Comparison of Different Approaches for Mobile Advertising

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Abstract

Mobile terminals, such as cellular phones and PDAs, have an enormous advertising potential: they are extremely popular and most people carry such devices with them all day, enabling personalized advertising. However, there is a serious danger that the Spam wave, known from e-mail communication, will spillover to mobile devices. In addition, it is important to take protection of private data seriously, because mobile terminals are also used for personal communication. In this article we discuss the special features and challenges of mobile advertising and introduce the MoMa-system for mobile advertising. MoMa supports personalized advertising using context information while guaranteeing data protection. We also name criteria for the comparison of mobile advertising systems and apply them to compare MoMa to other approaches.

1. Introduction

Advertising is defined as the non personal presentation of ideas, products and services, whereas the identifiable originator has to pay for it [15]. Mobile or wireless advertising is advertising using mobile terminals like cellular phones and PDAs as target platform. There are a couple of reasons why many experts consider mobile advertising as an encouraging branch of mobile business:

• **High penetration rate of mobile terminals:** Mobile terminals – especially cellular phones – are quite popular. According to the International Telecommunication Union (ITU) the worldwide number of mobile phones is far beyond one billion. The average penetration rate in western Europe is about 83 % [9]. For Luxemburg there is even an estimated penetration rate of 101 % [8], so there is a trend towards multiple devices per user. Such figures may include inactive subscriptions but they indicate: there are quite a lot of mobile terminals.

• **Mobile terminals are personal communication devices:** People carry their mobile device along most of the day and seldom lend it away or share it with other people, so mobile advertising can reach people almost anytime and anywhere. Conventional advertising like ads in newspapers or commercials on television can reach people only in certain situations and within certain time spans, e.g. TV-commercials reach people when they are sitting in front of their TV-set after work.

• **Individually addressable:** Mobile terminals can be addressed individually, so personalized and target-oriented advertising can be realized. Using conventional advertising very often people are reached that aren’t interested in the presented good or service.

• **Multimedia capabilities:** Some mobile terminals are able to play back multimedia content, e.g. little movies or jingles. In the future the number of terminals with multimedia capabilities will increase. Also the emerging mobile networks of the 3rd generation like UMTS promise enormous bandwidths for the transmission of such content.

• **Interactive:** Mobile terminals enable interaction. When one receives an ad on his mobile terminal about a service he is interested in, he can immediately request further information or forward the ad to friends. There are mobile advertising campaigns which try to exploit this viral or "word-of-mouth"-effect, e.g. the "Wella Virtual Kiss"-campaign by 12snap [17].

However there are also some serious challenges when talking about mobile advertising:

• **Spam:** The tremendous amount of spam-message in e-mail-communication is a big problem. There are studies that state values of far beyond 50 % for the portion of spam message, for example [16]. A survey recently conducted "[…] indicates that more than 8 in
10 mobile phone users surveyed have received unsolicited messages and are more likely to change their operator than their mobile number to fight the problem [...] [13]. Spam messages on mobile terminals are a bigger problem than on ordinary computers because of their limited resources due to their size and mobility (bandwidth, battery capacity, memory for storage of messages, computation power).

- **Limited user interface:** Mobile terminals have a very limited user interface, e.g. small display, no full keyboard. Most users won’t be willing to enter a lot of data using that limited interface. One way to assist the user when entering data is the usage of context information.

- **Privacy concerns:** Because of the personal nature of mobile terminals privacy concerns are very important for mobile advertising. End users will only provide personal data when data protection is guaranteed. Other privacy concerns occur if mobile terminals are located [2]. There are also legal requirements concerning privacy, for example the OECD "Guideline on the protection of privacy and transborder flows of personal data" or the "Carter of fundamental rights of the European Union".

- **Expenses of mobile data communication:** Today the usage of mobile data communication is still very expensive (e.g. about one Euro for 1 MByte data traffic when using GPRS or UMTS, 0.20 Euro for sending a SMS or 0.40 Euro for a MMS). This prevents many people from using mobile devices for internet research on products and services. Again nobody wants to pay for advertisement, so the advertiser should pay for the data transportation.

