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# An Empirical Study to Evaluate the Location of Advertisement Panels by Using a Mobile Marketing Tool

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## Abstract

*The efficiency of marketing campaigns is a precondition for business success. This paper discusses a technique to transfer advertisement content vie Bluetooth technology and collects market research information at the same time. Conventional advertisement media were enhanced by devices to automatically measure the number, distance, frequency and exposure time of passersby, making information available to evaluate both the wireless media as well as the location in general. This paper presents a study analyzing these data. A cryptographic one-way function protects privacy during data acquisition.*

## 1. Introduction

Billions of US Dollars are spent each year on mobile advertisement and marketing. A study conducted by ABI Research [1] predicted a market growth of $ 19 billion by 2011. After the study was published, the situation changed. In recessions, companies spend less money on marketing. The challenge is to spend the remaining budget most effectively.

Companies and advertisers aim at successful and cost-effective campaigns. Apart from the content, the choice of the advertisement media is highly relevant, meaning their location and the technology that is used. A success is achieved if the message reaches the recipient.

In the scope of our research project iCity [2], we are working on ambient intelligence systems in the field of mobile business. Part of our work was to install our wireless marketing system (service node) in cooperation with an industry partner who operates in the area of outdoor advertisement. The resulting study, which is presented below, leads to a new approach for evaluating locations in out-of-home advertisement.

We give an introduction (Section 2) in ambient intelligence systems. In Section 3, we define terms relevant to mobile marketing and provide a study on recent activities.

Section 4 introduces the iCity project and proposes new marketing technologies for both transferring content to the consumer's mobile device as well as collecting data for market research. We have analyzed this data empirically and have made interesting observations.

Data acquisition is always related to privacy issues. The collector could use the data to gather individual information about movement and behavior. Section 5 introduces an approach to protect privacy by the use of a one-way function to substitute identification characteristics with a unique pseudonym.

## 2. Mobile Business in Ambient Systems

In a typical Internet scenario, users have to manually enter information about their geographic location, even if the request refers to his direct environment and is submitted by a mobile device. Ambient intelligence systems (AIS) are a new approach similar to location based systems (LBS) to automatically connect mobile computing devices with environmental information. AIS do not only evaluate location-dependent information, but also other context information like personal knowledge about the receiver, his interests, or intentions.

AIS are integrated into the environment and can easily be accessed by personal mobile devices. Within the project iCity, the user can define a personal profile. This profile is used together with information stored on a service node to determine which services fit to his interests. All information is evaluated either located on the service node or the mobile device.

Inside a mobile business environment, AIS could be used for advertising, support, delivery of digital commodities, or mobile payment. This paper focuses on mobile marketing. Pedestrians can receive information about products available in their direct surroundings or receive coupons to spend in nearby shops. In contrast to ordinary push-marketing, the user receives only advertisement that he or she is interested in, increasing the acceptance.

# 3. Mobile Marketing

Mobile marketing is a subset of mobile commerce and mobile business. It includes every kind of marketing activity conducted on a mobile device. Since no common definition of mobile marketing is available, we will explain the major mobile marketing terms within this section.

## 3.1. Definition of Mobile Marketing, Business, and Advertising

Mobile marketing (as well as mobile commerce and mobile business) is not uniformly defined. On one hand, different Terms are used to describe the same business objects (e.g. wireless marketing, mobile marketing), and on the other hand the same term is used to describe different objects (advertisement, market research, sales) [3].
Henceforth, we adopt a definition by Möhlenbruch [4] according to the conventional marketing term: [Mobile marketing is] *"... the design, realization and control of marketing activities by use of wireless data transfer technologies on mobile terminal devices in line with a market-orientated business administration."*
According to Nicolai, Mobile Business is *"the initiation and partial respectively complete assistance, processing and maintenance of processes for the exchange of (economical) benefits."*[5]. Mobile advertising is often used as a synonym for mobile marketing, but is in a strict sense limited to activities making the customers aware of a product. It is a subset of mobile marketing: Activities like vouchers, which attract also existing customers, or campaigns to tighten existing customer relationships, are not part in advertising in a strict sense.

