Especially for mobile applications on 3G networks, the market research institute Forrester stated in their new Technographics Report [Ja03] that the early adopters of 3G technologies in the European countries could be separated in two main groups. Young women will dominate the first one, which is primarily interested in entertainment services on top of placing voice calls and sending text messages. The second group are young men, which primarily use the new technologies to help them organise their everyday work tasks, to communicate with colleagues and to identify them as an innovative person.

Based on the results of these studies, we suggest certain socio-demographic characteristic for a mobile marketing application evaluation group. The interviewed persons should not be older than 30 years and men and women should proportionally compose the group. Although the men in this age class are more open towards new technologies, women are more interested in mobile entertainment services. [GS97] [Ha03] Everyone in the test group should have prior experience with a mobile phone, since 3G users are most likely upgrading from 2G. After the network operators have introduced 3G services and new customers that never had a mobile phone before enter the 3G market, this particular restriction no longer applies.

The aforementioned characteristics are designed to create a test group resembling an early 3G market. They do not take into account if the application or the service is created and designed with a specific and possibly different target group in mind. Depending on the desired target group for users of the new application, it is possible this target group might not contain the available users or needs to be redefined to match the requirements. If this is the case, the sample group can be recruited from current mobile phone user that will supposedly switch to 3G after a few years. One example would be an application intended for business usage. Alternatively, the sample group could consist of "Early Adopters" to project the initial uptake of usage after the application has been introduced into the market.

Determining the size of a sample group is also of relevance. While there are formulas to calculate the minimum number of people in a sample group [En03] [Fr80], Kraemer notes that there are other constrains that influence this number. [KT87] These are, for example, limitations in the budget and time restraints. Even though an increased sample size will provide more precise results, the improvement is neither linear nor compulsory. The quality of the analysis will only be doubled if the sample group contains four times as many subjects – and the normal precision could already be sufficient, making the increased effort unnecessary.

The following formula is used to calculate the desired sample size N. s represents the standard deviation, z_{crit} the standard normal deviate and D the total width of the confidence interval. [En03] [KT87] [SC67] It should be noted that the sample size is for statistical reasons independent of the size of the population. [BEE01]

$$N = \frac{\left(4 S^2 \cdot Z_{crit}^2\right)}{D^2}$$

For evaluating V-Card (with the evaluation being a descriptive study designed to calculate the median value), a 30% confidence interval is deemed sufficient (D = 0.3). The desired significance criterion is 0.10, resulting in $z_{crit} = 1.645$. Results from pre-tests suggest a standard deviation of s = 0.5 on a 5-point Likert scale. The desired sample size

using the formula above is therefore calculated to be 30 persons ($4 * 0.5^2 * 1.645^2 / 0.3^2$) All of the 30 individuals should be aged 20 to 30 years, own a mobile phone and can be determined by following the cut-off method which limits the selection to those elements of the population that are the most relevant for the analysis.

4.2 Test Design

The test of the application will be conducted in two phases, in order to create measurements for V-Card (phase 1) and normal MMS operation (phase 2) as mentioned in section 2. In the first phase, the quality and appropriateness of the application should be measured. The second phase then collects data from the same group, which is then using already established software. This way, the benefits of the new application can be determined. In case of a novel application that has no related predecessors or other alternatives, the second phase can be omitted. For V-Card, the MMS clients of the mobile phones used in the test are subject for evaluation during the second phase to back up the claims that V-Card will offer an improved communication.
During the first phase (quality assurance), presenting use cases to the group will simulate real life usage unless the group already starts using the application without stimulation from the supervisors. A total of three use cases, each scheduled to take approximately 10 minutes to complete, make up the test scenario. The first use case is used as a simple introduction to the device, the network and the application. The second and third use cases already require some familiarity with both the device and the application. Both use cases demonstrate the extended features of V-Card and evaluate the ability to refine the communication process. When employed in the first phase, the phrase "[the application]" will be replaced with "V-Card", whereas "the MMS client" will replace it during the second phase.

1. Send a message with greetings using [the application] to one of your friends.
2. You plan to meet with several of your friends tonight. Use [the application] to send an appropriate message to at least 3 people.
3. You just received a nice message and you want to re-use it. Forward the message with [the application] to at least one other person.

After completing the use cases, the group can use the application for another 10 minutes without restrictions. Then the group is presented with a questionnaire that has to be filled out. All items are listed in the appendix and were generated by reviewing literature and interviewing experts. Additionally, items suggested by Davis [Da89] to measure the perceived ease of use were incorporated.
The questionnaire is divided into seven section, each containing four or three questions: Basic Data, Perceived Ease of Use, Cost, Mobility, Perceived Usefulness, Marketing and Privacy. At first, basic data about the test person is gathered, with a focus on monthly expenses and messaging activities. As discussed above, the next section tries to obtain data about the perceived ease of use. Note that the usefulness is not related to helping complete a task, but to create an appropriate message that fits the users needs. The section about costs tries to determine whether the user accepts sponsoring and what the

maximum costs per message should be. Naturally, the amount entered here can only be a rough estimate. The questions about mobility are meant to evaluate the usability outside the test situation.