The mentioned features and challenges of mobile advertising show an area of conflict: personalized advertising requires sensitive information about the end user, e.g. the end address of his mobile terminal, his fields of interest or his current location. On the other side there are privacy concerns when providing this information for a mobile advertising application. Within the Project "MoMa – Mobile Marketing" we develop a system for mobile advertising which gives consideration to both sides.

The rest of this article is organized as follows: in the second chapter we give an overview about related works concerning mobile advertising. Chapter three discusses different approaches of mobile advertising. The MoMa-System itself is introduced in detail in chapter four. In chapter five we name criteria for the comparison of mobile advertising systems, which are applied in chapter six. The last chapter gives a summary and draws a conclusion.

2. Related Work

The high potential of mobile advertising and its specific opportunities and challenges are widely accepted in literature, see [3, 23, 27, 26] for example.

The delivery of ads via SMS [4] is today’s most common form of mobile advertising, e.g. misteradgood.com by MindMatics. SMS is very popular – in Germany approximately 20 billion SMS were sent in 2003 [9] – but the length of the text messages is limited to 160 characters and images can’t be shown, so it shouldn’t be the only used channel in a marketing campaign [7]. There are so called "On-Pack"-campaigns where consumers can request digital advertising gifts like games, ring-tones or wallpapers by sending a certain code printed on a package of a bought product via SMS to a certain number.

**Location Based Services (LBS)** use information about the current location of an user to provide information concerning that location (e.g. [5]). This information could be retrieved using a GPS-receiver or with knowledge about the ID of the currently used cell of a mobile network. For advertising a LBS could provide an user with advertisement concerning shops in his nearer surrounding (e.g. [14, 1, 25]). LBS are the most prominent case of context sensitive applications [21], which use information about the current situation of an user to adapt themselves according to the needs of that user. MoMa isn’t restricted to location as the only context-parameter.

Some approaches even provide a monetary incentive to the consumers for receiving advertisement like the above mentioned misteradgood.com or the one described in [6]. The "Shopping Jacket" [19] is an advertising system based on "wearable computing". Other concepts of mobile advertising will be mentioned in chapter 3.

A very important concept when talking about mobile advertising due to the experience with unsolicited messages in direct-marketing and especially spam-e-mails is permission marketing [10]: consumers have explicitly to opt-in to receive advertising and can opt-out at anytime.

3. Different approaches of mobile advertising

In this chapter we will discuss different generic approaches of mobile advertising (see also Figure 1). On the first level we distinguish by the kind of communication mode used:

- **Broadcast:** broadcasting means that the same data is sent to all terminals in the whole network (global broadcast, e.g. DVB-H) or just a part of it (local broadcast) in a cellular network like GSM. An example for a local broadcast would be a cell broadcast whereas all terminals in the same cell of the mobile network would receive a certain message. This could be used...
for some kind of location based advertisement, e.g. when the broadcast cell is rather small in a city and there is a store in that cell which wants to announce a special offer to all users currently in that cell. Especially for global broadcasts of advertisement messages it could make sense to use a local application as a filter, so only ads are displayed that match the profile of the user.

- Mobile ad hoc networks (MANET’s) don’t require installed infrastructure like base stations, cables or routers. If the distance between two devices is short enough they can establish a peer-to-peer communication using a standard like Bluetooth or WiFi. Even indirect multi-hop communication is possible, if device A transmits data to B, which forwards it to C, if C can’t be reached by A directly. This kind of communication can be used for the distribution of advertisement following the concept of viral- or word-of-mouth-advertising [12]. The idea is that ads aren’t directly sent from the advertiser to the consumers, but that consumers send them to other consumers, leading to an dissemination with exponential growth. It is assumed that when someones gets an ad from a friend he is more likely to believe in the statement of the ad than if he got the same ad from the advertiser directly.