## 3.2. History

A study by Abi Research in April 2008 [1] approximated the expenditure on mobile marketing and mobile advertising to exceed 19 milliard USD until 2011. The presumably first mobile marketing campaign was started in 2000 when visitors of a club on Ibiza were informed via their mobile phone about exclusive event and news in the scene. They had to register via Internet and received messages per SMS or MMS, which today still are the most usual transmission medias in mobile marketing.
In the recent years, new transmission channels like Bluetooth or optoelectronic, visual codes (e.g. QR-Code, DataMatrix) were integrated into mobile devices. Conventional mobile advertising activities use the mobile Internet to distribute contents similar to those of the wired Internet: WAP-Pages are enriched by banners, links, graphics, newsletters, radio or video spots containing the advertisement. The provider of the biggest mobile advertising space, Vodafone Live!, created his portal when 9.99 EUR flatrate was introduced. Popular Internet offerings like Google, Amazon and eBay were provided in a miniature form for WAP-pages. Today, the portal is used by about 3.8 million visitors with 500 million page impressions per month. Similar portals are offered by other mobile network operators, for example T-Mobile and O2 in Germany. Whereas mobile devices and in particular location based or ambient systems offer a new technologies to enable personalized advertising, only traditional advertisement concepts known from television and PC-Internet are commonly used in mobile advertising.

1. http://www.abiresearch.com/abiprdisplay.jsp?pressid=837

## 3.3. Recent Communication Technologies

In recent years, new transmission channels like Bluetooth or optoelectronic, visual codes (e.g., QR-Code, DataMatrix [6]) were integrated into mobile devices. Although already established in Asia (e.g. [7]), western countries have problems on realizing these technologies (e.g. [8].
Bluetooth is already supported by most mobile phones and used for transferring mobile marketing content in short-range ad-hoc communication networks. According to the German mobile phone market, more than 95% of offered subscriber phones have Bluetooth function included. The Bluetooth penetration in the EU is above 70% [9]. iCity bulds up on this versatile, widely available short-range communication technology. Conventional mobile marketing builds up on networks provided by the mobile network operators. These services might suffer from a low acceptance due to additional costs for the customer and inconvenient interfaces. Short-range radio communication channels like Bluetooth are free of charge, neither customer nor service provider have additional costs. Conventional techniques from the Internet can be adopted, but don't have to: Service nodes with Internet access can use conventional Internet content management, but offline nodes can also send locally stored contents

## 3.4. Interaction Types in Mobile Marketing

The following section classifies mobile marketing according to the type of authorization and interaction.

**3.4.1. Opt-In and Opt-Out.** Mobile devices are very personal utilities and data storages. People feel annoyed if they receive too many unauthorized messages, and unrequested intrusion into privacy can violate both privacy law and competition law.
With respect to the way permission to communicate has been given, marketing strategies can be classified into Opt-In, explicit permission is granted before the activity starts, and Opt-Out, the customer has to declare if they do not want to take part.

An Opt-Out-strategy means dealing with the customer until they actively refuse permission. Serious Opt-In implementations also provide Opt-Out to revoke a registered service. However, pure Opt-Out-strategies provide the customer with information based on an assumptive permission. Such business policies have to face with heavy criticism: They are not only under legal discussion (Opt-In for SMS and E-Mail was already adjudged in Germany [10]), but also is their benefit to the advertised object debatable. Customers might feel annoyed by mass advertisements and refuse to use the service at all to the disadvantage of both serious and dubious service providers.

**3.4.2. Push- and Pull-Services.** The above definition differentiates between Opt-In and Opt-Out options by the kind of permission. Concerning the technical aspect of initialization of the communication, we can distinguish between Push- and Pull-Services. Push-Services are initiated by the service provider and can follow both an Opt-In or Opt-Out-strategy. Pull-Services use a pure Opt-In-strategy (except for Trojans or other malware) since they have to be activated by an intentional user action.
Contents incurring costs are typically implemented as Pull-, whereas cost-free and large-scale advertising favors Push-Services. Short-range communication channels like Bluetooth offer an environment for both Push- and Pull-Services, but usually only Push-Services are used.
Our project is currently implemented as a pure Push-Service, mobile devices receive new messages as soon as they are within range of the service node. Pull-Services which respond to active user requests are in development.