Each of the last two sections, Marketing and Privacy, tries to measure how much marketing content is accepted by the user and how much data about themselves the users are willing to give to the service provider. As with any marketing service, the provider of this service has an advantage if trusted by the user. With V-Card, the competing technology is MMS, which is offered by the network operator. They already have data about their users and were able to gain trust. By choosing a certain provider, the user has already shown a clear preference for this operator. 3rd party application provider are, in this case, at a slight disadvantage.

Using the same questionnaire for all persons in the test group tries to ensure the objectivity of the method. To increase the objectivity, also the use cases are given to the test group in printed form. Moreover, the entire group is to be separated into smaller groups that are asked to wander around, as the application needs to be tested in a mobile context. To provide basic assistance in case of network or device failures, a test supervisor accompanies each group. Therefore, the results of the entire group are not solely depending on a single supervisor.

Objective measurements can also be obtained by analysing the logfiles of the servers (WAP gateway, MMS centre etc.). With these, the total time needed to complete a task and the error rates as well as the reason for the errors are determined. Consequently, the application can be improved afterwards to help the user avoid the most common errors. The identification of the sources for errors is also needed for the explanation of the results, for example if network or device failures reduce the achieved scores.

For the second phase (added value analysis), the same test group is asked to complete the same three use cases using the applications that should be compared with the new application – in this specific case a “normal” MMS client. A possible distortion of the results might occur depending on which application is tested first and which is tested afterwards. Theoretically, the users gain experience with the device and the usage during the first test that may help them with the second test, especially when they are unfamiliar with the device, as it is the case with the new 3G mobile phones. Thus, the perceived ease of use could be better with the second application improving the results somewhat. Switching the order in which the applications are tested in a number of groups helps to identify the effects by calculating the correlation coefficient. As V-Card is an improvement over the already established MMS service, the effects can be considered neglectable, since the persons in the test group are already familiar with creating and sending short messages.

Comparing the results of both tests will show if the end users also perceived the improvements as planned. Should published values of the test be already available, they could be used for reference – if the number of people in the test group is sufficiently large, it is also possible to compare different results gathered in studies of the first phase. If the network and the devices facilitated in both tests are identical, the second phase can also help to eliminate influencing factors, especially if both phases can be conducted at the same time and the same test site.

5 Conclusion and future work

Testing mobile applications with regard to functionality and end-user acceptance is an important part of the software development process. Especially applications incorporating marketing aspects require acceptance, because their aim is to create a positive image of the featured product or brand and performance problems or applications errors diminish or even negate this effect. Within the mobile context, additional challenges appear. First and foremost, mobile device are regarded as trusted, personal devices by the user. As a result, the protection of privacy and data security are important aspects for customers. [BF02]

The suggested framework can be used to evaluate mobile marketing applications and an adoption for testing mobile applications in general seems possible. A practical implementation of the framework by testing both V-Card and MMS is planned and will be the next step in refining both the questionnaire and the framework. Future research might also focus on including additional items to examine aspects not yet covered. For example, one issue when testing mobile applications over a relatively new infrastructure is the available hardware. Not only does a newly implemented network infrastructure introduce the possibility of new errors – which are unrelated to the application but may be attributed to it by the user. It also presents a problem of acquiring a sufficient amount of end user devices for testing, especially if the test design requires the simultaneous use of multiple devices. Hardware aspects are currently not a topic within the framework, but could become one if necessary.

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Appendix

Basic Data
I own a mobile phone for X years / I don't own a mobile phone (skip next 3 questions)
I have a regular contract/pre-paid contract
I spend approximately X Euros per month for my mobile phone
I send approximately X messages (SMS and MMS) per month

Perceived Ease of Use
Learning to operate [the application] was easy for me
I found it easy to get [the application] to do what I want it to do
It would be easy for me to become skilful at using [the application]
I found [the application] easy to use

Cost
I would pay a maximum of X Cent for using [the application] once
I would accept sponsoring for [the application] if it reduces the costs
I find it fair if longer, extensive usage is more expensive than short, quick usage
I would accept it if additional features cost more

Mobility
I found [the application] reacted fast enough
I thought the transmission of data for [the application] took too long
I could use [the application] while in motion
I can use [the application] quickly whenever I want to

Perceived Usefulness
I was able to use [the application] in a way that exactly fitted my needs
I had everything I needed to achieve the outcome I wanted
I would use [the application] regularly in my everyday life

Marketing
I would recommend [the application] to my friends
I don't mind if [the application] contains some advertising
I would give the provider some data about me if that would be necessary for using [the application]

Privacy
I have concerns about my privacy when using [the application]
I fear that using [the application] will cause unwanted effects
I know and trust the service provider of [the application]