Examples for advertising-systems based on that idea are ”AdPass” [22, 11] or ”eNcentive” [20]: consumer A visits a store, where his mobile terminal receives an advertisement about a certain product from an ”information sprinkler” installed by the owner of the store. Some time later A stays in the same room as person B also equipped with a mobile terminal running that MANET-advertisement-application. The ad is automatically transmitted. B’ s device can also transmit that ad further to C. If C decides to purchase the product, A and B may receive a reward. Only ads that match the user’s fields of interest are displayed on his device.

- The most common communication mode in mobile networks is usage of a dedicated point-to-point-connection, e.g. a SMS is sent to a certain mobile terminal identified by its phone-number or an user requests a WAP-page where information about a product is embedded. Since mobile terminals can be addressed individually it is possible to realize highly personalized advertising or direct marketing. We further distinguish push and pull mode: in push mode the user receives an advertisement without directly requesting it (but hopefully he gave permission to the advertiser), in pull mode the user (or an application running on his device) explicitly requests each advertisement. The service of avantgo.com is an example for a pull-service: Using Avantgo one can download selected web pages onto a mobile device to read them offline. Along with the requested pages there is advertisement included matching the user profile.

Within the MoMa-approach we combine push and pull mode and also use context information. This combined smart push/pull-approach as we call it is discussed in detail in the next chapter.

4. The MoMa-System

4.1. Overview

The basic principle of the MoMa-system is illustrated in figure 2: The end users (or consumers) create so called orders according to a given catalogue. This catalogue is a hierarchical ordered set of possible product- and service-offers which are described by appropriate attributes: on the uppermost level we may have ”gastronomy” for example, which could subsume categories like "pubs", "restaurants" or "catering services". Each category is specified by certain attributes, in the gastronomy example this could be "price level" and "style". When creating an order the client application will automatically fill in context and profile parameters where appropriate, which could be "location" and "weather": the gastronomy facility shouldn’t be too far away from the current location of the user and beer gardens shouldn’t be recommended if it’s raining.

On the other side the advertisers put offers into the MoMa-system. These offers are also formulated according to the catalogue. When the system detects a pair of a matching order and offer the end user is notified the way he specified (e.g. SMS, e-mail). He then can decide if he wants to
contact the advertiser to accept that offer, but this is beyond the scope of MoMa.

There are several implementations of the MoMa-client for different platforms, for example for Symbian OS (see figure 3) and J2ME for mobile terminals and one for Desktop-PCs.

### 4.2. System details

Each end user of the MoMa-system (see figure 4) has an unique user-id and at least one general and one notification profile. The general profile contains information concerning the user which could be relevant for the creation of an order, e.g. age, family status, fields of interest. Additional profiles are possible, e.g. one where his family status isn’t mentioned. A notification profile describes how (SMS/MMS, e-mail, text-to-speech, etc) an user wants to be notified when an offer matching one of his orders is found; this notification mode can depend on the current time, e.g. no text-to-speech-calls to phone number A from 9 pm. till 8 a.m., send a SMS instead. The instances of both kinds of profiles can be stored on a server of the anonymization service, so they can be used on different terminals an user may own. Only the notification profiles have to be readable for the anonymization service, the general profiles can be encrypted in a way only the user can decrypt them.