**3.4.3. Mobile Direct Response and Permission Marketing.** Only customers willing to interact with the provider can be convinced to buy the advertised product or be informed in detail about services which are of their interests. Direct response marketing tries to identify potential consumers and motivate them towards voluntary interaction. Permission marketing is very similar, but the customers action is restricted to the permission for sending content on a specified topic. Both types are always Opt-In and come without extraneous information.
Our project supports permission marketing within service nodes on campus of Koblenz University. Students only get information according to a previously submitted interest profile. Mobile response and permission marketing were not tested in our early outdoor advertisement test runs, but are underway.

## 4. iCity in Practice

### 4.1. The iCity Project

iCity is a project currently in progress at the Artificial Intelligence Research Group of the University Koblenz-Landau. The project aims at developing a framework for ambient intelligence systems. Mobile devices with computational capabilities like smartphones or PDAs are used to support pedestrians with personalized, location-dependent and time-dependent services. The transmission is free of charge, including the last meter. Short-range wireless communication like Bluetooth is used to avoid charges by Mobile Network Operators.
Since personalized information is linked with private data that might need protection, transactional security and privacy are major issues. With a view on applications in electronic commerce and electronic payment, secure payment procedures and delivery of digital commodities have to be considered.
The project is tested in three fields of application within the business environment of our project partners:
*Mobile Marketing:* In cooperation with awk Aussenwerbung GmbH, iCity is used to enrich advertising columns or placards with a new channel for digital booklets, coupons or additional product information. The target customers may receive conventional or augmented content on a new communication media. Furthermore, the advertising company gains new means of market research: The AIS can count the bypassing Bluetooth-enabled devices and the fraction of potential customers receiving the services.
*Mobile Ticketing:* A challenging application for AIS is the purchase, storage and inspection of digital public transport tickets and the support of dynamical timetable information. At the same time, technical particularities (i.e. the absence of an uninterrupted common network access), legal issues (i.e. transfer of money and digital commodities), digital right management and privacy aspects (i.e. avoidance of movement profiles) have to be considered. iCity in public transport has been developed in cooperation with the Koblenzer Elektrizitätswerk und Verkehrs AG.
*Mobile Health:* Ambient systems are already in use by nursing services. These highly specialized systems enable Point-of-Care diagnostics and monitoring, i.e. for chronic disease management or to aid elderly or people in need. These systems mainly aim at assisting nursing staff, providing long-term monitoring or alerting emergency medical services in the case of need [11]. iCity aims at giving help to patients by offering additional information for their medications. A digital ”package insert” could help to inform the receiver on the way, and a reminder starts an alarm to take medication on time. This should help to get used to proper habituation, particularly while getting familiar with the new social situations.
Application areas in health care always require a high level of reliability as well as confidential data processing.

## 4.2. Preceding Projects

iCity will be based on the completed projects dealing with location based, personalized information systems, namely Iason [12], City on Foot [13] and Campus News [14][15][16]. Artificial intelligence was employed to filter incoming messages which were transferred from service nodes to mobile phones using Bluetooth. These messages were semantically annotated with metadata about the content and customized to a user interest profile. By using artificial intelligence techniques for filtering, only relevant information was presented to the user.
The results have already been used in day-to-day operation by the Studierendenwerk Koblenz, the University of Koblenz-Landau, the University of applied science Koblenz/Remagen, and the Koblenz Touristik.
Service nodes are installed at selected points of interest. The service nodes continuously scan for mobile devices with activated Bluetooth in visibility mode and attempt to transfer server-stored content via Push-Service.
The system installed at the university is called *Campus News*. It is used to provide information, news and events on campus, plus the daily cafeteria menu. The students can register and submit their interests to the system. After having expressed interest, students will only get only messages regarding their profile. E.g. after having transmitted special eating habits, a vegetarian will never get any meat menu.
The average number of different mobiles detected per month is about 2 000 phones at the university with 6 500 students. Since the introduction of the system in April 2007 more than 31 000 messages have been transmitted to 3 500 students.
The *StadtInfo Koblenz* System [17], conducted by the tourism board of the city of Koblenz, is used for transmitting historical information about sights and event announcements.