For the creation of an order \( X \) the user chooses one of his general and notification profiles each and specifies what kind of product or service he is interested in using the categories and attributes of the catalogue. In doing so single attribute values will be looked up automatically in the chosen general profile respective the available private context parameters where applicable. Please note: the order \( X \) itself contains no declaration about the identity or end addresses of the user. Afterwards the user-ID, the index of the chosen notification profile and a randomly generated bit string are put together and encrypted using a key negotiated between the trustworthy party and the end user. The resulting cipher text be denoted with \( C \) and can’t be decrypted by the MoMa-operator or one of the advertisers. For the architecture it doesn’t matter if a symmetric or asymmetric encryption algorithm is applied; using symmetric encryption is favorable in terms of computation power needed (which is limited on mobile devices) but requires a secure channel for the initial transmission of the key. The piece of random data included ensures that we get a different \( C \) for each order even when posting exactly the same order \( X \) using the same notification method multiple times. The pair \( \{ X, C \} \) is sent to the anonymizer which forwards it to the core system. This loop way ensures the MoMa-operator cannot retrieve the IP- or MSISDN-address of the order’s originator. Should a private context parameter change while an order is active (e.g. location of an user) the updated \( X' \) along with the old \( C \) will be sent to the core server, where the old order \( X \) can be looked up by \( C \) and be replaced with \( X' \). An order may also have an expiration date.

On the other side of MoMa the advertiser defines his offer \( Y \) using the catalogue and transmits it to the MoMa-server directly. Furthermore he deposits different templates for the notification (one for SMS, one for e-mail, one for MMS on terminal type A, . . . ) of end users on the publishing & rendering-server.

Triggered by events like new/updated orders and offers or changed public context parameters the MoMa-server tries to find matching pairs of orders and offers. For each match \( \{\{X, C\}, Y\} \) found \( C \) along with the ID of \( Y \) will be sent to the resolver-component of the trustworthy party. Here \( C \) is decrypted so the notification profile can be looked
up to request the needed notification message from the publishing-server. This message will be dispatched to the given end address by the resolver.

The advertisers don’t have access to the personal data of the end users, especially they can’t find out about the end addresses to send unsolicited messages. Even the operator of MoMa only sees the cipher text $C$, which could be considered as a transaction- or “one-time”-pseudonym, the most “anonymous” form of pseudonymity [18]. Other kinds of pseudonyms like role- or relationship-pseudonyms are used multiple times (for one usage scenario like internet shopping respective one communication partner) so there is a danger for them to be revealed.

If there is already a matching offer in the database, the user gets immediately an answer, so we could consider this as pull-advertisement; if the matching order is entered into the system after the offer, the notification of the user is a push-advertisement. Using context information we can amend the orders, so MoMa is a combined smart push & pull-approach.

Because of the limited user interface of a mobile application MoMa tries to support the usability in several ways: the usage of the profiles as well as context information reduces the amount of data to be entered for each order. The profiles can be synchronized to different mobile terminals an user may own. There are not just MoMa-clients for different kind of mobile terminals, but also one PC-client, because for the maintenance or initial creation of the profile data it may be more comfortable to use a ”real” computer. To make allowance for the different types of mobile terminals there are different templates for user notification on the publishing-server.
4.3. Public and private context

The special architecture of MoMa with regard to privacy concerns requires the distinction of public and private context information:

- **Private context**: Parameters of private context are retrieved by the mobile terminal and its sensors or the mobile terminal is at least involved. Thus private context parameters can’t be retrieved anonymously but they can be processed anonymously. Examples: position, background noise level, temperature, calendar, available technical resources, appointment calendar.

- **Public context**: This context information can be retrieved without knowledge about the identity of the respective user. Examples: weather, traffic jams, results of sport events, time of day.

For the reasonable processing of some parameters of the public context it might be necessary to know about certain private context parameters: The weather in a given city is a public context parameter, but you have to know the location of the user to look up the weather of the right city.

4.4. Business model for MoMa

There are the following roles within the business model of MoMa (for a discussion on the concept of a "business model" see [24]):

- **Advertisers**: They have to pay for each actual contact generated by MoMa. The price of one contact depends on the kind of the advertised product or service: one contact for a "beer"-advertising won’t be as expensive as a contact for and ad concerning real estates. Depending on the volume of traffic caused by a category the price can be adjusted.

- **Operator of the MoMa-system**: As additional source of revenue he can sell statistical analyses about what kind of products and services the consumers in a certain region and timespan were interested in.