## 4.3. Field Test with awk Aussenwerbung

In the following paragraph we will focus on mobile marketing. We will not go into further detail on other aspects.
Together with our industry partner awk, we installed a service node inside an advertising pillar at the entrance point of a shopping area (see Figure 1). The goal of the installation is to study the acceptance and to analyze the influential factors. As described above, the service node scans for surrounding mobiles and tries to submit the advertisement message to passersby. It is possible to send text messages, music clips or video trailers.

In a previous test case, the service node delivered a coupon of 25 Euro which was refunded for opening a new bank account. This pre-test from November to December 2007 resulted in 500 to 2 500 detected mobiles per day, over 300 transmitted coupons, and a few additional bank accounts.

Figure 1: Advertising pillar

## 4.4. Empirical Results

**4.4.1. Conventional Approaches.** A commonly used measurement in the advertisement business is the cost per thousand (CPT) ratio. CPT is used as a benchmark to calculate the relative costs of an advertising campaign. It shows how much a company has to pay to reach 1 000 potential consumers. To calculate the price, it is important to know how many people could notice the advertisement. The FAW (Fachverband Aussenwerbung e.V.), the Fraunhofer-Gesellschaft and the GfK (large German market research company) have identified a reference-number called $G_x$-Value.
This number evaluates effects like positioning, lighting and traffic. The $G_x$-Value is the result of the qualitative and quantitative reachability of the location. Therefor, the passersby frequency by bus, train, car and on foot are represented by the quantitative factor. The position of the panel is important for the attention of the ads and is integrated as the qualitative part. It evaluates the distance of a panel to the street, the footpath and the angle (horizontal and elevation) to the field of view. Also, additional circumstances have to be considered, like if exposure time to the passersby is sufficient to receive the Bluetooth message or if something obstructs the view to the panel.
Both quantitative and qualitative elements are weighted equally and have to be greater than zero, otherwise the location is not attractive.

**4.4.2. The iCity-Approach.** To transmit the ad message to Bluetooth-enabled mobile devices, it is necessary to scan the area surrounding of the service node. We can use this scan to learn about the behavior of passersby. The collected

data can be analyzed and used for statistical evaluation. Our observations are explained by examining data gathered on February the 23rd. The node is placed inside a pillar on a traffic refuge in the city center (see Figure 2). Pedestrians sometimes have to wait at traffic lights, so they sometimes have more time to recognize the advertisement message.
The location of our service node is passed by between 3 000 and 5 000 passersby per hour. Nearly two-thirds of them pass by car or bus. The number of pedestrians is between 400 and 1 000. These numbers were gathered manually by observation, either by counting the passengers on-site or by analyzing a video tape.

**Traffic.** As we have learned before, the traffic by pedestrians is one part needed to determine the $G_x$-Value. By using our new approach, we can automatically determine this value and economize manual counting by staff, and at the same time gaining a higher accuracy. Some random imprecisions during counting caused by staff's observation skills or camera angle are replaced by the statistically predictable percentage of Bluetooth-enabled devices (which could be determined for example by a survey). During one entire day, the service node counted 4 831 different mobile phones. The frequency started with five people passing the pillar between 5 and 6 am, and increased to 782 between 15 and 16 pm. On this day, an average frequency of 310 different mobile phones per hour could be identified. To make a statement about the total amount of passersby, we have to look at the percentage of Bluetooth-enabled mobile phones. According a study by Statista GmbH [18], 27% of mobile phone users are using Bluetooth. Considering this fact, the real number of passersby results in a factor of four times higher than counted by our test run. A more exact study on Bluetooth visibility would help to correct the data by statistical means.

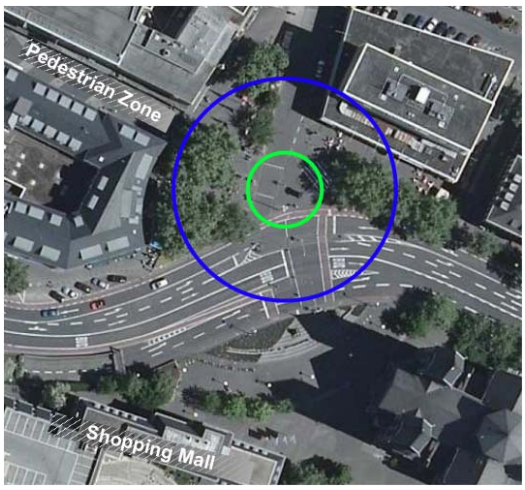


Figure 2: Position of the pillar with 10 and 30 meters radius

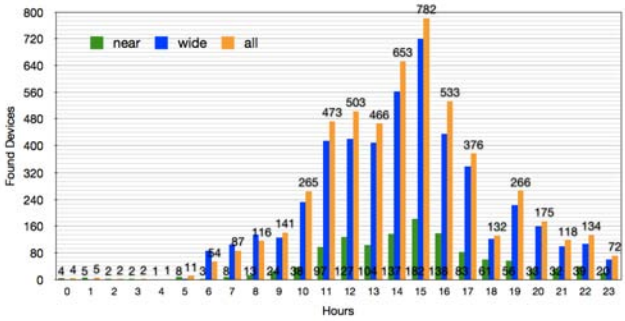


Figure 3: Visitor frequency during February the 23rd

**Distance.** The message on an advertisement pillar achieves the desired effect only if it is noticed by the passersby (referred to as pedestrians). Figure 3 shows the pedestrian frequencies at different times. The yellow bar depicts of all observed mobile phones with activated Bluetooth. The other two bars represent the phones in 10 and 30 meter radii. It reveals that 800 pedestrians passed the pillar very close, whereas 4 831 passed in total. The people who crossed the pillar within 10 meters could recognize the adverts potentially better than the others.
Assuming that we have a percentage of 27 % Bluetooth devices in visibility mode, the real number of pedestrians is approximately around a factor of four higher. This lets us come to the conclusion that the total number of people who probably took notice of the advertisements is around 3 200.

**Exposure Time.** A further measure for reachability is time. It is plausible that people who amble and those who have to wait for the traffic lights to turn green perceive more of their environment compared to those that are in a rush. These people are more susceptible to adverts as others. An analysis of the collected data gives an idea about the average duration within the service zone (see Table 1). The average length of staying was 32 sec. This is influenced by a high number of pedestrians who did not stop, 4 368 stood there for less than 10 sec. Neglecting these facts we have an average time of 4 minutes. 419 detected people stood there between 2 and 10 minutes. The maximum time was reached by one person, waiting there for 42 minutes.

| Time (sec.) up to<br>Detected Mobiles Phones | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10<br>4368 | 70<br>184 | 130<br>89 | 190<br>42 | 250<br>41 | 310<br>18 | 370<br>17 | 430<br>12 | 490<br>9 |
| 550<br>5 | 610<br>2 | 670<br>5 | 730<br>7 | 790<br>5 | 850<br>4 | 910<br>6 | 970<br>2 | 1090<br>5 |
| 1150<br>2 | 1270<br>1 | 1390<br>2 | 1450<br>1 | 1510<br>1 | 1810<br>1 | 2110<br>1 | 2530<br>1 | |

Table 1: Duration of stay in the service zone

**Recurrence.** The possibility of recognizing a message on an advertisement pillar is not only influenced by the duration of stay in the service zone. The exposure also grows by the frequency of recurrence, making ads more memorable. We analyzed the collected data to learn about the passersby recurrence. The results show that most crossed the service zone just only (see Table 2). If we neglect those not returning and look at the 435 other visitors, we have found out that they in average visited the service zone 3.5 times. It should be noted that 17 people returned more than 10 times. The maximum was one pedestrian passing 24 times and another one passing 21 times.