- **Provider of context information**: The context provider delivers public context information about the weather, results of events or traffic situation and is paid by the MoMa-operator.

- **Trusted party**: The trustworthy third party acts as mediator or "pseudonymizer" between end users and the core of the MoMa-system and is also paid by the MoMa-operator. As trustworthy party a data security firm, a non-profit association or a government institution could act.

- **End users**: The end users aren’t charged for using MoMa, but they have to pay the fee for the transferred data volume to their network provider when submitting an order. Since one order’s data size is less than one KByte the costs caused by the usage of MoMa are almost negligible.

The different roles and the flows of information and money between them are shown in figure 5. On a deeper level one could also consider the mobile network operator as role within the business model: he receives money from the MoMa-operator (for the dispatching of notification messages) and from the end users. The depicted data flow from the MoMa-operator to the end users occurs when downloading the client application and new catalogue information. When introducing a system like MoMa there is the well known "hen-egg"-problem of how to obtain the critical mass of advertisers and end users: without a certain number of advertisers there won’t be enough interesting offers but without offers MoMa isn’t interesting for end users. In turn without end users MoMa won’t be an attractive advertising platform. To overcome this problem there is the possibility of automatically putting offers of well-established eCommerce-platforms into the system without charging the operators of those platforms. Since many of those platforms offer webservice-interface this can be achieved without much effort.

5. Criteria for the comparison of mobile advertising systems

We identified the following criteria as the most important ones for the comparison of mobile advertising systems:

- **Anonymity**: We talk about anonymity when it is not possible to find out the identity of an end user. If an advertiser doesn’t know about the identity of an end user he can’t send him unsolicited messages. The end user will only provide personal information like year of birth, hobbies or the current location for a mobile advertising application when he can be sure that the advertisers cannot retrieve the identity behind such a profile.

- **Efficient usage of bandwidth**: Since bandwidth is a scarce resource in mobile networks it is essential only to transmit data really necessary. Sending an ad to a mobile device which isn’t displayed wouldn’t be an efficient usage of bandwidth.

- **Danger of spamming**: Like mentioned above people are afraid of spam-message in mobile networks. Meanwhile there are laws that prohibit spam messages, but in most cases it is nearly impossible to catch the originators. So it’s preferable to have platforms for mobile advertising where spamming is technically impossible.
• **Reliability of advertisement transmission:** An advertiser (and maybe also the end user) wants to be sure that his messages reach the people interested in his offers indeed. There might be also consumers who don’t want to miss a special offer.

• **Synchronous advertisement delivery:** For some advertisers it may be important to have an estimate how long it takes until a message receives the consumers, especially if it is about a timely limited offer or for example if an publican wants to spread advertising with special offers in an ad-hoc-manner when missing customers. There are even situations thinkable when it is important for the end user to be informed as fast as possible, e.g. when waiting for offers by accommodation brokers in an overcrowded city.

• **Personalization and context sensitivity:** Not all advertising approaches are capable of personalization and context sensitivity of the same degree. Ads should be personalized to gain higher user acceptance.

• **Costs for data transmission:** Nobody wants to pay for getting advertisement, of course. But there are kinds of advertisement where the recipient has to pay for the data transmission caused by an advertisement message, for example when receiving an advertisement mail. For a single e-mail the costs may be negligible, but mobile data transmission is relatively expensive.

We don’t consider the initial cost for buying a mobile device as a criterion for the comparison of mobile advertising methods, since there are too many different types of devices on the market. Furthermore we don’t think people take different methods of mobile advertising into account when buying a mobile device. Some kinds of mobile advertising might be possible only using device more expensive than others, e.g. the MANET-advertising approach requires WiFi or Bluetooth capabilities. Such features won’t be available on very cellular phones.

6. **Comparison of mobile advertising systems**

Using the criteria discussed in the last chapter we can compare the different mobile advertising approaches:

• **Anonymity:** Broadcast methods provide the highest level of anonymity, since using this mode messages are sent to an anonymous group of people according to their definition. It is impossible to break that anonymity. Since MoMa acts as mediator between advertisers and end users there is anonymity, which can be improved using a trustworthy party as described in section 4.2. For the conventional push- and pull-approach there is no anonymity, but it is also thinkable to employ an anonymization-service operated by a trustworthy party. If an attacker is able to compromise the trustworthy party the anonymity gets lost.

The two examples of MANET-advertising mentioned above attach some kind of pseudonym or preferable a private key signature to each transmitted ad, so each user whose device participated in a transmission-chain may receive a bonus in case of purchase. If this signature is encrypted with the public key of a trustworthy party other users have no chance to reveal the identity of an user. Otherwise a manipulated client software could display the unencrypted pseudonym of each ad’s sender. If Bob is the only person within the range of Alice’s device and she receives an ad, the displayed pseudonym is the one of Bob.

• **Efficient usage of bandwidth:** All methods except filtered broadcast and MANET-advertising use the available bandwidth relatively efficient. Using these methods we have to send a lot of data over the air which isn’t presented to the user. The users of MoMa produce some data traffic when maintaining their profiles.

• **Danger of spamming:** MoMa, filtered global and local broadcast as well as the MANET and pull approach prevent spamming. In contrast to these methods like unfiltered broadcast and push-mode advertising are very vulnerable concerning spamming.

• **Reliability of advertisement transmission:** Push, MoMa and both types of global broadcast have the highest reliability when considering the chance that the ad actually reaches the recipient. Local broadcasts don’t reach users outside the certain part of the network (which might be intended to have some kind
of location awareness). The MANET approach cannot guarantee that an interested user meets another user with a certain ad on his device. When using the pull method we have to wait for the next request of the user.

- **Synchronous advertisement delivery:** Push-mode (including MoMa) and broadcast advertising guarantee that consumers receive the advertisement message almost immediately. Using advertising based on ad hoc networks it can take several days or even much longer until an ad reaches the target group (if at all). For pull mode advertising it depends on how often the user submits a request.

- **Personalization and context sensitivity:** The MoMa and the pull approach allow an high degree of personalization and context sensitivity. Push, MANET-advertising and filtered broadcasts allow only personalization when profiles are used. Local unfiltered broadcasts provide at least context sensitivity concerning the parameter "location", global unfiltered broadcasts allow no personalization and context sensitivity at all.

- **Costs for data transmission:** Delivery of advertising using broadcast, push or MANETs causes no costs for the end user. MoMa causes no costs for receiving an advertisement (these costs have to be covered by the MoMa-operator who will bill the advertiser) but he has to pay for the traffic caused by submitted orders. The most expensive method is pull-advertising because the end user has to transmit data each time he wants to get information.

Altogether the MoMa-system performs quite well when compared to other approaches. This is because the mentioned criteria where considered when MoMa was designed. One drawback of MoMa might be that it requires a relatively powerful mobile device, but in a few year such kinds of devices will be widely spread. Also MoMa seems to be a quiet complex application from the user’s point of view when compared to mobile applications popular today (download of ring tones/wallpapers): user have to download and install a client-application and to configure profiles. Furthermore due to the complicated architecture the system’s maintenance might be laborious.

7. Summary and conclusion

We discussed the special features and challenges of mobile advertising and gave an overview of different methods of mobile advertising, including a detailed description of the MoMa-system. Several criteria for the comparison of mobile advertising systems were introduced and applied.

The MoMa-system acts as mediator between advertisers and end users. Latter can define orders based on different profiles and according to a catalogue for free, while the advertisers have to pay for each contact. Spam messages are not possible. The architecture of MoMa enables highly personalized advertisement using context information while privacy can be guaranteed. This can be achieved by the distinction of private and public context parameters. Because of the highly personalized nature of the advertisement provided by MoMa we hope the advertisement provided by MoMa won’t be perceived as advertisement, but as valuable information.

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