As shown above, the data collected from our service node

| Recurrence<br>Detected Mobiles Phones | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 4396 | 219 | 90 | 42 | 27 | 19 | 10 | 8 | 3 | 3 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 21 | 24 | |
| 1 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | |

Table 2: Recurring stays in the service zone

can be used to determine the parameters necessary for the $G_x$-Value of a location. The data of pedestrian traffic, exposure time, duration, recurrence, and passersby distance can be used instead of traditional observation to evaluate the quality of a location beyond the $G_x$-Value.

## 5. Privacy

To avoid sending the same message more than once to the same person, a service node has to recognize users it served before and at the same time remember the messages already sent to them. To provide the advertiser with additional opportunities of market research, user data has to be stored. The additional way of data acquisition described above supports additional benefits for advertising companies, but also new challenges for privacy protection. The data could be abused to monitor movement and behavior against the consumer's will. The acceptance could decrease, or the system could even be illegal depending on prevailing laws. The first subsection introduces statutory considerations on privacy using German law as an example. The second subsection describes a system for anonymization of personal data.

Former approaches mainly concentrate on exchanging personal identification characteristics by a pseudonym according to a list or by avoiding data acquisition at all [19]. We propose an approach using pseudonyms without a pseudonym list, without the possibility of aggregating data from different sources, and with access to the data only by concurrent access to the mobile device address, a secret key, and the stored data. The secret key can be deleted after the associated gathering is completed, completely destroying the link without losing the collection.

### 5.1. Statutory Substantiation of Privacy and Confidentiality

The user has to be assured that on the one hand no one can access his private data without permission, and on the other hand an authorized communication partner will only receive as much private information as he needs to execute the chosen services.

In Germany, privacy is defined by the Federal Data Protection Act as *"... particular data about personal or factual circumstances of a determined or determinable natural person"* (BDSG §3.1 [20]). The law of data avoidance and frugality prohibits unnecessary gathering or processing of personal data. Natural people have to be informed about data storage and must have control over processing and deletion. They may grant permission for data storage, but may revoke it afterwards. Similar laws are established by the EC directive 95/46/EG.

Recent judicial decisions in Germany are not sure, whether IP-Addresses are private or not (e.g., [21] versus [22]), because the courts are not sure if the person or his personal computer can be determined by the to some extent dynamical addresses. The discussion did not start yet for Bluetooth addresses, but it is most presumable that this individual device address has to be considered as personal data and therefore is protected by existing laws.

### 5.2. Necessity of Protecting Private Data Storage

Independent from statutory requirements, services have to provide privacy and confidentiality to be accepted by customers. Users will not support technologies if they feel observed or insecure. Customers feeling observed could avoid service nodes at all, causing the contrary of the original advertisement aims.

Privacy protection is necessary because receiver could use transmitted data for other purposes against the concerned person's will: It is not uncommon that companies near insolvency illegally sell customer's data to dishonest third parties. By merging personal data from different sources, the affected persons can get into precarious or inconvenient situations, including spam, phishing, social engineering or, if combined with profiling, even decreased credit-worthiness or job chances.

It is not possible to watch every data collection by data protection officers, so the correct storage depends on cooperation and lawful behavior. The public device address cannot be protected by technical means. With help of the pseudonyms described in this section, data protection officer could more easily identify companies implementing privacy protection. Reliable companies will keep the benefits of data

acquisition without additional privacy risks.
Data collection could be abused by three sources:

1) The advertiser himself could abuse the data.
2) The advertiser could sell the data to an unauthorized third party, which is not exceptional for companies close to bankrupt.
3) An unauthorized third party could infiltrate the advertiser's data system by hacking.

The risk of private data abuse tightens in ambient systems, in particular if combined with Bluetooth technology. While it is easy for a hacker to disguise the Bluetooth address, for example as described by Nitulescu [23], it is fixed in most ordinary devices and sent during every communication. The recipient as well as every other person within transmission range could record bypassing devices to generate movement profiles or aggregate additional data. The address is linked to the personal device, independent from the identification characteristic used on application layer.
It is not possible to prevent the monitoring of bypassing Bluetooth devices by technical means. This is not a shortcoming of ambient systems, but of the Bluetooth design. It also is impossible to control what the recipient will do with submitted messages. But it is possible to provide technical features to enable reputable companies to store personal data in a protective way and help to fulfill statutory requirements. In general, it is not the goal of data acquisition or data storage to harm the concerned persons. Personal data has to be stored to provide the services requested by the customer, for example a public transport company would have to store tickets bought by a passenger if he wishes to pay by a monthly debit. Companies also want to acquire data about customers for market research, for example to determine optimal product placing, advantageous locations for new subsidiaries, or the perceptibility of advertisement. These data could be acquired by scanning for nearby Bluetooth devices, but a reliable company is not aimed to link data to certain persons.

### 5.3. Data Privacy Protection by Use of Cryptographic One-Way Pseudonyms

Herein a new approach is proposed, using pseudonyms without a pseudonym list. These pseudonyms can be used to anonymize market research data [24]. The mobile device address (or any other unique identification characteristic $I$) is encrypted via an asymmetric key $K$ and the result's hash-value is used as pseudonym $P$ (see Figure 4):

$$P = h(c(I, K)) \tag{1}$$

It is not possible to aggregate data from different sources, for example different companies, or to access data without concurrent access to the device address, the key, and the stored data. The mobile device is only determinable at the moment it submits its address. The secret key can be deleted after the associated gathering is completed, completely destroying the link without deleting the data set.


Figure 4: Creation of a Pseudonym using One-Way-Functions

Both encryption and hash are used to create a pseudonym from the Bluetooth-address. The RSA-Algorithm is a one-way trapdoor function, it is impossible to reconstruct the original message without knowledge about the corresponding key. Hash functions are one-way functions, it is impossible to construct a message generating a chosen hash-value. The advertisement company uses one private key for pseudomization in each data collection. No corresponding public key is created, making it impossible to reconstruct the original characteristic. The advertisement company can still generate the pseudonym to collect new market information, but only if the corresponding mobile device address and the key is accessible. Different data collections can not be aggregated due to different encryption keys.
Using only asymmetric encryption, it would not be possible to find out if the company retains a hidden decryption key. Instead of the encrypted characteristic, only its hash-value is stored, making the reconstruction impossible even with knowledge about a decryption key.
It is not possible to create any link between data collections and identification characteristics if the secret key is deleted after the related data gathering is finished, even if the device address is known. The anonymous results are still accessible.

## 6. Conclusion

### 6.1. Results

We have proposed a new way to employ Bluetooth for a mobile marketing tool that transmits marketing content and at the same time collects data for market research. We get information about the reachability of passersby, including frequency, distance, duration of stay and recurrence. This could be used to evaluate both the service node itself as well as the general suitability of the location (e.g. to evaluate existing or planned pillars). In advantage over conventional, manual acquisition, this study is fully automatic, cost efficient, more versatile and less affected by random errors.
We introduced a way to generate pseudonyms by using cryptographic one-way functions to collect data without breach of privacy. Although it would always be possible to record visible Bluetooth-devices, our approach supports a

way to link the device to a data collection only by concurrent access to the device address, a secret key and the collection.

### 6.2. Further Objectives

From our first test run, we gained information about the potential recipients of advertisement messages. It would now be important to know if potential consumers are interested in location based, personalized information.
The current test run uses a Push-Service model, the transmission is initialized by the service node. By enabling Pull-Services, the customer would initialize the transmission or even interact with the service node. Ambient systems could not only be used for mobile marketing, but also for the other cases in iCity described above.

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